Peter R. A. Oeij

THE RESILIENT INNOVATION TEAM

A study of teams coping with critical incidents during innovation projects

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"Without deviation (from the norm), 'progress' is not possible".

Frank Zappa, with Peter Occhiogrosso (1989). The real Frank Zappa book. New York etc.: Poseidon Press (p. 185).

"We are here to learn"

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Chapter 1

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A study of team dynamics during complex innovation projects: objectives and study design

Abstract

This chapter introduces the study and provides an overview of the book. The research objective is explained within the framework of relevant literature and the conceptual model is described. The main question is divided into sub-questions which are related to the various chapters. An explanation of the applied methodology is provided. An elaboration of that methodology, the fieldwork procedure and measuring instruments is provided in the appendices to this chapter.

Key words: research problem and objective, theoretical background, conceptual model, methodology

1 Introduction

The problem statement and objective underlying the study

Innovation as a team process is the human effort in teams to develop, support and implement the renewal and improvement of a product, a service or a process. We understand innovations as the renewal that the team is developing, which may be a product, a service, a method, a process; it can be tangible (e.g. an object) or intangible (e.g. knowledge). Innovations are often described in phases, ranging from ideas and inventions to 'valorised' products/services. For our purposes, the phases themselves are of less practical importance. We therefore use the term 'innovation' irrespective of its phase.

An important question is why projects and innovations often fail. Failure rates of innovation projects are high. 'Urban legends' report failure rates of 80% or higher, however these figures are not empirically justified (Castellion & Markham, 2013). Castellion and Markham (2013) report a failure rate of 35-50%, based on the definition of a new product as having been successfully established in the market place. On average, they say, empirical research found the failure rate to be around 40%, between 1985 and 2004. The problem statement of this study is that the substantial failure rates of projects and innovations is a big expense for both companies and society.[1]

There are many reasons why projects and innovations fail or succeed, and there are several overviews of possible factors (e.g. Cooke-Davies, 2002; Jacobs & Snijders 2008; Han & Lorenz, 2015; Mulder, 2012; Sauser, Reilly & Shenhar, 2009). Shenhar and Dvir (2007) argue that most people believe projects fail due to poor planning, a lack of communication, or inadequate resources, but the evidence suggests that failure is often found even in well-managed projects run by experienced managers and supported by highly regarded organisations[2]. Projects are strongly affected by the dynamics of the environment, technology, or markets. That is why 'one size does not fit all', and project success demands an adaptive approach to adjust the project to the environment, the task, and the goal (Shenhar & Dvir, 2007: 9-10). Being able to adjust a project requires a shift of attention from only the 'hard factors' to including the 'soft factors'. Hard factors, such as the project management's iron triangle - the triple constraint of the criteria to complete the project on time, within budget and within performance goals or requirements - remain important, but soft factors, such as behaviour, leadership, skills, communication, and organisational culture, should not be ignored. The complexity of projects, where the small details of projects are inherently unpredictable, which can have serious consequences, is more often caused by people, than by a product or process, according to project managers (Azim, Gale, Lawlor-Wright, Kirkham, et al., 2010). Team behaviour and the environment of teams therefore contain crucial leverage factors for both failure and success. This study has chosen specific aspects of team dynamics as its research topic[3].

The following theoretical gaps, practitioner problems, and a societal goal were identified for further study:

- theoretical lacuna: this study applies insights from crisis and safety management within the field of innovations and their teams, which is somewhat novel. The gap is reflected by the absence of discussion about effective team work as developed within crisis and safety management in the innovation management literature. Combining insights from innovation management with insights into organisational defensiveness theories is helpful so as to zoom in on team behaviour and expand our understanding of factors that might reduce innovation success. Studying how innovation teams can benefit from these insights is an attempt to partly fill this theoretical gap;
- practitioner problems: although it is unclear how many innovations really 'fail' - definitions of failure vary - the reported average of 40% of product innovations is significant. It seems clear that organisations have much to gain by improving the process of innovation in teams, acquiring a more profitable return on investments (ROI). This study intends to create knowledge that can help to reduce the percentage of failing innovation projects. Its main contribution is to develop a team context ('mindful infrastructure') and team behaviour ('innovation resilience behaviour') that foster intrapreneurship - acting like an entrepreneur within the organisation - and risk taking, instead of playing safe and avoiding risky experiments which are so crucial for innovation;
- societal relevance: successful innovation can contribute to a society's competitiveness and is a crucial factor in its citizen's wellbeing and welfare.

Research objective

The research objective is to find out how project teams can improve their innovation processes, and thus, to help close the observed gaps. A driver of that objective is the failure of innovation projects (Castellion & Markham, 2012; Mulder, 2012). As the focus is on team behaviour in this study, the research asks how team members might deal with the fact that innovation projects might be complex, and that risk-averse behaviour may be involved in the failure of innovation projects. The innovation process in a project might be negatively affected by complex experiences that could trigger defensive behaviours (Cicmil & Marshal, 2005). As a consequence, team members become risk-averse, make defensive responses, and the innovation project might be threatened. Our purpose is to investigate the conditions under which such innovation teams can perform better.

For this purpose the study used insights from the crisis management and safety literature of High Reliability Organisations. These organisations proved able to perform without major accidents while working under high pressure. What characterises these organisations is that they have developed a high level of awareness of possible mistakes, and the ability to deal with mistakes in the event that they might occur, which they call 'collective mindfulness'. On the basis of this awareness their teams are able to function very effectively; they excel in anticipating and preventing risky situations that might escalate, and if such risky situations emerge nonetheless, those teams are able to contain the risks, get back on track, and keep the system functioning and performing under pressure. High Reliability Organisations (HROs) have developed organisational environments that encourage trust, and openness, and extremely high motivation and psychological effort to eradicate mistakes and the possible causes of mistakes. HROs invest heavily in organisational learning, and in combining rules and procedures with modes of high adaptivity, and being able to manage the unexpected (Weick & Sutcliffe, 2007).

The assumption is that innovation teams can learn from the teamwork of High Reliability Organisations. Two concepts are derived from the crisis management and safety literature which we call 'mindful infrastructure' and 'innovation resilience behaviour'. Mindful infrastructure involves the organisational facilitation of effective team work; innovation resilience behaviour is the team behaviour itself, which is built on five principles that ensure it is effective. The study investigates these concepts in relation to critical incidents that might confront innovation teams in the innovation process.

The terminology will be further discussed and explained in Section 2, and the line of reasoning in the study is as follows. By applying the principles of HROs, it is expected that teams can successfully deal with critical incidents during their innovation projects. Critical incidents (Flanagan, 1954) are situations or events that threaten the successful process of an innovation project. The ability of the teams applying the HRO-principles means that they can solve critical incidents and even prevent them from occurring, or from escalating once they emerge (Alliger, Cerasoli, Tannenbaum & Vessey, 2015). Such team behaviour can only be expected if teams are embedded in a team environment that enables this kind of behaviour when performing in complex projects (Vidal & Marle, 2008). Such project teams, for instance, must ensure that they are creative, and at the same time cost-effective. In such seemingly incompatible instances it might be tempting to achieve only the goals for which the team is held accountable, and that are tangible. Being cost-effective is perhaps more tangible and accountable, and psychologically less effort (Kahneman, 2011) than being creative, but is to the detriment of the innovation goals of a project. How can a team serve both goals if it is so difficult? This study therefore explores the aspects of a team environment that enable what we call 'innovation resilience behaviour'. The term we use for this kind of organisational facilitation is 'mindful infrastructure'. We assume that what HRO-teams can do, could also be beneficial for non-HROs, in order to reduce the failure rate of projects and innovations in project teams.

The main question of the study is: *How do project teams deal with critical incidents during their innovation projects?*

In Section 2 of this chapter, the theoretical background related to HRO-principles of crisis management and safety literature is discussed, which will result in a conceptual model of the study. Section 2 explains why these HRO-principles can be useful for innovation project teams, but also why it is hard to acquire the competencies that HRO-teams have. Section 3 tries to link the HRO-literature with that of teams and leadership and describes the main variables and constructs of this study, resulting in the conceptual model. The central question and subdivided research questions will be determined from that elucidation. The plan of the study will be presented, including in which sub-study (and chapter) each research question will be addressed. The chapter ends with a presentation of the research methodology in Section 4. An elaborate description of the methodology, including the fieldwork, measuring instruments, and data, can be found in the appendices.

Chapters 2 to 7 each contain a different sub-study investigating one or more research questions; Chapter 8 discusses findings, answers the research questions from an overall perspective, draws conclusions, identifies the study's relevance and limitations, and ends with suggestions for future research. Chapter 9 deals with the practical implications of the study results.

Scope of the study

When we talk about the innovation resilience behaviour of teams (Team IRB)[4] we do not mean innovative behaviour. Innovative work behaviour aims to achieve the initiation and intentional introduction of new and useful ideas, processes, products or procedures (De Jong & Den Hartog, 2007: 43). It deals with creativity and implementing an invention. Team IRB is intended to successfully deal with critical incidents in order to keep an innovation project on track, or get it back on track. Team IRB has some overlap with the 'innovator resilience potential', which is the potential for future innovative functioning and coping with future setbacks after having experienced a professional setback (Mönkemeyer, 2013: 31). A setback can be the termination of a project or a project failure, and resilience is here regarded as positive adaptation within the context of significant adversity. Innovative functioning could be enabled by innovator resilience potential, which consists of outcome expectancy, self-efficacy, optimism, hope, self-esteem and risk propensity (Mönkemeyer, 2013: 13-14). Team IRB differs from innovator resilience potential in that it is regarded at the level of team behaviour and not as individual coping ability or (malleable) personal qualities. Innovator resilience potential enables innovative behaviours (for example in subsequent projects after the termination of one that was not successful), whereas Team IRB, again, underlines the critical recovery during an ongoing project. This does not mean that Team IRB can also be innovative in itself, however, or *support* innovative behaviour.

In this study the actual innovation (and invention) is made subservient to the process of innovation in teams. Enhancing our knowledge about this process in project teams can contribute to reducing the gap between the targets of a project plan and the actual project results. The application of HRO-principles in innovation management contexts are thus examined. Such contexts consist of project teams carrying out innovation projects that might be complex, and where defensive behaviours may play a role in relation to risk aversion; exactly the kind of behaviour that you may not want to influence the innovation process as it may kill creativity[5].

The study's approach transfers HRO-principles from the domain of crisis management and safety to that of innovation management. The five HRO-principles, presented below, focus on the behaviour of people in teams without explicitly explaining what an organisation that houses such team behaviours should look like. It is therefore helpful to bear in mind that the wider organisational environment of an innovation team is not studied, but its changeability is regarded as a given. We do not, for instance, investigate the behaviour of stakeholders, the fluctuation of markets, or organisational policies that influence what happens in teams. We examine certain behaviours of project teams performing innovation projects and we try to understand certain factors that help explain the success and failure of those teams. We do this without studying the organisation's design. For this purpose we develop a conceptual model that gives innovation resilience a central role, together with mindful infrastructure. These concepts also play a central role in HROs. Our conceptual model unfolds a way of reasoning that sees the complexity of innovation projects as a possible driver for defensive and risk-averse behaviour, especially when critical incidents may occur. We will argue that the presence of mindful infrastructure that enables innovation resilience behaviour can help teams to deal with critical incidents in such a way that they can overcome defensive and risk-averse behaviour. The potential for a successful innovation project should be improved.

2 Theoretical points of departure

Why should innovation teams act as mindful and innovation resilient?

There are four reasons why project teams in innovation should become capable of innovation resilience behaviour and these reasons are interrelated. The first reason is that many projects and innovations are not successful (Castellion & Markham, 2012), and that greater success improves the competitiveness of organisations. The second reason is that higher alertness and resilience make teams more effective and efficient, analogous to HROs which make almost no mistakes (Alliger, Cesaroli, Tannenbaum & Vessey, 2015). The third reason is that organisations could make a challenging business case for higher success rates of innovation processes because it would not only save costs but improve their returns on investments more often, and faster (Castellion, 2013). The fourth reason is that there is suggestive evidence that organisational mindfulness is associated with a greater number of patents, as an indicator of innovation (Vogus & Welbourne, 2003). These reasons suggest a sense of urgency for agents in the innovation management domain to act.

HROs invest in mindful working because it makes them more reliable; to them safety is more important than economic goals. Investing in HRO-principles is also beneficial for non-HROs, however. These organisations do not invest in safety, but in organisational learning. Weick, Sutcliffe and Obtsfeld (1999; 2008) plausibly suggest that learning capabilities enhance innovative capabilities, trust, motivation, collaboration and communication, and thus favour non-HROs. Teams nowadays are ubiquitous in the working world; many teams face challenges that can drain resources, adversely affect performance, and diminish team cohesion and team member well-being (Alliger, Cerasoli, Tannenbaum & Vessey, 2015).

The relevance of the crisis management and safety literature for innovation management

High Reliability Organisations include power grid dispatching centres, air traffic control systems, nuclear aircraft carriers, nuclear power generating plants, hospital emergency departments, wildland firefighting crews, aircraft operators, and accident investigation teams. They operate "under very trying conditions all the time and yet manage to have fewer than their fair share of accidents" (Weick & Sutcliffe, 2007: 17-18)[6]. According to Weick and colleagues (1999; 2007) the reason for this reliability is that these organisations have the characteristics of 'mindful organisations'. Five characteristics of mindful organisation constitute a collective state of mindfulness. The attractiveness of HROs as a model or ideal type is that any organisation can be measured against them (Hopkins, 2014).

Despite some very good examples of HROs, there is no authoritative, systematic, representative and quantitative evaluation of HROs that provides compelling scientific evidence why HROs operate safely and how they manage to do so (Lekka, 2011)[7]. The best evidence of HROs to minimise accidents and mistakes comes from the many, but scattered studied cases. Weick and colleagues (1999) analysed these studies and drew general conclusions about HROs that count as an authoritative analysis (Hopkins, 2014). Although Lekka (2011) is critical in her review of the present state-of-the art of HROs, and asks questions about the transferability of HRO principles to other branches, about the underlying mechanisms of the HRO principles and how these interact and each contribute to a HRO status, and the sense of urgency about investing in risk reduction for mainstream organisations, there is qualitative research that provides evidence of why and how HRO principles are effective. Lekka's critique partly explains the observation that HROs were overlooked by mainstream organisation theory for a considerable time (Scott, 2003). HRO theory was not part of the mainstream in organisation theory around the turn of the century for three reasons (Weick et al., 1999): there was insufficient coherence to generalise, the existing work was more descriptive than theoretical, and the key HRO processes remained unarticulated. Weick, Sutcliffe and Obstfeld (1999) intended to fill this gap by not only providing an overview, but by simultaneously reconceptualising HRO-thinking into five key principles that allowed hands-on interventions to be designed, and served as a basis for standardisation in (quantitative) research and evaluation (Hopkins, 2014). They provided a synthesised overview of HRO developments, by presenting a detailed understanding of what organising for high reliability actually means, according to them.

The five HRO-principles

The HRO-principles have a psychological basis in the motivation to pursue cognitive effort in order to detect errors and act upon them, adapting the situation to effectively deal with (possible) errors. In this sense reliability refers to the stability of cognitive processes. The motivation to continually be aware of unforeseen situations leads to stable cognitive processes with which to detect possible errors, and to a variable pattern of activities to adapt to events which require revision. This stability of cognitive processes ensures continuous learning from events that unfold in slightly different ways each time, and that eventually results in reliability. Reliability is thus grounded in adaptive human cognition and action (Weick et al., 1999: 86-88).

Weick and colleagues then relate stable cognitive processes to effective error detection in five areas of concern: preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience, and the under-specification of structures (in later publications the latter was changed to deference to expertise). These five concerns are tied together by their joint ability to induce a rich awareness of discriminatory detail and a capacity for action, which the authors call 'mindfulness'[8] (Weick et al., 1999: 88-90). The authors indirectly propose that, although they may not be ranked, they all matter. The principles are related. They are, however, not clear about their inter-relationships and the necessity of the relationships. Nonetheless, those five principles are what Weick et al. (1999; 2008) have induced from accounts of effective practice in HROs and from accident investigation, and can thus be regarded as the evaluation and assessment of indicators for successful HROs. A successful HRO is an organisation characterised by the absence of failures and errors through maximising its reliability, by applying these five principles.

1. Preoccupation with failure (Weick et al., 1999: 91-104) involves learning from events that seldom occur and to converting them into grounds for improvement[9].
2. Reluctance to simplify (Weick et al., 1999: 94-96) involves restricting simplification in interpretations in order to increase the number of precautions and minimise surprises[10].
3. Sensitivity to operations (Weick et al., 1999: 96-99) involves perceiving the integrated big picture of operations in the moment, at a higher level than operational level, and comprising the collective mind beyond the individual operator[11]. There must be an unambiguous relationship and alignment between the actions at shop floor level and management level.
4. Commitment to resilience (Weick et al., 1999: 99-101) involves anticipation and resilience. Anticipation is the prediction and prevention of potential dangers before damage is done, whereas resilience is the capacity to cope with unanticipated dangers after they have become manifest, and learning to bounce back (Wildavsky, 1991). Resilience is the ability to not only bounce back from errors, but also to cope with surprises in the moment, and to respond as they occur. It is anticipation, but at the same time being able to contain a surprise and avoid it escalating[12].
5. Under-specification of structures (Weick et al., 1999: 102-104) refers to loosening the designation of the 'important' decision maker in order to allow decision making to migrate with problems. Weick and Sutcliffe (2007) later renamed this as 'deference to expertise': it is not the highest rank that makes decisions, but the person who is most expert[13].

HRO-thinking is as much about psychology and culture as about structuring organisations

HROs, as described by Weick et al. (1999), are organisations in which organising by people – i.e., assembling ongoing interdependent actions into sensible sequences that generate sensible outcomes (Weick, 1979: 3) – constitutes solidified behaviours that we could term culture. The five principles stimulate specific cognitive and social psychological behaviours that make people mindful of aspects of their work, and thus unfold an organisational way of working, built on everyone's behaviour. But HROs are also organisations with a certain structure, an organisational design in terms of departments, teams and jobs. Responsibilities, targets and resources are designated and allocated to these organisational building blocks. HROs, moreover, have two faces in terms of their structure. On the one hand they are a static organisation and designed as in an organisational diagram, but on the other hand they are operational organisations dealing with uncertain situations in real life. As static organisations, HROs are nothing special, they can even be quite bureaucratic, with many rules and regulations, but as operational organisations, dealing with uncertainties, they must be able to learn-while-doing in order to prevent or contain accidents. The tasks of the static organisation differ from those of the operational organisation, and therefore, the structure of the organisation must have requisite variety to deal with unexpected situations and to possess some slack. While Weick and his colleagues seem to stress the psychological behaviours related to HRO-thinking, we would like to emphasise that these behaviours cannot be seen as disconnected from the way an organisation is structured[14].

Scientific evidence or entrepreneurial gut?

It was noted above that projects and product innovations have a substantial failure rate, at an average of at least 40% (Castellion & Markham, 2012; Mulder, 2012). Castellion and Markham argue that the failure rate of new products can be whatever management tolerates, for example: "If the market research needed to reduce the failure rate costs $100,000 (including building physical products) and the delay in launch results in an opportunity loss of sales of $400,000 and the cost of failure following launch is $250,000 then some management decision-makers would proceed to market quickly and hope they are lucky" (Castellion, 2013). In other words, the urgency to prevent failure is a business case and not rocket science. Apart from the sense of urgency, there is the issue of whether HRO-thinking is suitable for non-HROs. The evidence of HRO-principles in organisational performance is limited and context-specific. Perhaps the most essential performance goal for HROs is safety, especially for those HROs where safety errors come at great societal cost. Paradoxically, the delivery of energy and electricity from a nuclear power plant, for example, is its primary production goal, and can at times be made subordinate to the safety of lives and the environment. The performance criterion of HROs in terms of organisational effectiveness is thus measured by their maximised reliability (Weick et al., 1999), whereas for a bureaucracy that criterion might be efficiency, and for a private firm it might be profit. Maximising reliability to maximise safety comes with investment in mindful organising, such as investing in training and facilitating the five key principles. For HROs, making the trade-off between investing in these resources and running the risk of failure is not for a matter of discussion. Safety pays off.

For non-HROs the trade-offs may be not as clear when the investments are high (Rousseau, 1989). The development of the five HRO-principles requires high investment in the selection and training of staff competences, and in organisational 'slack' to create space for manoeuvring, all for the sake of safety[15]. Clearly, investments in HRO-principles need a solid business legitimation. Not only are they a huge investment, the evidence that HRO-principles are working is merely suggestive, and the literature lacks convincing direct tests of whether, and through which mechanisms, genuine and emulating (i.e. hospitals) HROs enhance reliability (Lekka, 2011; Vogus & Iacobucci, 2016). Despite growing evidence that HRO-principles are slowly but surely taking effect in hospitals (Vogus & Iacobucci, 2016), investing in them remains a management choice, presumably based more on entrepreneurial guts than scientific fact. Weick and Sutcliffe (2007), however, are of the opinion that HRO-principles require a sense of urgency for non-HROs as well. The urgency for non-HROs is not to invest in safety, but to invest in (organisational) learning[16]. In other words, there is managerial choice about whether such investments in learning and slack will pay off. Investments like these require entrepreneurial guts, a humanised mindset, and the conviction that the business will benefit in the long term. Entrepreneurial guts means taking the financial risk of investment in organisational learning. A humanised mindset is the acknowledgement that the quality of the work of staff is an important asset that enables experimenting and developing skills, and reducing the work related risk of health and stress. The conviction that a long term view is preferable over a short term view reflects the opinion that a focus on efficiency will not make a company innovative and resilient if there is no space to absorb knowledge and no organisational slack that allows for flexible manoeuvring when necessary[17]. In sum, for such investments to happen, wisdom is particularly required over solid proof.

To connect HRO-thinking about safety- and crisis management to innovation management and project teams, we will introduce the elements of a conceptual model that explains how innovation resilience behaviour – a transfer of HRO-principles to the context of innovation – can emerge. Mindful infrastructure must be present to enable Team IRB. The next section discusses mindful infrastructure elements as the antecedents of Team IRB. Additional elements of the conceptual model are also introduced.

3 Towards a conceptual model

We start by defining key words in the study, such as 'team', 'project' and 'innovation'. The research framework is then discussed, including the mindful infrastructure and innovation resilience behaviour of teams as the main concepts. To complete our reasoning about how innovation processes unfold, we describe the role of perceiving projects as complex, defensive behaviours and risk-aversion, and the perception of project goals in terms of the progress experienced and expected results.

Project, teams and innovation

A *team* consists of two or more individuals, who have specific roles, perform interdependent tasks, are adaptable, and share a common goal (Baker, Day & Salas, 2006: 1578). *Work teams* are defined as 'collectives who exist to perform organizationally relevant tasks, share one or more common goals, interact socially, exhibit task interdependencies, maintain and manage boundaries, and are embedded in an organisational context that sets boundaries, constrains the team, and influences exchanges with other units in the broader entity' (Kozlowski & Bell, 2003: 334; see also Mathieu, Maynard, Rapp & Gilson, 2008). A project team is a group of people working on a project for a limited period of time. A *project* is a planned set of interrelated tasks to be executed over a fixed period and within certain cost and other limitations, and with a certain goal or target to be achieved; it is a temporary and unique endeavour undertaken to deliver a result (Vidal & Marle, 2008: 1094) and is often seen as a collection of simultaneous and sequential activities which together produce an identifiable outcome of value (Pich, Loch & De Meyer, 2002: 1011)[18]. In *project-based settings or organisations*, individuals are often part of a resource pool that is drawn from according to some combination of their skills, competencies and attitudes, and the needs of the project or team task. Individuals may simultaneously be members of several teams (Mathieu et al., 2008: 442).

Originally projects were exclusively meant to involve unique, one-time initiatives, such as developing new products or implementing new IT systems. They include activities that do not belong to the mainstream of operations. That has radically changed, however, as many organisations today are built around projects, such as organisations in the fields of construction and engineering, IT, research and development, and business consultancy. Network organisations and matrix organisations are examples of organisational structures in which projects may very well be the central building block. Generally speaking, the share of projects is rising, while the share of operations in many organisations is declining (Shenhar & Dvir, 2007: 3-4; also Hobday, 2000).

A consequence for the organisation and division of work is the growing importance of teams, notably project teams. Whereas teams can often be permanent (as elements within larger departments or not), this is not the case with project teams, and that has all kinds of consequences for team dynamics such as routines, knowledge sharing, team building, team cohesion, interpersonal relations and so on (Hobday, 2000; Tuckman & Jensen, 1977; Zaccaro, Marks & DeChurch, 2012)[19].

Innovation in this study is any objective that is being newly developed within a project by a project team, and by which 'objective' should be understood as the target of goal of the project. The innovation can be a product, a service, a process, a method, knowledge, technology, even a new idea[20]. We are focusing our study on the innovation process of the project team. As a consequence, it is not imperative that the innovation is 'finished' or 'successful', for example because it has been adopted by end-consumers or valorised on the market. The *innovation process* is the period during which the project team is busy working to realise the goals of the project. The team's behaviour is our central concern[21].

The research framework

The main purpose of this thesis is to investigate the relationship between mindful infrastructure as a characteristic of the organisation - the team environment - and innovation resilience behaviour (Team IRB) as team behaviour - what the team does; especially how teams deal with critical incidents during innovation projects. Our reasoning is that the presence of mindful infrastructure enables innovation resilience behaviour. Because of the presence of mindful infrastructure, team members can perform risk-taking behaviour in a controlled manner. The interactions between team members, and their thoughts and feelings, are build on trust, confidence, self-reliance, shared goals and interdependence.

Mindful infrastructure is a semi-structure that functions as the organisational facilitation for team behaviour to perform innovation projects, specifically as an enabler for innovation resilience behaviour. Semi-structures are a combination of order, prescriptions, and rules (structure), and the decision latitude to move freely and make autonomous choices. Semi-structures “exhibit partial order, such that some aspects are prescribed and others are not” (Brown & Eisenhardt, 1997: 28). Semi-structures evolve over time and partly reflect the idea that ‘everybody knows how we work here’[22].

Mindful infrastructure consists of four elements: team psychological safety and team learning behaviour, complexity leadership and team voice. We derived these four antecedents of Team IRB from the HRO-literature reviewed (e.g. Lekka, 2011). These antecedents are enablers of Team IRB and together constitute the mindful infrastructure, defined as the organisational capacity to anticipate unexpected problems and the capacity to contain such problems, by enabling organisation members to act accordingly[23].

Team psychological safety and team learning (Edmondson, 1999; 2012: 122-144) allow team members to make mistakes without being punished and to explore and experiment. Complexity leadership (Lawrence, Lenk & Quinn, 2009) enables a team and/or its leader to effectively deal with mixed messages, opposing logics and apparent incompatibilities. It enables leadership to look for synergy, instead of choosing for ‘cost effectiveness at the detriment of innovative solutions’ and thus synergizes transactional and transformational leadership goals. Transactional goals are based on exchanging task execution for remuneration, and are therefore (particularly) task-oriented, whilst transformational goals are based on transforming both the organisation and behaviour by inspiring, stimulating and vision-sharing, and are therefore (particularly) relations-oriented (e.g. Den Hartog, Van Muijen & Koopman, 1997; Yukl, 2012). Team voice or participative decision making (Buchanan & Badham, 2008; LePine & Van Dyne, 2001; Van Dyne & LePine, 1998) encapsulates organisational politics and enhances problem ownership among team members. It improves methods of constructively dealing with diverse stakeholder interests. Apart from a team’s formal decision latitude to a certain extent, this mindful infrastructure facilitates risk taking, recovering from mistakes, space for experimentation, and ways to communicate and cooperate constructively. It therefore enables innovation resilience to emerge.

Innovation resilience behaviour (Team IRB) is a set of team competencies that can help a team anticipate unexpected events, manage those events, and bounce back onto the right track once a project takes, or has taken, an ineffective course (a mishap) with regard to its innovation goal. Based on Weick and Sutcliffe (2007) Team IRB is found when teams are able a) to be alert of 'weak signals', b) to resist oversimplification by suggesting valid alternatives, c) to remain sensitive to what is done in the projects, why and for whom, d) to be able to change course when needed, and e) to defer to expertise[24]. Such team behaviour would enable teams to effectively deal with critical incidents. It would prevent that the complexity that can be experienced around and within a project, easily and unconsciously result in defensiveness. Teams would be better armoured against such behavioural pitfalls.

Defensive behaviour

A consequence of the presence of mindful infrastructure and innovation resilience behaviour is that defensive behaviours are not triggered and complex issues are approached openly and with more self-assurance. Defensive behaviour or organisational defensive routines are any action, policy, or practice that prevents organisational participants from experiencing embarrassment or threat but, at the same time, prevents them from discovering the causes of the embarrassment or threat (Argyris, 2004a: 392). We contend that defensive behaviour may lead to risk avoidance in project teams, but, innovation resilience behaviour may suppress defensive behaviour and make project teams more conducive to risk-taking actions and seeking creative solutions[25].

Perceived project complexity

The next element in the framework is the complexity of projects and their predictability and controllability by teams. Vidal and Marle distinguish five elements that make up the complexity of projects: (1) size of a project system, (2) variety of the project system, (3) interactions and interdependencies within the system, (4) context and environment dependency of the project system, and, (5) uncertainties and the propagation of change as consequences of complexity (Vidal & Marle, 2008: 1097-1098, 1105). Innovation projects are not complex because innovation is working on 'newness' per se, while working on routines projects is working on 'routineness', but because the processes and outcomes are relatively unpredictable and uncontrollable. When projects are perceived as highly complex this may cause defensive behaviours. Due to their innate uncertainty, innovation projects may be perceived as more complex than highly plannable projects which may result in risk aversion and defensive behaviours in teams[26].

Perceived project progress and project results

Mindful infrastructure operates at the project team level and allows mistakes to be made, critical reflection and the exploration of new knowledge; it has been developed and cultivated because it assumes the need to adequately deal with situations that are conducive to mixed messages (contradictions, paradoxes and dilemmas). Complexity leadership (by an individual or distributed across the team) and the participation of project team members, conversely, enables work towards constructive solutions and decisions. Mindful infrastructure - including team psychological safety and team learning behaviour, team voice and complexity leadership - can help teams deal with conflicts or disagreements in a constructive manner. Teams have a voice and are committed. The team climate is receptive to innovation. In such an environment teams can be innovation resilient, which means that they can effectively prevent, manage or solve critical incidents that threaten their innovation project. It is thus expected that project progress and project results, as perceived by the team, are positive. Figure 1 shows this reasoning.

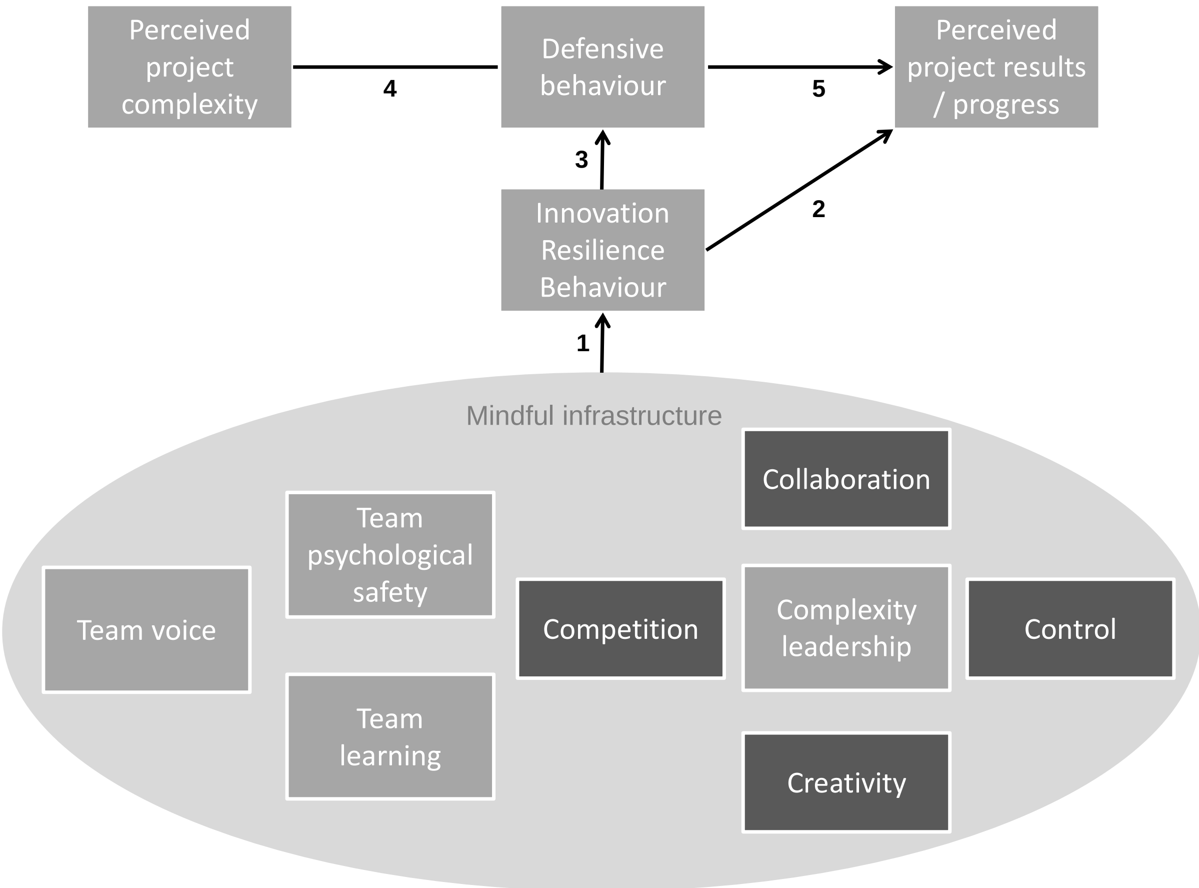


Figure 1 Framework of the research

The content of the chapters

The central part of the research is the relationship between mindful infrastructure and innovation resilience behaviour in the framework (Number 1 in Figure 1). The study will investigate the constructs of mindful infrastructure and innovation resilience. We will also research the effects of Team IRB on how team members perceive their own project progress and project results (2). The relationship between perceived project complexity and defensive behaviour (4) on the one hand, and between defensive behaviour and perceived project results and progress (5) on the other, in the framework, is primarily theoretical: the model suggests that (high) complexity may induce (several) defensive behaviours that then (negatively) affect the project results. This means that these relationships will not be empirically tested. Defensive behaviour and its association with how team members perceive their project success (5), and with the level of Team IRB in teams (3) will be analysed. Another study will analyse how team leaders deal with critical incidents. This analysis shows that some team leaders apply a research-oriented approach that avoids the pitfalls of certain defensive behaviours, especially the pitfall of not validating one's decisions and actions. This leadership behaviour partly overlaps with complexity leadership in the framework, therefore the main focus is relationship 1. We will specify the relationships being investigated later. Critical incidents in each project were discussed with the teams studied. We will investigate whether teams, in dealing with critical incidents, are able to realise critical recoveries, as an expression of Team IRB, and whether there is an association with the presence of mindful infrastructure (Relationships 1 and 2). A final issue is what innovation management teams can learn from the study results. This is less a separate research question as an overall topic in the general conclusion.

The main question of the study, as noted above, can now be specified as follows: *How do project teams deal with critical incidents during their innovation projects by developing mindful infrastructure and innovation resilience behaviour?*

The overall hypothesis is that the presence of mindful infrastructure enables innovation resilience behaviour, and that the presence of innovation resilience behaviour has positive effects on project outcomes. The main question is divided into seven research questions. These questions are related to hypotheses which will be presented in the separate chapters. The seven research questions are:

1. What is mindful infrastructure, what is innovation resilience behaviour (Team IRB), and what is their relationship?
   This question stresses the relationship between mindful infrastructure and Team IRB and addresses the content of those constructs.
2. Does innovation resilience behaviour affect perceived project results and perceived project progress?
   This question explores the association between Team IRB and project goals.
3. Do teams have different configurations of mindful infrastructure?
   This question relies on the assumption that "there is more than one way to skin a cat" and investigates possible combinations of elements of mindful infrastructure that can all enable Team IRB.
4. Is innovation resilience behaviour associated with defensive behaviours?
   While it is assumed that Team IRB can suppress defensive behaviour, we are aware that their relationship is difficult to investigate. New ways to undertake such a research are explored.
5. How do project leaders manage innovation projects?
   The analysis is directed at describing project leader behaviour in managing - rather than leading per se - the project, and in how they deal with critical incidents.

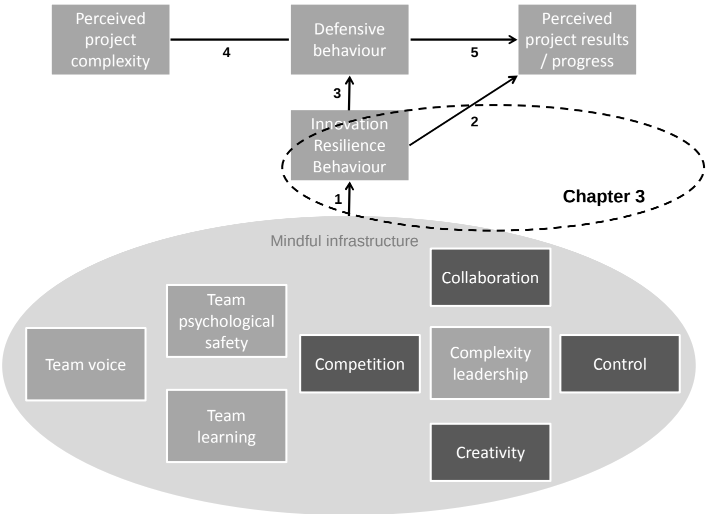
6. How do teams respond to critical incidents during innovation projects?
   This question aims to describe the presence of mindful infrastructure and Team IRB in relation to how teams deal with critical incidents.
7. What can innovation management teams learn from HRO teams?
   The theoretical framework assumes that innovation teams can learn much from HRO teams. This question is addressed in the overall conclusion on the basis of the study's results.

We will briefly describe each study, and in which chapter each study is presented as a narrative of the whole research process between 2011 and 2016. We conducted a pilot study to test our first draft of the constructs and improved them on the basis of that pilot (Chapter 2). We then performed eighteen 18 case studies. At first we tested the main relationships of the framework model and examined the presence of mindful infrastructure and Team IRB (Chapter 3 and 4). During the interviews, however, we were struck by two findings. One was that respondents became defensive when we discussed the topic of defensiveness in their teams. The other was that some team leaders had a very systematic approach that fitted well into what reflective practitioners are supposed to do. We decided to follow our curiosity and dedicate a chapter to defensive behaviour (Chapter 5) and to reflective practitionership and organisational learning (Chapter 6). A last research chapter (7) was dedicated to critical incidents in the 18 innovation projects and how the teams dealt with these incidents during their innovation journey, from the viewpoint of innovation resilience behaviour. Chapter 8 discusses conclusions and recommendations for future research, and Chapter 9 considers the valorisation of the study and presents some of the implications for practice.

Study 1 (Chapter 2) Pilot study based on one case

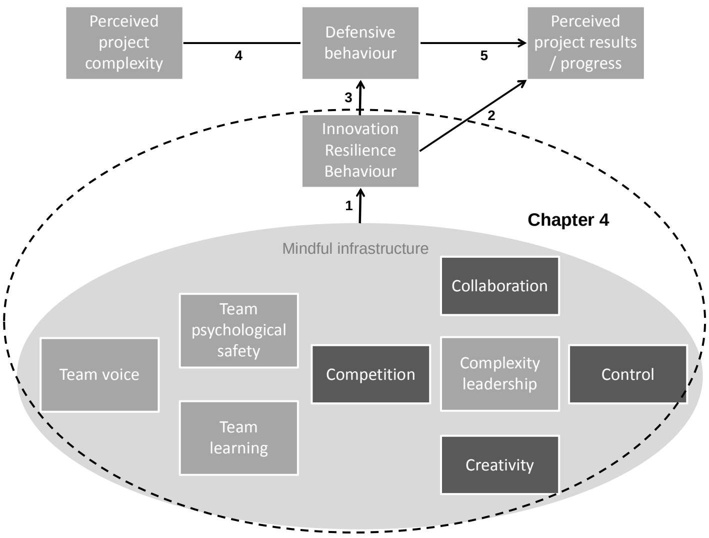
This study is a pilot-study to research an initial model and constructs with the purpose of developing the framework for the research. A single case study will be conducted by gathering survey data, conducting in-depth face-to-face interviews, and observing a project team during a team meeting. The study first explores the relationships between team mindfulness, team psychological safety, team learning behaviour, the type of innovation project and perceived project complexity on the one hand, with team innovativeness, and team external and team internal effectiveness on the other. It then investigates the factors that cause projects to be complex, according to the team studied. Defensive behaviours are observed during a team meeting. The findings are used to refine the research framework, the model relationships, and the measuring instruments. Figure 1, above, is a result of this pilot-study.

Study 2 (Chapter 3) Regression analysis of main relationships in the model



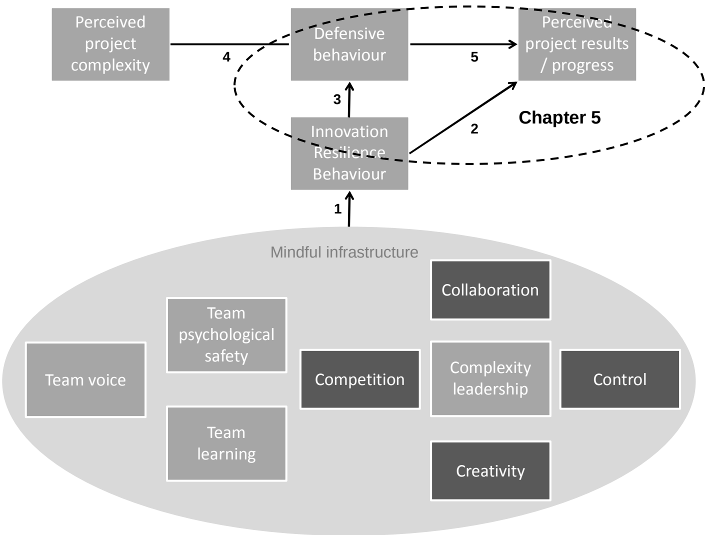
Study 2 explores the main relationships in the model (1 and also 2) as perceived by participants in the case studies, using quantitative survey data, and addresses the research questions '(1) What is mindful infrastructure and what is innovation resilience behaviour (Team IRB)?' and '(2) Does innovation resilience behaviour affect perceived project progress/results?' The relationship between mindful infrastructure and innovation resilience will be investigated, as well as the relationship between Team IRB and project goals, specifically project progress and project results. The main elements of mindful infrastructure will be assessed as the factors that enable Team IRB. Multiple regressions will be carried out to examine which variables determine the project outcomes. Mediation analyses will be conducted to study the indirect relationship effects on the project goals. The data in this study is from 260 team members and team leaders. The data from 18 project managers is also used as an external measure in assessing the validity of the project results.

Study 3 (Chapter 4) Qualitative Comparative Analysis of patterns of mindful infrastructure



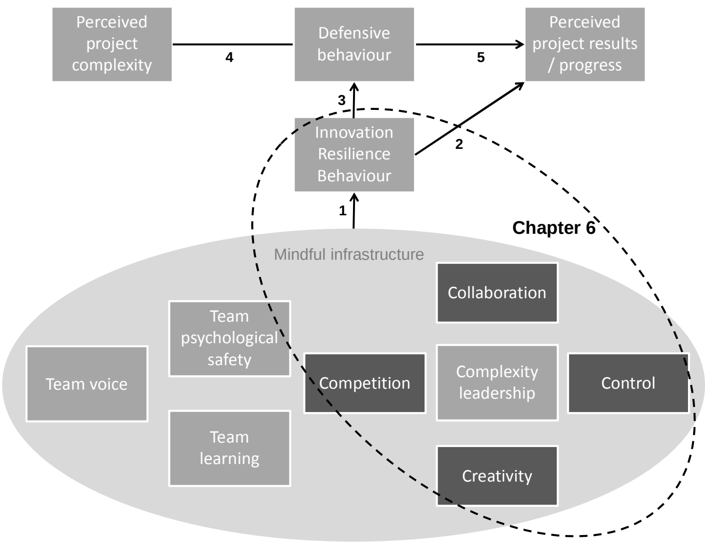
The question addressed in this study is '(3) Do teams have different configurations of mindful infrastructure?' Eighteen case studies of 'innovation projects carried out by project teams' are the basis for this chapter, which tries to assess the degree to which these teams differ in their constituted mindful infrastructure; analyses will also assess which combinations of variables in mindful infrastructure, so-called 'configurations', are associated with the presence of Team IRB in those teams. While Study 2 assesses the causal relationships of the model, Study 3 focuses on patterns that can explain Team IRB (Relationship 1 in the framework). For this purpose the Qualitative Comparative Analysis technique will be applied.

Study 4 (Chapter 5) Study of how teams show defensiveness



Question '(4) Is innovation resilience behaviour associated with less defensive behaviours?' is addressed in this study of eighteen teams who performed defensive behaviours. It is an explorative investigation of self-reported defensiveness, of interpretations of certain team behaviours by the researcher, and a discourse analysis of audio-recorded conversations during the interviews. Teams with high and low scores for the level of Team IRB are compared for defensive behaviour and the association with their project success (Relationships 2, 3 and 5). This study was undertaken following the experience of the researcher, where interview respondents began to speak in defensive terms when the topic of defensive behaviour in their team was addressed.

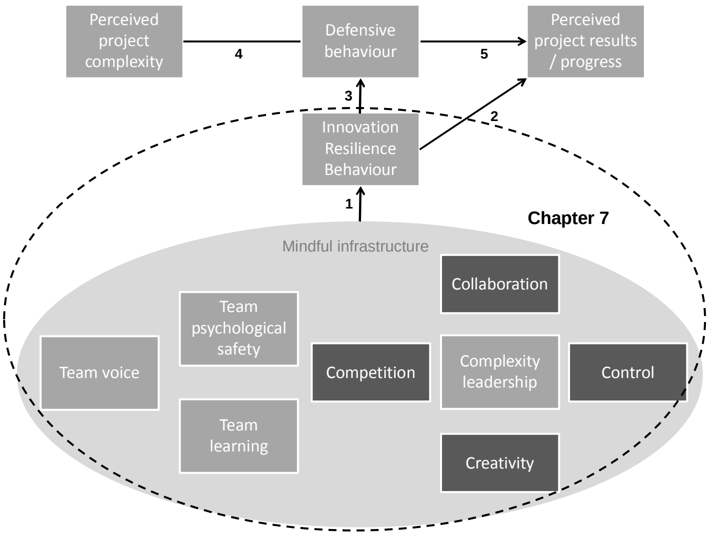
Study 5 (Chapter 6) Study how project leaders manage their projects



This study investigates the question '(5) How do project leaders manage innovation projects?' by focussing on the model of the reflective practitioner and by applying this model to the project leaders studied. Interview data from individual and group interviews is the main data source. The analysis tries to assess whether project leaders implicitly apply a rigorous research methodology when they have to deal with critical incidents. A conceptual relationship is then developed between the model of the reflective practitioner and the model of organisational learning. In trying to make the relationship between reflection and learning transparent in the combination of both models, team leaders are given the tools to enhance the validity of their decision making, especially when dealing with critical incidents. This study was prompted by the researcher's observation that some team leaders seem to be implicitly applying a rigorous research methodology in dealing with issues and incidents, which resembles the model of the reflective practitioner. This chapter describes what happened in terms of leadership, and slightly deviates from the framework's complexity leadership, because some leaders have a quite specific approach. To interpret our findings, we included models of the reflective practitioner (Schön, 1983) and organisational learning (Argyris & Schön, 1974; 1996) in this chapter.

Studies 4 and 5 were not originally planned in the research proposal (Oeij, 2013), but emerged as relevant topics during the fieldwork. The instruments used to re-analyse part of the data and interpret the findings were not developed in advance but during the thesis. These chapters are thus more explorative and lead to the formulation of follow-up research to validate the findings in future investigations.

Study 6 (Chapter 7) Study how teams deal with critical incidents



'How do teams respond to critical incidents during innovation projects?', Question 6, analyses how the eighteen teams deal with critical incidents in their practice. By comparing teams that score high and low for the level of Team IRB the study will determine whether teams differ in how they minimise, manage and mend critical incidents (Relationship 1: in comparison with Chapter 4 this chapter is more descriptive and in-depth). The data from the in-depth interviews of the eighteen teams are the core of this analysis.

Question '(7) What can innovation management teams learn from HRO teams?' is considered in every study, but will be particularly addressed in the concluding Chapter 8. This chapter will offer the overall, and general conclusions of the research.

Chapter 9 is not a research chapter but a translation of the study results from scientific investigation to practical implementation, often called valorisation. Recommendations are made as to how to develop 'The Resilient Innovation Team'.

4 Research methodology

This section briefly presents the applied methodology. An elaborate description of the methodology, the field work procedure, and measuring instruments is provided in the appendices.

Ontology and epistemology

The applied view of reality or ontology is that part of it is observable as hard facts, and part is experienced and in the human mind, and not observable to anyone other than the person in question. From here it follows that reality is partly objective and subjective, as different individuals can look differently at what might be the same object, or a similar experience or thought, and consequently, differ in opinion about what they see. To study or know about reality, the epistemology, it makes sense to apply methods that can look from different angles and that enable the matching of modes or findings to be integrated into knowledge that is built on multiple views. Multiple views acknowledge that there is not 'one truth'. Nonetheless, this study's endeavour is based on pursuing a rigorous method to gather and analyse information and present the findings in a compelling story, that is also verifiable.

The methodological approach that we use is critical-realist and pragmatic; pragmatic critical-realisms, perhaps. "Critical realism holds that an (objective) world exists independently of people's perceptions, language, or imagination. It also recognizes that part of that world consists of subjective interpretations which influence the ways in which it is perceived and experienced" (O'Mahoney & Vincent, 2014: 2-3). Put simply, positivists assume that reality can be measured in objective and generalisable ways, while interpretivists or constructionists claim that 'discourses' generate local and fragmented realities which differ by nature. Critical-realism claims that both have truth and value. Pragmatism (Graff, 2013) implies looking for common ground among several explanations of reality. I see myself as a critical-realism pragmatist. As a consequence we seek not only value in both positivist and interpretivist approaches, but also necessity of understanding real life. The study topic, team processes in innovation projects, specifically requires a case study approach to explore new avenues for investigation and to acquire rich information. It is too soon to test only hypotheses with quantitative data. On the other hand, much scientific knowledge is available about teams and their behaviour that can be tested in a meaningful way within the context of innovation teams and their projects. Combining both avenues of research makes sense to better understand practice.

Methodology

This study combines the positivist approach of hypothesis testing using quantitative data with the interpretivist approach of theory building (and hypothesis-generation) from cases with qualitative data. As a consequence case studies are combined with surveys, quantitative data analysis with analysing talk, interviews with observation and discourse analysis, because in the first place we contend that the triangulation of theories, methods and data sources render a richer picture of 'reality'; and in the second place, what we are studying requires a critical-realist pragmatic approach, for several reasons. These reasons are:

1. The way that mindful infrastructure and innovation resilience behaviour are related and what effects they have is largely unknown and, so far, and not researched in the context of innovation management. This requires in-depth study, an exploratory and qualitative approach, as via case studies (Yin, 2009);

2. We know that team processes are multifaceted and we also know that successful innovation journeys take different routes to success (Van de Ven, Polley, Garud & Venkataraman, 1999). We assume that the teams and projects in our sample are no different, which required data collection and analysis techniques that investigate variety and yet allow some degree of generalisation. In-depth interviewing and using a pattern-creating technique such as Qualitative Comparative Analysis (Ragin, 2008) were needed;
3. We knew that no population frame of 'teams' or 'projects' was available from which to draw a random sample, limiting the application of inference statistics, but, as noted, some generalisation was desired. We therefore hoped to involve organisations that would not only allow us to talk to a few teams, but were also interested in surveying a larger target population within their organisations. This allowed conventional statistics to be used for multivariate analyses;
4. Certain topics demand certain research techniques. Defensive behaviour, for instance, cannot be researched validly by interviews, unless one uses specific instruments in specific settings, such as therapeutic environments. Argyris and Schön (1974: 6-7) have stressed on several occasions that it is impossible to derive people's defensive theory-in-use from interviews. We therefore needed observations and specific instruments to analyse talk (conversation) to get a feel for the role of defensive behaviours in teams.

In summary, we chose the case study as the main approach to gather information, and selected eighteen projects/project teams[27]. In each case we held face-to-face and group interviews with team leaders, team members and the project manager, at which the team/leaders were accountable for gathering data that was rich and 'thick'. We approached these teams, their managers, and an additional sample of colleagues in their organisation, performing the same kind of project-based innovation projects, with a questionnaire to gather data suitable for statistics. Finally a team was observed during a team meeting. To analyse the data we used quantitative 'correlational' techniques (e.g. multiple regression analyses), quantitative 'configurational' techniques (qualitative comparative analysis), and qualitative techniques (discourse analysis, content analysis)[28]. To interpret the results we used deductive reasoning (e.g. the use of the HRO-literature in crisis management and safety in the domain of innovation management) and inductive reasoning (e.g. in making sense of defensive behaviours and reflective leadership we used the theories of organisational defence mechanisms, reflective practitioner model and organisational learning model).

Notes

[1] Referring to reports by the Standish Group IT research advisory firm, Mulder (2012: 19) notes that the success rate of IT/ICT projects has never been more than 30%, that 60% to 90% of innovation projects fail, that large building and construction projects exceed their time and budget boundaries by 50% to 100% more as a rule than an exception, and that 65% of worldwide mega projects fail to achieve their organisational goals. Referring to organisational change in general, according to research by McKinsey & Company, about 70% of all changes in all organisations fail (Meaney & Pung, 2008). Finally, referring to product innovation, Castellion and Markham (2012) report a failure rate of 35-50%, based on the definition that a new product should have been successfully established in the market place. On average, they say, empirical research found the failure rate to be around 40%, between 1985 and 2004. In sum, although these rates are nonetheless substantial, it seems that 'urban legends' reporting failure rates of 80% or higher are not empirically justified (Castellion & Markham, 2012).

[2] Sticking to traditional project management, based on the triple constraint or iron triangle of the criteria to complete the project on time, within budget and with in performance goals or requirements, on the one hand, and the assumption of many executives and managers that all projects are the same and that they can simply follow standardised project management approaches, on the other hand, explains why projects go off-track. Project leaders and project teams become frustrated as they try to fulfil unrealistic expectations of stability, start losing sight of the business rationale behind their project when focusing on project requirements instead of the stakeholders' wishes, or employ the wrong approach to their specific project (Shenhar & Dvir, 2007: 9-10).

[3] Three premises in contending why innovations often fail from the perspective of human behaviour, are:

1. Innovations are new, and therefore, possibly in conflict with the human condition in having a preference for routine situations. Innovations, however, often require deviant behaviour. Human behaviour is characterised by seeking control and in applying fight and flight responses towards threatening and anxiety-rich situations, which are triggered unconsciously. Remarkably perhaps, humans who cognitively are aware of the need to innovate because it is their job, may unconsciously perform behaviours that form a counter-forcing power for innovation. These behaviours are known as 'defensive behaviours' or 'organisational defence mechanisms' (Argyris & Schön, 1974; Argyris, 1990). We assume that humans exhibit defensive behaviour during organisational innovation processes. and, moreover, that they are often not aware of it;
2. Innovation processes vary from simple to complex, from gradual to disruptive, and from incremental to radical. Changing the canteen's furniture is relatively simple, whereas changing the corporate culture is not. However, innovations are often complex, not only in their content ('new furniture', 'cultural change'), but because of the contextual factors that confront teams. Such factors are, for example, the variety of internal and external stakeholders, the need for comprehensive communication, the variety of tasks to be performed by involved persons, tangible and intangible conditions related to resources, targets and deadlines, the diversity of interests, power, and intelligence. The internal processes of the team causes also complexity, such as cooperation, communication, diversity, team politics, leadership. Whether innovations succeed is to a large degree dependent on how humans behave within such contextual boundaries. This is by no means easy, as by interacting together and responding and reacting to one another, people together constitute what happens. The emergent complexity of these interactions cannot be planned (Stacey, 2012), although humans tend to always find certain ways to gain a sense of control over what is happening. Humans, for example plan what should happen, monitor the ongoing process, and make decisions when they arrive at milestones or when they drift away from them. Humans can easily simplify complexity by preferring easy-to-understand reasoning (Kahneman, 2011). Complexity is understood as perceived complexity by team members. Complexity is perceived when team members are confronted with 'mixed messages' concerning their tasks and performance, for example the incommensurability of means and goals, conflicts of interest, inconsistent demands from stakeholders, misapprehensions of team members. We assume that humans are inclined to a rational approach in complex innovation processes. Even when they say they are aware of the difficulty of managing and predicting complex processes, this does not mean that people tend to seek alternative explanations if they cost much psychological effort;
3. Contending that innovation processes may suffer from the consequences of complexity and defensive behaviour calls into question what can be done against that. Studies of human behaviour and group dynamics in crisis and safety management studies indicate that humans are capable of 'unnatural', or 'deviant', behaviour when they employ extra effort and motivation in ultra-conscious ways (Weick & Sutcliffe, 2007). Research traditions in this field developed notions, constructs and theories such as 'high-reliability' and 'mindfulness'. Here, reliability

refers to rarely making mistakes or causing accidents; this is due to highly alert modes of operating: mindfulness. Mindfulness - not the approaches in positive psychology or Buddhism - has been addressed in other ways and other terminologies in the context of business and innovation, such as by 'resilience' (Hollnagel, 2006), 'agility' (Dyer & Shafer, 1999), 'vigilance' (Janis, 1989), 'adaptiveness' (Tofler, 1985), 'dynamic capabilities' (Eisenhardt & Martin, 2000; Teece, Pisano & Shuen, 1997), 'core competencies' (Prahalad & Hamel, 1990), 'responsiveness' (Beunza & Stark, 2003), 'flexibility' (De Leeuw & Volberda, 1996), and even 'requisite variety' (Ashby, 1958). These studies open comparable ways for improving innovation in organisations, such as by being willing and able to respond to changing situations. High reliability and mindfulness bear a similar promise, but they add to this, being able to respond when change unfolds. We assume that humans can improve team innovation capabilities through 'innovation resilience behaviour', a set of behaviours that operate as countervailing powers against the forces that inhibit innovations due to defensive behaviours, stemming from crisis management and safety studies and based on the notions of high reliability and mindfulness.

[4] This study addresses innovation resilience behaviour at the levels of teams: team innovation resilience behaviour, in short Team IRB. In the chapters that have already been accepted for publication, IRB can be used instead of Team IRB.

[5] We distinguish two types of risk taking behaviour, 1. 'controlled' risk taking versus 2. 'overconfident' risk taking and 'sensation-seeking' risk taking. Controlled risk taking is not defensive behaviour, but conscious, validated, well-chose behaviour, whereas defensive behaviour is sub-conscious. 'Overconfident' risk taking and 'sensation-seeking' risk taking are a form of reckless behaviour.

[6] In crisis management and safety studies, there are three literature streams that dominate the field when it comes to explaining and dealing with accidents, namely Normal Accident Theory, High Reliability Organising and Resilience Engineering (Hopkins, 2014). The theory of normal accidents (NAT), developed by Perrow (1999), states that major accidents in many hazardous technical systems are inevitable, if a system is characterised by both tight coupling and interactive complexity. Coupling refers to the degree of interdependence among a system's components (e.g. humans, technology, procedures). Interactive complexity refers to the unpredictable and non-observable interactions between the system components. The interdependency of tasks and processes implies that a failure that occurs in one part of the system can quickly spread to other parts. There is a lack of sufficient knowledge and time for such systems to fully understand, intervene and contain potential failures, respectively due to the system's complexity and the tight coupling of tasks. High risk systems in Perrow's definition involve nuclear weapons, aircraft and military systems; whereas lower risk systems are manufacturing plants, such as oil refineries and chemical plants. The problem with the theory is that human operations cannot prevent accidents from happening; it seems to be just a matter of time. In trying to develop a theory that stresses organisational design (tightly coupled complex tasks and processes), it was not only the tendency to blame accidents on front line operators that was pushed to the background, but also 'sloppy management' as a major possible cause of problems (Hopkins, 2014). Apart from the role of management being neglected, NAT does not explain how and why so many complex systems do not seem to fail (Weick, Sutcliffe, Obstfeld, 1999). Originally the theory of high-reliability organisations (HRO) was too imprecise to solve the problems with NAT. In the 1980s three organisations were studied that had not experienced disaster – the US traffic control system, a company operating both a nuclear power station and an electricity distribution system, and US navy nuclear aircraft carrier operations. The topic was why these organisations appeared to function without mishap, and from these findings the first definition of HRO emerged (Hopkins, 2007). The basic answer was that certain hazardous organisations had enjoyed a record of high safety over long periods of time, when such organisations could have failed many times, but did not, and thus were highly reliable (Roberts, 1990). It proved impossible to corroborate such descriptions with (statistical) evidence, although the figures lend plausibility to seeing these organisations as highly reliable, they do not provide criteria to identify other organisations as HROs (Hopkins, 2007). Hopkins observed a shift in assessing an organisation as an HRO from how safe it is, to what the organisation needs to do in order to become an HRO, when Weick and Sutcliffe reconceptualised HRO as a model of 'mindful organisation' (Hopkins, 1987; 2014). Five characteristics of mindful organisation – preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience, and deference to expertise, – together constitute a collective state of mindfulness. The attractiveness of HRO as a model or ideal type is that any organisation can be measured against it (Hopkins, 2014).

Resilience engineering is a third stream that has become popular, which Hopkins puts to the sword mercilessly. "It offers itself as something new, when in fact it is hard to see in what way its 'precepts and concepts' depart from those of HRO theory", writes Hopkins (2014: 9), and goes on to demonstrate just how similar the resilience approach is to HRO theory. Resilience theory identifies four features or abilities of resilience described as the 'four cornerstones' (Hollnagel, 2011): 1] knowing how to respond to disruptions in a prepared way or by adjusting normal functioning, 2] knowing how to monitor (possible) threats, 3] knowing how to anticipate developments, threats and opportunities in the future, and 4] knowing how to learn from experience. Hopkins illustrates that this responding, monitoring, anticipating and learning are at the heart of HRO, and notes that HRO is not mentioned in the indexes of three main important resilience engineering books, and that there is almost no reference to HRO theory, which led him to conclude that 'the emergence of new concepts must be understood in terms of the social function they perform for their proponents, rather than the intellectual work they do (…) theory is merely a matter of fashion'. A more recent literature review of resilience engineering (RE) adds that 'it would be misleading to portray RE as radically innovative, since most of its core concepts and principles were borrowed from other fields and even RE seminal papers recognize inspiration from HRO', and concludes for the future positioning of RE with other theories that: 'In particular, progress is necessary to articulate RE with other safety management paradigms (e.g. HRO)' (Righi, Saurin & Wachs, 2015: 145, and 149). We therefore further ignore this stream.

[7] As a background, we discuss studies that have reviewed the literature. We did not review all the literature ourselves but based our views on meta-studies. We did search in the relevant databases to check for sources related to innovation management, however, most articles deal with the implementation and evaluation of HRO principles, with very many contributions regarding team work in medical, care, and education organisations. Researchers conclude from their evaluation of the HRO literature that there is no systematic overview available (Hopkins, 2014; Lekka, 2011). Research on the effects of high-reliability is remarkably scarce. Since 1989, when the concept emerged (Roberts, 1989), there has been much case study research into whether or not organisations have applied HRO principles or whether their safety performance can be explained by the presence of HRO principles. Early studies were inductive by nature, and built theory from practice. The study of HRO was for a long time based on three cases - the air traffic control system of the US Federal Aviation Administration, the power grids of the Pacific Gas and Electric Company, and US marine nuclear aircraft carrier operations - on which the concept of HRO was built, and from which HRO characteristics could be derived (Roberts & Rousseau, 1989). Applying the concept, subsequent investigations tried to assess whether organisations could be characterised as HROs or not. Much research was thus prescriptive and descriptive (Tolk, Cantu & Beruvides, 2015). After the publication of Weick and Sutcliffe's book (the first edition appeared in 2001) quantitative measures and scales were developed to capture the presence of the five key principles - to be discussed further – that together make up collective mindfulness. A stream of empirical research followed, often applying surveys, to a large extent in the sector of hospitals and nursing. The attention given to health care in HRO was based on a critical report on medical errors, entitled 'To err is human', describing high numbers of unnecessary patient deaths in 1999, and the launch of a centre to transform health care into a high reliability industry in 2009 (Tolk et al., 2015). Despite this shift from qualitative to more quantitative research, Lekka (2011) observes that more research is required to enable an assessment of organisations as 'reliability-seeking' or achieving 'HRO status', and especially to ascertain the predictive validity of such HRO measures. 'In particular, evidence is lacking about the extent to which organisations that exhibit 'collective mindfulness' or have reliability seeking characteristics also tend to hold better safety records in comparison to those organisations that have tendencies to 'mindlessness'' (Lekka, 2011: 13). Moreover, little is known regarding the factors or underlying mechanisms that enable the development of HRO characteristics, as Lekka (2011) writes. Although several authors stress the advantages of HROs, Lekka (2011) notes four limitations in HRO research and the applicability of the HRO concept.

- The first is that research has been carried out in a very limited number of organisations for a long time, which are 'exotic' in so far as they are highly specific and do not leave much room for generalisation, for instance specific military organisations and air traffic controllers. For such non-profit organisations where safety is of primary importance, it may be clear why HRO key principles are relevant, but it is rather unclear for market organisations that face economic pressures or public organisations that must be efficient. Since safety may be irrelevant for such organisations compared to productivity, the questions remain: which of the key HRO principles are relevant to them, and how can these principles be best developed and implemented?
- Second, HRO research lacks a theoretical-empirical framework that goes beyond descriptive relationships and that provides generalisable evidence of cause-effect relationships between HRO principles and key performance indicators, such as safety records.

- Third, HROs are able to identify and anticipate unexpected potential failure scenarios, and, moreover, to spot errors when they occur and identify a timely and appropriate course of action in real time to avert catastrophic consequences. Research in healthcare has shown that effective anticipation and prevention of errors in real time is not always possible. Sustaining almost error-free performance is not only extremely difficult, it is very hard to understand how it functions and it can be developed. Taking HRO processes out of one context and applying them in another is complicated by their context-dependency (Lekka & Sugden, 2012).
- Fourth, the work environments of HROs tend to be experienced as stressful, often because individuals are expected to behave in ways that are very different to how they would behave outside work. In operational HRO-cultures the emphasis is on adherence to rules and procedures, hierarchical, non-participative decision-making, attention to detail, and perfectionism. This raises a question about the effects of HRO environments on individuals. While empirical research suggests that individuals flourish in work environments that offer autonomy, participation, personal development and creativity, HRO environments tend to feature their absence (Rousseau, 1989). Experimentation and innovation are discouraged, normal operations are hierarchical, and job demands are high due to the grave consequences of error. When there are emergencies the work has high psychological and physical work loads. Jobs are potentially stressful. Based on Rousseau's research (1989), Lekka assumes this will impact mainstream organisations in their consideration to implement HRO principles.

[8] Mindfulness in HROs is both the willingness to see and the willingness to act, and this continually expands the ability to discover and manage unexpected events; the creation of shared cognitive awareness and the varied ability to act, and variations in action patterns, thus becomes a 'collective mindfulness' throughout the organisation. In contrast to this kind of organisational learning, if people are blocked from acting on hazards and from detecting weak signals of hazards, these hazards will be ignored and denied, and errors will accumulate unnoticed. Mindlessness, risk-avoidance and defensiveness will reign, characterised by reliance on past categories, acting on 'automatic pilot', complacency, and fixation on a single perspective without awareness that things could be otherwise (see also Argyris, 1990). HROs actively strive to suppress this inertia or mindlessness. How they do this is relevant to organisational theory and the practice of organisations.

[9] That is, in at least three ways: 1] treating any and all failures as signals of the health of the system as a whole, 2] a thorough analysis of near failures, near misses, and 3] focussing on liabilities of success. HROs make rich reports of the limited available errors for learning. They reward and encourage the reporting of errors. They are reluctant to regard success as a reason for leaning back and being complacent.

[10] This is realised in several ways: 1] making fewer assumptions and socialising people to notice things more; 2] the effort to match internal complexity with external complexity, to cultivate the requisite variety ('conceptual slack') and to assume that it takes a complex system to sense a complex environment; 3] negotiated complexity, that is the negotiation and continual renewal of informal interorganisational agreements, allowing divergent perspectives and the incidence of disagreement and conflict, which are managed by continual re-negotiation. This requires interpersonal skills, mutual respect, norms that curb bull-headedness, hubris, headstrong acts, and self-importance, continuous negotiation, the re-accomplishment of trust, and simultaneous cultivation of credibility and deference; and 4] a novel form of redundancy, namely scepticism, to counteract potential complacency, and the trust that these cross checks, doubts and this wariness will improve reliability.

[11] The concern is to be sensitive to catch errors in the moment. In such a state catastrophic failures are forestalled by large numbers of ongoing small adjustments that prevent errors from accumulating. Ongoing action occurs simultaneously with attention, and people act thoughtfully, with wisdom and heed, say the authors. They reflect-in-action like reflective practitioners, as Schön (1983) would have it. This collective big picture, or 'having the bubble' in navy terms (Roberts & Rousseau, 1989), of acquiring sensitivity to operations is a shared accomplishment. It can be achieved through a combination of shared mental representations, collective story building, multiple big pictures ('bubbles'), assessing situations with continual updates, knowledge of physical interconnections and parameters for plant systems, and active diagnosis of the limitations of pre-planned procedures. The combination of higher-level cognitive activities, social construction of coherent explanations and physical knowledge all produce mindfulness in the moment, claimed Weick et al. That is an active process in which members are actively searching for answers, and in doing so, as an ongoing effort, they are socially constructing their awareness. Sensitivity to operations is a qualitative, social and interactive process, in which people perceive what happens, integrate information and extrapolate its meaning to present and future actions (see also Weick, 1995).

12 To be resilient means also to utilize the change that is absorbed. HROs develop capacities for resilience in several ways, so as to prepare for inevitable surprises by expanding knowledge and technical facility, and generalised command over resources; and to acknowledge the reality of fallible humans and murky technology and to install error-prevention and error-containment systems. HROs, for example, use informal latent networks for the rapid pooling of expertise to handle merging crises in a flexible way; they are able to improvise and recombine actions that are already in their repertoire in novel combinations, and they develop constructive ways to deal with ambivalence toward the applicability of past practice. HROs simultaneously both believe and doubt their past experience, because situations are at the same time once-only situations and seen-it-all-before situations.

13 This approach eliminates the paradox that the adoption of orderly procedures to reduce error often spreads errors further. HROs break out of routines that might amplify error and gain flexibility by enacting moments of organised hierarchy, by uncoupling links, as in the case of garbage can structures. In a garbage can, problems, solutions, decision makers and choice opportunities are independent streams in an organisational system. Such temporal structures lack planned cause-effect outcomes as in common organisations, due to the loosening of hierarchical constraints, which Weick and colleagues (1999) call the 'enactment of more anarchic modes of functioning' in favour of flexibility and expertise.

14 HROs 'in action' are not bureaucracies but learning organisations. HROs that are performing through safe and effective operations have acquired remarkable abilities, which Weick et al. have called 'collective mindfulness' and which is constituted of the five key principles. Collective mindfulness is a combination of cognitive behaviour and industrious behaviour, which is present among the collective of personnel, and which is supported by organisational procedures and tools, and guided by a leadership who deems it of utmost strategic and operational importance. Cognitive behaviour refers to stability in the cognitive processing of variation in activities in detecting deviations and weak signals, while industrious behaviour points to the ongoing effort to perform this cognitive processing and proactively and reactively adapt to events which require revision in a resilient manner. Since everyone is working mindfully in this way it becomes part of the personnel collective and constitutes the organisational culture. Organisational procedures and tools include briefing and debriefing, reporting, monitoring and continuous training, support learning and mastering the cognitive and industrious behaviours. Leadership at all levels in the organisation sets the example of these behaviours and makes room for seemingly opposite behaviours – such as following procedures and deviating from them when deemed necessary, or centralising decision making in complex interlinkages while decentralising operational interventions at lowest levels - in which organisational members learn to function in continuously changing settings without losing trust in each other. Although Weick et al., in evaluating seminal HRO-studies, do not provide evidence about the separate contribution of each of the five key processes to collective mindfulness, or how and to what extent that explains the reliability of the organisation's work processes (see also Lekka, 2011), they give a plausible account about the why and the how of collective mindfulness as a mechanism for reliability. Their analyses show that preoccupation with failure, a reluctance to simplify, and sensitivity to operations make use of the same stable cognitive processing behaviours that reinforce mindful behaviours, and that commitment to resilience and under-specification of structures guarantees timely action and loosens enough boundaries to remain flexible and perform reliable. The multifaceted character of collective mindfulness makes it difficult to produce a meta-review from which generalisations can be easily drawn about the state of the art among HROs and non-HROs (Leka, 2011; Tolk et al., 2015). If one only takes the levels into account, for example, it is understood that reliability cannot be seen as disconnected from systems, positions, programmes, processes, individuals, teams, and their interconnections. Collective mindfulness resulting in reliability is, apart from procedures and tools, largely a set of cognitive processes. Weick and colleagues (1999) summarise the five principles that counter the problematic combination of Perrow's (1999) combination of interactive complexity and tight coupling in the following process-oriented manner: "Mindfulness both increases the comprehension of complexity and loosens tight coupling. People preoccupied with failure *comprehend more* of the potential complex interactions in a system and create alternative paths for task performance that loosen couplings. People who simplify reluctantly *pay close attention* to the details of complexity rather than abstract them away and *see more* components that can be rearranged in more ways to avoid tight invariant sequences. People who maintain sensitivity to operations *see more* interconnections and *comprehend more* complexity in the moment which enables them to make adjustments that loosen time-dependencies, introduce redundancy, and in general, loosen tight coupling. People who develop capabilities for resilience *stay attuned* to unfolding events for longer time intervals which increases the likelihood that they will be able to *comprehend* puzzling interaction. Resilient

systems also create slack resources and alternative means to a goal, both of which loosen couplings. And people who loosen hierarchical access structures *increase the comprehension* of complexity by marrying problems more closely and more quickly to experience and expertise, and reduce the likelihood of tightened coupling by isolating problems earlier in their development before they spread and constrain other system properties." (Weick et al., 2008: 51; italics added). It should be noted that the italicised parts are verbs that point to the psychological process of organising that has characterised all of Weick's work ever since the late 1960s (Weick, 1979). The added italics indicate that mindfulness is foremost in acting and organising, about what people do; it is more about verbs than nouns as it is dynamic and not static. To do this in highly qualified manners demands the acknowledged sense of urgency to make the effort because it is seen as indispensable for success. Organising for reliability requires mindfulness and this demands high motivation and psychological effort, suppressing automated behaviour, acknowledging the risk of defensive behaviour and risk-averse behaviour. For all humans this is hard work and for most of them it is unfeasible (Argyris, 2010; Kahneman, 2011); HRO-staff learn this through training and reflective practices because they must master it. Their work environment facilitates mindful acting and learning. Shifts are briefed and debriefed intensively to improve rules and procedures. Yet, HRO-staff simultaneously learn not to unthinkingly follow and apply these rules and procedures: that would be mindless; they learn to handle apparent incompatibilities by being extremely heedful and by using professional empathy to understand what is going on in depth, and what might be overlooked (Weick & Roberts, 1993). The stress on cognitive and social psychological competencies is not at the expense of structuring organisations. Having tools and procedures in place is one way of doing so. Another one is to design autonomy, voice and flexible decision making into the working process and into jobs and teams. HROs seem to clearly understand that in order to be able to respond to unexpected events, organisations need 'slack' and employees need decision latitude to intervene when needed (Christis, 2010). Designing the requisite variety (Ashby, 1958) into the psychological fabric and the organisational structure is the answer to Perrow's gloomy 'normal accident' perspective. HROs seem to manage in doing so by implicitly applying a root-cause analysis that is conducive to designs where complex requirements demand requisite variety (Achterbergh & Vriens, 2010; Christis, 2010; De Sitter et al., 1997; MacDuffie, 1997).

15 These investments favour HROs but do they also benefit non-HROs? Medical sectors that are taking over the ideas of HROs use a similar line of argument. Since the Institute of Medicine in the USA found that millions of people suffer adverse consequences from medication errors and that there is a yearly estimated 98,000 deaths in hospitals, many have advocated that hospitals should emulate HRO-principles and many are doing so (Vogus & Iacobucci, 2016). For profit organisations without life or death urgency the business case for investing in HRO is less obvious. Perhaps it should be more compelling for organisations for which successful innovation is vital for economic survival, as they lose a lot of money due to the failure rate of innovations (Castellion & Markham, 2012). The validity of this argument can be doubted, however, as there appears to be an acceptance of relatively high failure rates. A possible reason for preserving the urban legend of the 80% failure rate of innovations, according to Castellion & Markham (2012), is that it absolves the new product practitioner of failures and heightens recognition for achieving success. Another common notion is that successful innovations require entrepreneurial risk-taking – without which there would not be innovation at all – but that such risky choices will naturally not always turn into positive outcomes. Investing in innovation and accepting a relatively low success rate thus seems more or less normal. Compare Perrow's point of view, which regards normal accidents as 'normal failure': innovation implies the complex and tight coupling of interdependent agents and resources resulting in unpredictable emerging critical incidents? But some do not accept that, such as Van Wulfen, who 'was really amazed that a lot of managers, practitioners and researchers seem to accept a one out of seven effectiveness rate of innovations', and decided to develop a toolkit for innovators (Van Wulfen, 2012).

16 Here is what they have to say about it (Weick, Sutcliffe & Obstfeld, 1999: 113-114; 2008: 58-59): "The piece that is missing in this tidy picture is that it is not just safety that costs money. Learning does too. And this is where the pragmatics of reliability and efficiency begin to blend. If we view safety as a process of search and learning, then the costs of building an infrastructure that induces mindfulness can be viewed as an investment in both learning and safety. Investments in safety are defined as investments in mindfulness that mean greater familiarity with the system, an enlarged response repertoire, and clearer accountability, all of which can create competitive advantage. To invest in mindfulness is to assign a high priority to the probability of error and to the importance of responsibility for mistakes, internal criticism, and the removal of self-serving defensive postures. Furthermore, to encourage mindfulness is to tap into intrinsic motivation and increase performance-enhancing perceptions of efficacy and

control. But whether a high reliability approach leads to sufficient returns in the form of avoided disasters or enhanced performance to justify its implementation, *remains an empirical question, difficult to assess and perhaps ultimately unknowable*. The choice by mainstream organisations to pursue high reliability organising in the absence of obvious threats may ultimately be an issue of identity and appropriateness (who do we want to be and how do we want to go about our business), rather than an issue of reality and consequentiality." (italics added).

17 The difficult challenge for some organisations will be to build in slack to be resilient and innovative and at the same time strive for flexibility and efficiency to remain competitive.

18 The research focuses on project-based teams, who differ from permanent teams. Permanent teams are a group of participants from several functions who are permanently assigned to solving ongoing problems of common interest, whereas a cross-functional team - such as a project-based team - is a group of employees assigned to a functional department that meets as a team to resolve mutual problems (Daft, 2000: 324). While permanent and cross-functional teams have clear-cut boundaries in relation to the problems or tasks that they deal with, this is not the case with certain project-based teams. Task forces and project teams, for example, are temporary organisational forms. Whereas a task force is a temporary group that is given a delimited problem to solve, a project team is a group of personnel across departmental lines that carry out some portion of the regular work of the organisation (Scott, 2003: 240-241). Apart from these 'structural design' elements, project-based teams function in a 'looser' context than permanent teams. Shenhar and Dvir (2007: 3) discuss a process approach in which they offer a distinction between operations and projects: "*Operations* involve repetitive, ongoing activities, such as manufacturing, service, and production, whereas *projects* involve unique, one-time initiatives, such as launching new products, new organisations, or new ventures, improving existing products, and investing in the company's infrastructure".

19 Maybe it is even questionable to speak of teams in the sense of project teams. According to Tuckman's linear metaphor of group development (Tuckman & Jensen, 1977), project teams barely have the time to mature into well 'performing teams', but are stuck at the level of 'storming and norming groups'. In other words, they stay as a loosely coupled group of individuals instead of becoming a solid team. We use this linear thinking simply to suggest that 'project teams' may be a misnomer and that project-based or project-oriented working simply implies working within a temporary structure on a task within certain time limits. Members of project teams in many cases are also members of other projects. An individual can work on a variety of projects, and the project team members constituting each project (team composition) may also vary. To further complicate this matter, the literature talks about multi-project teams and multi-project-multi-team settings. The first refers to teams doing more than one project; the second to more than one team working together on more than one project (Hobday, 2000; Zaccaro, Marks & DeChurch, 2012). For our purpose it suffices to say that we study project teams that are organising innovation as a project-based endeavour.

20 The OECD (2005), for example, distinguishes between product innovation, process innovation, marketing innovation and organisational innovation.

21 Team behaviour is affected by a multitude of factors (e.g. Mathieu, Maynard, Rapp & Gilson, 2008; Stewart, 2006) which makes it complicated to pin down those factors that determine the successful outcomes of innovation projects (Hülsheger, Anderson & Salgado, 2009). This study not only looks at the 'hard side' of project management (time, budget and performance), but also at the 'soft side' of projects, such as managerial, social and organisational aspects (Antoniadis, Edum-Fotwe & Thorpe, 2011; Azim, Gale, Lawlor-Wright, Kirkham et al., 2011; Sauser et al., 2012; Shenhar & Dvir, 2007). In this research the focus is, however, on the 'soft side' of team behaviour in innovation projects. There are many other reasons why innovation projects may go awry, such as the quality and reception of a new product or service, the decisions of investors and top management regarding a project, and difficulties transferring an invention into an accepted innovation, which are not being investigated.

22 Structures are seen as the hardware of organisational design, such as the organisational diagram, divisions/departments/teams/function/jobs, and the organisational functions relevant for the organisational goals (such as production, maintenance, sales, HR, ICT etc.). Corporate policy documents design the expected behaviour of team members (vision, goals, policies, accounts of past behaviour and results). Culture is the solidified behaviour constituted by the individual behaviour of team members based on their manifest and latent values and norms. Structure and culture interact, and are, moreover, co-determined by strategy/strategic behaviour and external factors. Semi-structure is a term that holds elements of structure and culture, and makes it difficult to specify exactly what it is and what it is not. Mindful infrastructure, as a semi-structure, contains solidified behaviour. One

could argue that mindful infrastructure is not only an organisational characteristic but at the same time a characteristic of the behaviour of team members, and that this behaviour can also change and develop over time. In other words, the observation that it is solidified does not imply it cannot change. It can of course. In our view it is solidified behaviour in the sense that it precedes innovation resilience behaviour: mindful infrastructure is 'on the left side' of the equation compared to Team IRB.

23 Weick et al. (1999), Weick and Sutcliffe (2007), Sutcliffe and Weick (2013), Vogus (2012), Vogus & Sutcliffe (2012), and Vogus and Iacobucci (2016) state that reliability and safety are a consequence of 'organising', the process of interaction between persons that constitutes sense and meaning, and, in this case, a collective capability in detecting and correcting errors and unexpected events. This 'organising' generally precedes Team IRB. If Team IRB is the team behaviour to deal with unexpected events, then the next step is to select the antecedents of Team IRB that constitute mindful infrastructure. From her literature study on HROs Lekka (2011) made a mindmap of processes and characteristics associated with HROs. Three of these characteristics are that HROs 1] foster strong learning, 2] have just cultures, and 3] have 'mindful' leaders at the very top of the organisation. The learning orientation is characterised by continuous (technical) training, root cause analysis of incidents, open communication, and reviewing procedures in line with the organisational knowledge base. We therefore see team learning (Edmondson, 1999), the ongoing process of reflection and action, by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions, as a relevant antecedent of Team IRB. A just culture is the notion in which staff are not punished for actions, omissions or decisions taken, which are commensurate with their experience and training, but where gross negligence, wilful violations and destructive acts are not tolerated. A just culture involves two team elements, team voice and team psychological safety. Voice refers to intentionally expressing relevant ideas, information, and opinions about possible improvements, even when others disagree (LePine and Van Dyne, 2001). Team psychological safety is the shared belief that the team is safe for interpersonal risk taking, and suggests a sense of confidence that the team will not embarrass, reject, or punish someone for speaking up, implying mutual respect and trust (Edmondson, 1999). 'Mindful leadership' in HROs involves leaders who encourage communicating 'bad news' and the proactive investigation of organisational flaws, and leaders who balance the pressures of production and business with safety. Complexity leadership can connect such seemingly contradictory goals. Complexity leadership is therefore another antecedent of Team IRB that enables leadership behaviour aligned with situational needs, and encompasses different styles; competitive, cooperative, creative and controlling styles (Lawrence, Lenk & Quinn, 2009). Team psychological safety, team learning, team voice and complexity leadership are regarded as antecedents of Team IRB. For example, Vogus (2012) explains that psychological safety is a function of management decisions to support front-line action – in his words "a function of leader behaviours and discursive practice" that facilitates this – and, as such, belongs to "potential antecedents of mindful organizing rather than analogies of it" (Vogus, 2012: 667). He argues in the same vein regarding safety climate. Elsewhere, Vogus and Sutcliffe (2012) point to the important role of transformational leadership, in order for employees to participate and to learn. Such leadership creates a context and enables mindful acting. Other antecedents, according to Vogus and Sutcliffe (2012) are task interdependence and organisational size. If task interdependence is high, as in HROs, mindfulness is critical to make difficult and effortful work legitimate and acceptable. At a higher organisational level than the team level this interdependence also has a relationship with organisational size. In larger organisations, mindfulness is more 'fragmented' (Vogus & Sutcliffe, 2007), as parts of such organisations are more 'loosely coupled' when size grows. Task interdependence and the need for counter fragmentation are realised by providing teams with a voice, a shared goal, and relationships that allow trustful communication (Baker, Day, Salas, 2006; Salas, Sims & Burke, 2005). "Superficial or ingenuous conversation may soothe in the short run but is likely to block progress in the longer run. This is especially true for teams engaged in innovation and involved in other work activities that call for behavioural and organizational change" (Edmondson & Roloff, 2009: 202). Mindful infrastructure ensures the social-relational context of respect and trust which encourages people to speak up and question interpretation, and counteracts tendencies to act defensively, due to feelings of threat, discomfort or feelings of incompetence (Sutcliffe & Weick, 2013). Team members, thus, must pay attention to the interrelationships of their activities through heedful interrelating, a shared pattern built on individual actions in which individuals understand how their action fits into the larger action and the mechanism of the system as a whole. Heedful interrelating implies that 1] team members understand the relationships of their action, the system, and its goal; 2] they understand how the interactions contribute to this goal; and 3] they maintain a conscious awareness of the evolvement of the

system and their actions when performing their tasks (Weick & Roberts, 1993; Sutcliffe & Weick, 2013). Mindful infrastructure is a necessary but not sufficient condition for Team IRB. "That infrastructure must be organised and enacted through conduct that enables organisational members to recognise emerging problems earlier and to manage them more decisively" (Sutcliffe & Weick, 2013: 151). Managing innovation projects by teams should thus establish team behaviours that are aimed at the five principles to anticipate critical events and to deal with them resiliently. The four antecedents are enablers of Team IRB and together constitute the mindful infrastructure. To link these elements to a research model a final step is to describe its relationship with the team and leadership literature (e.g. Avolio, Walumbwa & Weber, 2009; Hülsheger, Anderson & Salgado, 2009; Mathieu, Maynard, Rapp & Gilson, 2008; Stewart, 2006).

1. Team psychological safety and team learning
   Team psychological safety is meant to suggest a sense of confidence that the team will not embarrass, reject, or punish someone for speaking up, implying mutual respect and trust among team members as a team climate (Edmondson, 1999: 354). Team learning at the group level is an ongoing process of reflection and action, characterised by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions (Edmondson, 1999). Team safety and team learning are both important for innovation processes, where team members may have to 'deviate from the norm', depart from their comfort zones, and reflect critically on new and unexpected events. In the case of project teams these elements of mindful infrastructure gain importance, considering that project team memberships are fluid, short-lived and that roles, tasks and hierarchy may be more ambiguous than in permanent teams. It is assumed that mindful infrastructure coincides with feelings of safety and options for learning, which is beneficial for creative and innovative processes in teams, because better use is made of ideas and the (critical) opinions of all team members.
2. Team voice
   The function of decision making in teams is omnipresent. Since decisions are inextricably bound up with interests, there are links with power and conflicts. Team voice provides team members with influence in decision making. Power, or organisational politics, is considered to be a relevant element of mindful infrastructure. When the attitude to power is constructive it may enhance critical reflection and problem solving in teams when team members focus on (rational) task-related, instead of (emotional) relationship-related, conflicts (De Dreu & Weingart, 2003; De Dreu, 2006). Avoiding relationship-related conflicts may also diminish personal tensions and evoke interpersonal trust, which then can facilitate problem-solving and mindful decision making. Power and conflicts are thus not necessarily negative aspects of organisations, because they can enhance innovation under certain circumstances, for example when dealing with task conflict rather than relationship conflict in the case of constructive problem solving. According to Buchanan and Badham (2008: 6), power is always present for a number of reasons, as it is rooted in 1] the personal ambition of individuals, 2] organisation structures that create roles and competing departments, 3] decisions that cannot be resolved by evidence and reason alone but which rely on the values and preferences of those involved, and 4] the organisational changes that threaten to push people out of their comfort zones and challenge vested interests, which they then struggle to preserve. It is assumed that mindful infrastructure goes hand in hand with constructive politics, problem solving and the employee voice in decision making in project teams.
3. Complexity leadership
   Leading innovation projects and project teams may at times be reconciling possibly incommensurable goals, such as innovativeness versus budget and time constraints, attuning diverging interests of stakeholders, diverging talents and backgrounds of team members. Leadership implies combining transformational and transactional goals, task-orientation and people orientation. A meta-analysis of leadership behaviours and teams (Burke, Stagl, Klein, Goodwin, Salas & Halpin, 2006) concluded that both task- and person-oriented leadership behaviours (respectively transactional leadership, initiating structure, boundary spanning on the one hand and transformational leadership, consideration, empowerment and motivation on the other) explain a significant amount of variance in team performance outcomes (perceived team effectiveness and team productivity). The authors conclude that leaders need to be trained in both types of behaviour as they both contribute, and are needed, for teams to be effective (Burke et al., 2006). The literature on complexity leadership is helpful in this area. Organisations grow in complexity, as places where people's actions interact with sufficient intricacy, so that what unfolds and develops cannot be predicted by standard linear equations,

but emerges out of the myriad of behaviours, and cannot be reduced to simplistic relationships, because the whole is more than just the sum of all of the parts and elements (Uhl-Bien & Marion, 2009). The essential point of leading teams in complex settings, is that no-one can fully predict and control outcomes, but that some have more power over others to influence the direction of decisions and the distribution of resources, rewards and so on (Groot & Homan, 2012; Stacey, 2012; Blomme, 2014). Complexity leadership, in such instances, requires different leadership styles attuned to situational requirements (Lawrence et al., 2009 speak of 'behavioural complexity' regards leadership). The leadership of project teams working on innovation projects requires the reconciliation of possibly opposing views, such as the project management's triangle of money, time and results on the one hand, and creative, innovative outcomes on the other. We assume that this kind of leadership of project teams and innovation projects is an essential part of mindful infrastructure.

24 Also of relevance it seems, are f) to monitor vigilantly what the team does, g) to brief and debrief decision making during the project, and h) to reflect and organise feedback loops in order to learn from what the team does (Chapter 2), but we did not systematically include these in our measuring instruments.

25 In our research framework, the role of defensiveness and risk-avoidance, and the complexity of the innovation projects and project environment, are relevant for carrying out innovative projects by teams.

26 Risk aversion is the behaviour of humans when exposed to uncertainty in an attempt to reduce that uncertainty (Kahneman, 2011). Innovation requires teams to be creative and deviate from the norm, but uncertainty may drive teams towards conformity (Pech, 2001), especially when these teams are relatively large (Almandoz, 2014). Risk aversion may emerge when creativity is killed (Amabile, 1998) and when team members feel incompetent and threatened, which prompts organisational defensiveness routines (Argyris, 1990). When teams feel confident that they can manage a difficult job, however, they will not be risk-averse. Of course, innovation teams consist of members who it is assumed are selected to do the job. Risk avoidance, however, is not a conscious type of behaviour, and it is plausible that teams would like to perform successfully. There are many reasons and explanations for risk averse behaviour. The psychological literature discusses heuristics and biases which may subconsciously undermine 'complex' choices, decision making and judgment (Kahneman, 2011), and lists of defensive behaviours that may be detrimental to the quality of performance (e.g. Ardon, 2009). While one assumption is that both perceived project complexity and defensive behaviours may have a negative influence of innovation results, they are not the main focus of the research.

27 In selecting the cases we could not keep factors such as type of innovation (technology) or type of sector constant, as we were dependent on the cooperation of organisations. We mitigated this problem by selecting organisations that were known for being innovative and functioning in environments where (continuous) change was a necessity for their performance. Being interested in studying innovation processes, we targeted organisations that could offer projects with critical incidents and their own willingness to learn from those situations and processes. We further focussed on project-based innovations to limit the variety/heterogeneity where possible. The number of cases, 18, is limited from the viewpoint of drawing statistical inferences, but an important goal is hypothesis generation for theory building which does not require a large number of cases (Yin, 2009).

28 The distinction between correlational and configurational techniques is taken from Cambré (2015).

Chapter 2

Can teams benefit from using a mindful infrastructure when defensive behaviour threatens complex innovation projects?

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Abstract[1],[2]

Projects are often doomed to fail. An explorative case study which carried out team-based complex innovation projects in a research and technology organisation suggests three main results. 1] Project team leaders experienced that the complexity involved in the various aspects of team functioning, made it prone to mixed messaging. 2] One of the meetings observed indicated that defensive behaviours were prevalent. 3] The team members' self-assessment reports on team performance suggested that team outcomes improve in the presence of team psychological safety, team learning and team mindfulness. The study indicates that complex innovation projects may be negatively affected by defensive behaviours, but this behaviour can be overcome by creating a mindful infrastructure based on team psychological safety, team learning and team mindfulness.

Key words: project complexity, defensive behaviour, mindful infrastructure, innovation, team, resilience, mindfulness, innovation resilience behaviour

1 Introduction

A problem for many organisations is the failure of projects (Sauser, O'Reilly, Shenhar, 2009). The success rate has an average of approximately 30% during the past two decades (Mulder, 2012). The literature mentions several reasons why projects may fail. Different types of projects, varying from innovation, ICT and large scale infrastructural projects, do not (completely) succeed due to the presence of fail factors (e.g. type of project manager, the organisation is not equipped to perform the project, bureaucracy), or the absence of success factors (e.g. management support, sufficient resources, commitment, a coherent or consensual conceptualization of project success) (Mulder, 2012; Sauser et al., 2009). Many studies sought 'hard' explanations for the success or failure of projects, among which included such explanations as new technology and knowledge, the scale of projects and financial aspects, whereas a growing stream of research is focusing on the 'soft' side of projects, such as managerial aspects, stakeholders, leadership and team dynamics (Azim, Gale, Lawlor-Wright, Kirkham et al., 2011; Antoniades, Edum-Fotwe & Thorpe, 2011). Many studies have demonstrated that most projects do not meet their time and budget goals, nor do they succeed in satisfying their customer and/or company expectations (Sauser et al., 2009), and yet, most approaches of project management are based on this 'iron triangle' of time, budget and performance (Shenhar & Dvir, 2007). As more and more organisations become eager to manage the soft side of projects, a shift is taking place from solely stressing typical factors, such as project mission, planning, communication, politics, control, top management support, technical tasks, etc., towards, at the same time, managing managerial, social and organisational aspects (Sauser et al., 2009; Antoniades et al., 2012). However, this 'opposing logic' which vacillates between the need for operational efficiency in the present, while simultaneously trying to innovate successfully for the future (Katz, 2004), confronts project managers and teams with mixed messages. Such mixed messages send 'weak signals' warning that projects are in danger of failing which makes it difficult to deal with them properly so that these teams can take notice and respond in an adequate manner. However, in order to overcome their own 'defensive behaviour' human beings at times behave 'unnaturally', which means they must use great effort to do something they normally would not do, namely challenging their 'unproductive reasoning'. In situations where people, e.g., feel uncomfortable, incompetent, or threatened, they are inclined to be less reflective and less effortful in their thinking. Kahneman (2011) refers to this as 'fast thinking', while 'slow thinking' means putting much thinking effort in getting a difficult task done right. Slow thinking is unnatural in the sense that human beings are inclined to think fast in most situations. In threatening and embarrassing situations, for example, we 'fight or flight', which is a helpful routine when it prevents us from trouble or being harmed. It does not help us in situations that do not require routine behaviour, but instead, demand effort, like in the case of creative, entrepreneurial and innovative acting. Solving a new problem, for instance, requires slow thinking. Psychologically, this is quite a demanding cognitive and motivational task, which can account for the lack of evidence proving that human beings are capable of changing the nature of their behaviours into 'productive reasoning' (Argyris, 2010), i.e., intensively looking for alternative explanations, solutions, choice options as the basis for a well-funded decision. Only specially-trained teams are capable of dealing with weak signals adequately because their core task is to manage the unexpected, as is the case in high reliability organisations (HROs). HROs organise for high performance in settings where the potential for error and disaster is overwhelming. They have no choice but to function reliably, otherwise severe harm may result (Weick & Sutcliffe, 2007: ix-x). Their teams can be found in nuclear power plants, surgery teams in emergency rooms, crisis management organisations, fire fighting departments, traffic control towers, and aircraft carrier flight decks. Responding adequately to weak signals demands what Weick and Sutcliffe (2007) call a 'mindful infrastructure', which refers to the organisation's capability to be alert to unexpected situations and to be able to act simultaneously. Today, private and public organisations outside the field of crisis and safety management, and which are confronted with unforeseen events and the need for innovation, are seeking to gain advantage from HROs and their mindful and high reliability operating.

However, the literature concerning mindful infrastructures in relation to innovation projects has not yet been well-developed nor has it been widely applied to business organisations (Vogus & Sutcliffe, 2012). Furthermore, the literature on defensive behaviour in regard to innovation projects is simply non-existent, which leaves a void that has become more and more acute as the complexity of projects is increasing and as a result there are many non-linear causal relations that are hard to predict and difficult to control (Cicmil & Marshall, 2005; Vidal & Marle, 2008; Geraldi, Maylor & Williams, 2010). At the same time, the emergence of mindful behaviours as a consequence of the dominant 'traditional' project management approaches and management practices is impeded (Shenhar & Dvir, 2007; Stacey, 2012). These traditional approaches are strongly rooted in linear thinking, which is in keeping with the 'iron triangle'.

This particular contribution places an emphasis on innovation projects. In order to understand better why innovation projects often fail, the following questions will be addressed. Are innovation projects complex in the sense that they intend to address 'opposing logic', and can defensiveness be observed in teams performing such projects? Furthermore, can having a mindful infrastructure prove to be helpful in achieving better performance of innovation teams? To contribute to the knowledge base on the failure and success of innovation projects, an exploratory case study has been undertaken in one research and technology organisation (RTO), whose core business is performing innovative research projects.

The research design allows for the triangulation of three empirical data sources, namely in-depth interviews, team observation, and survey. The study focused on the dynamics within innovation teams, and explored how the perceived complexity of projects might be conducive to defensive behaviour. In addition, it was explored if team mindfulness, team psychological safety and team learning behaviour could combine together to constitute a mindful infrastructure, and whether or not this mindful infrastructure had a positive correlation with how team members perceived the project results. Team mindfulness, team psychological safety and team learning behaviour are suggested by scholars from the field on safety and crisis management studies as important ingredients for teams in being alert and attentive to weak signals.

The explorative study produced three main findings.

1. The project managers of innovation projects experienced complexity, namely they had to account for time and budgets, but also for innovative results.
2. We were indeed observing performed defensive behaviours that seem to be associated with risk avoidance during a team meeting.
3. A positive correlation emerged between the presence of a mindful infrastructure and the perceived project results found among the surveyed team members.

The article first explores the relation between complex projects and defensive behaviour, and then discusses how a mindful infrastructure might be used to suppress defensive behaviours. Subsequently, the case study is introduced in which defensive behaviours and certain aspects of a mindful infrastructure were examined among the members of innovation teams, and then followed by the results of that study. Finally, we evaluate the results, practical implications, and we make suggestions for further research.

2 Defensive behaviour, complex projects and mindful infrastructure

2.1 Defensiveness and complex projects

One might wonder why projects fail. Shenhar and Dvir (2007) discuss several projects that shared that they were run by highly-talented and dedicated managers, the best professional teams, the latest project management tools, and received support from the top management, and yet, they still failed to succeed. The one continual thread that runs through all of these failures is to not recognize the extent of uncertainty and complexity involved, to not communicate this to one another in so doing, and to not adapt the management style to the story. The predominant application of a 'traditional' approach to project management can be accounted for in these failures. This approach is driven by the 'iron triangle' in which project managers feel successful when they have completed a project on time, within the budgetary means, and within the performance goals (Shenhar & Dvir, 2007: 7).

It might be difficult to believe that highly-skilled project managers and teams do not realise that complex projects require another approach than a traditional project management technique. Shenhar and Dvir (2007: 7) stated that "when managers finally understood what went wrong and why, it was too late to fix the problem". We agree that managers notice when things go wrong, but we doubt whether they will actually understand what went wrong and why. For over forty years, the organisational psychologist Argyris studied productive and unproductive behaviour in organisations. His work (Argyris, 2004a, 2010; Argyris & Schön, 1996) showed that many well-qualified people do not realise at all that they have produced unproductive reasoning. Instead, they use defensive reasoning. Argyris (2010: 60-64) explains this inconsistency by pointing out that human beings have a theory-in-use that differs from the theory they espouse. Besides, he writes there are two models of reasoning, defensive reasoning (Model I) and productive reasoning (Model II). Argyris states people believe that they act according to their espoused theory, but often they do the opposite. Argyris observed from many cases that the actions of human beings are governed by four values in Model I defensive reasoning:
1. be in unilateral control,
2. win and do not lose,
3. suppress negative feelings, and
4. behave rationally.

These values serve to protect and defend the self against fundamental, disruptive change. The defensive reasoning mind-set is our theory-in-use and is applied when we face threatening or potentially embarrassing situations. However, the theory that is espoused, is usually Model II productive reasoning, of which the governing values are as follows:
1. to seek valid (testable) information,
2. to create informed choice, and
3. to monitor vigilantly in order to detect and correct error.

The empirical fact to date is that very few individuals can routinely act on these espoused values. It is questionable if human beings espouse Model II, as it assumes that one is familiar with the values of Model II and has internalised these values. Perhaps some practitioners and researchers underestimate how difficult it is to acquire these values.

How does project complexity lead to defensive reasoning? Project complexity[3] consists of a combination of differentiation, interdependency and uncertainty (Baccarini, 1996; Gul & Khan, 2011). Differentiation refers to the number of varied elements, and interdependency to the degree of interrelatedness among those elements. Uncertainty refers to the degree to which the goals and methods of a project have been well-defined (Turner & Cochrane, 1993). The three elements apply to both 'hard' and 'soft' complexity, namely 'things' and 'people'. This study is particularly interested in learning how people perceive complexity. Project complexity refers to how complicated and involved the team members experience that a project is.

Perceived project complexity implies that executing such projects are fallible endeavours, which may even invoke feelings of anxiety, scepticism, moral duty and commitment, which in turn are mediated by power relations, and which can be both encouraging and inhibiting (Cicmil & Marshall, 2005). Argyris' action theory predicts that humans seek unilateral control which makes them feel comfortable. If humans perceive a situation as being complicated, they may feel anxiety and are inclined to restore the situation to a state of control. Complexity is a source for sending mixed messages, which is one of the most frequently occurring causes of defensive behaviour.[4]

What can project managers and teams do to prevent themselves from being defensive? If being defensive is a natural behaviour, then productive reasoning would urge that this routine behaviour be deviated from. When studying the field of risk and crisis management, one will learn that unnatural behaviour is helpful when having to deal with unexpected situations (Weick & Sutcliffe, 2007; Barton & Sutcliffe, 2009).[5] Complexity leads to unexpected events in project teams and their environments, as humans perform multiple responsive interactions at a 'local' level that lead to 'emergent patterns' that cannot be predicted (Stacey, 2005). 'To manage the unexpected' one needs to know that humans tend to accept all that confirms their expectations as evidence, and they actively seek such evidence (confirmation bias, Weick & Sutcliffe, 2007: 23-27, 167). High-risk organisations train their personnel to counteract confirmation seeking tendencies by learning to fight their own expectations, and in so doing to perform unnatural behaviour. These organisations have chosen a 'mindful infrastructure' to combat the mechanism of expectations, that make people, for example, who are preoccupied with 'weak signals', resist oversimplification, and induce them to be resilient, i.e. so that they are able to maintain or regain from errors, setbacks and disappointments, which subsequently allows them to continue their operational focus. Such mindful organisations, whose members perform the mentioned unnatural behaviours[6], become 'high-reliability organisations' (Weick & Sutcliffe, 2007: 2-17).

Can project teams benefit from using a mindful infrastructure when defensive behaviour threatens whether or not complex innovation projects will be successful? Weick and Sutcliffe (2007: 9) describe mindful infrastructure as the capacity to anticipate 'unexpected' problems and the capacity to contain such problems. This infrastructure combines a situational awareness and the capability to act properly within teams, and is built on whether or not the relationships between team members feel safe. We suggest three constructs to be part of a mindful infrastructure, namely team mindfulness, team psychological safety and team learning, which are indicators for awareness, acting properly and safe relationships. Our study hopes to contribute to a research agenda to further examine antecedents and consequences of a mindful infrastructure outlined by scholars in the field of safety and crisis management (Vogus & Sutcliffe, 2012).

Team mindfulness, based on the insights of Weick and Sutcliffe (2007: 32-35), can be defined as a collectively shared mental orientation in which one is continuously alert in regard to unexpected events and what might go wrong during the project. Team mindfulness should alert team members to spring into action when a project threatens to go off-track.[7] Team mindfulness can lead to voicing concerns, which is a prerequisite for teams so that they are able to reflect upon their actions. Speaking out, however, is not self-evident. Argyris (2010) has pointed to the triggering of organisational defensive routines when voicing concern could very well imply embarrassment, rejection or punishments from one's team members.

Therefore, team psychological safety can be regarded as an important condition to make 'the undiscussable discussable', which is defined as the shared belief that the team is safe for interpersonal risk taking (Edmondson, 1999). Edmondson holds that team psychological safety is meant to suggest a sense of confidence that the team will not embarrass, reject, or punish someone for speaking up, implying mutual respect and trust among team members as a team climate (1999: 354).

To better enable team mindfulness, teams may also have to perform team learning in addition to team psychological safety. Learning by individuals is inhibited when people face the potential of being threatened or embarrassed (Argyris, 2010; Barton & Sutcliffe, 2009). That is why the absence of learning threatens team performance (Edmondson, 1999). Team learning at the group level is an ongoing process of reflection and action, which is subsequently characterized by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions (Edmondson, 1999).[8]

3 Case study and research design

The discussion gives way to three assumptions. We speak of assumptions instead of hypotheses because we are not testing propositions but exploring their nature. The first assumption is the view that some projects are perceived as more complex than others, and that these projects differ in their being more complicated. There is less likelihood of obtaining the required results. Innovation projects, for example, differ from routine projects in the sense that the latter follow standardized trajectories, whereas the first are, to a certain extent, journeys into the unknown. A second assumption is that the perceived complexity of a project functions as an impetus for humans to stay in control of a situation which subsequently activates defensive behaviour. Consequently, defensive behaviour may function as a counterforce for innovative behaviour. The third assumption is that unnatural behaviour is helpful in order to overcome this defensive behaviour, and to make team members more aware of how they are acting ineffectively.

To explore these assumptions a case study was carried out in a large Research and Technology Organisation (RTO) in the Netherlands, which thought that it might be possible to carry out its innovation projects in a more innovative way. Sometimes, the results achieved during these projects did not provide breakthroughs. The management thought that perhaps by promoting the collaboration between the project team members, a key variable for both innovative and efficient project outcomes might be obtained (Hoegl & Gemuenden, 2001; Bruns, 2013).

The RTO is a project matrix organisation whose goal is to develop innovative and applicable knowledge which can benefit the economy in general (a quarter of its turnover), while at the same time acquiring commercial orders commissioned by private or public bodies. Our study focuses on exploring the management of innovation projects carried out at the level of project teams. These teams consist of scholars from different disciplines.

The RTO basically carries out two types of projects, namely innovation projects and routine projects. Innovation projects in this organisation are characterized by uncertainties such as partly open specifications and the unpredictability of results, whereas routine projects are known for their definitive functional specifications and their clients' somewhat solid demands. Routine projects are commercial assignments in which the knowledge available is meant to be applied to find specific solutions. Conversely, innovation projects aim to develop new knowledge and new applications.[9]

Team member collaboration is likely to be supported by using a mindful infrastructure. We are contending that defensive behaviour could stand in the way of innovative outcomes and we are suggesting that by implementing a mindful infrastructure, a mediating or moderating role could be played. The research design explored the aforementioned three assumptions and investigated whether team mindfulness, team psychological safety and team learning behaviour might be helpful to project teams which are managing complex innovation projects, and in this way defensive behaviour in teams could perhaps be overcome.

The research questions are threefold:
1. Are innovation projects perceived as complex and conducive to mixed messages?
2. Can defensiveness be observed in teams performing such innovation projects? and
3. Is a mindful infrastructure associated with better perceived project results?

The assumptions suggest that there is indeed a relationship between perceived complexity and defensiveness in teams performing innovation projects, and that a positive relationship can be found in the areas of team mindfulness, team psychological safety and team learning, on the one hand, and the perceived project results, on the other.

Since this research was explorative, we performed three triangulating steps to optimise information resources. To obtain a sound understanding of the complexity of innovation projects in the first step, six project managers on innovation projects were interviewed face-to-face. We made an inventory of the bottlenecks they had encountered and investigated whether they had reported problems in connection with collaboration in teams. In a second step, a meeting was observed in which one of the six managers' project team had gathered in order to study the prevalence of defensive behaviour. The third step comprised a survey among team members in order to study the relationship between the areas of team mindfulness, team psychological safety and team learning, and the perceived project results.

3.1 Data, constructs and measures of the survey

Out of a total of 379 individuals who were randomly approached through the RTO's intranet, 150 responded, thus producing a response rate of 40%. Eighty-three surveys were filled out completely. Thirty-six % indicated that they worked mainly on innovation projects; 58% indicated that their work was mainly on routine projects; and 6% reported that their work included neither of these, and they were subsequently excluded from the analyses.[10]

'Team mindfulness' is constructed by adapting the 'organisational mindfulness' scale from Weick and Sutcliffe (2007: 87).[11] 'Team psychological safety' and 'team learning behaviour' were reproduced from Edmondson (1999).[12] 'Perceived project complexity' was based on the five aspects of project complexity distinguished by Vidal and Marle (2008: 1097-1098, 1105): the size of a project system, the variety of the project system, the interactions and interdependencies within the system, the context and environment dependency of the project system, and finally, the uncertainties and change propagation as resulting consequences of complexity.[13] 'Innovation project (1)' and 'routine project (0)' formed a dichotomous variable based on the contrasts of projects which were either directed at developing new knowledge and solutions as opposed to projects for customers that apply existing knowledge.[14] The perceived output of projects was measured with three scale variables, namely 'team innovativeness', 'external team effectiveness' and 'internal team effectiveness'. 'Team innovativeness' was constructed by De Dreu and West (2001).[15] 'Perceived external' and 'internal effectiveness', derived from Musallam (2011)[16], reflect the degree to which objectives are met that are associated with external factors, such as budgetary constraints, overall goals, and the interest of clients and stakeholders, on the one hand, and the management of team processes as internal factors, on the other.[17]

4 Results of the three research steps

4.1 Perceived complexity in innovation projects: Face-to-face interviews

The findings from the face-to-face interviews accentuated the events and issues that project managers experience which complicate the performance of innovation projects.[18] The bias towards negative experiences, thus by underexposing what has gone particularly well, was caused by the scope of the research. The project managers mentioned the (1) structural characteristics which enhance the project complexity, for instance that initially project goals are often ill-defined, and team composition is diverse and based on questionable criteria. With regard to (2) the group dynamics in teams, the respondents mentioned that communication between team members is friendly and never confrontational, despite of the fact that they are very well aware that everyone has his or her own motives and possible competing interests. Project managers indicate that communication is sometimes difficult, as team members work in several other projects simultaneously, making it difficult for them to find time to meet, and they are also working in different geographical locations. Project managers also point to a number of (3) external factors, such as the management style of higher management and the organisational culture that could create dilemmas between business goals and innovation goals. These are bottlenecks that contribute to project complexity in terms of high cognitive demands. We suggest that they may contribute to role ambiguity, conflicts of interest and less effective cooperation among team members, as well as evoking groupthink and conformation bias. The 'opposing logic' between business goals and innovation goals is an example of a mixed message, which can provoke defensive behaviour. It is important to mention that the respondents never spoke in these terms explicitly. When explaining why the processes in their teams did not always go according to their wishes, they tended to either attribute the causes to external factors or they tended to identify the structural and behavioural characteristics which had been mentioned.

The complexity that is perceived by project managers points to relational aspects and management issues, not to the content of the innovation itself. There are several situations with regard to structural characteristics, group dynamics and external factors which can be conducive for conveying mixed messages. It could very well be that this is what causes the defensive behaviour. To examine this we observed a team meeting.

4.2 Defensiveness: Team observation

Argyris and Schön have stressed on several occasions that it is impossible to derive people's defensive theory-in-use from interviews (Argyris & Schön, 1974: 6-7; also 1996: 13, 76-77).[19] Following this guideline defensive behaviour was studied by observing a meeting of one of the project teams, consisting of six participants, which was videotaped (90 minutes were recorded). The meeting was one of the team's regular meetings to discuss the progress of the project. We would describe the atmosphere as constructive and friendly. The participants exclaimed afterwards that they had felt that it was a good meeting and that substantial progress had been made. It proved to be difficult to detect defensive behaviour during the meeting. This fact in itself possibly stresses how subtle defensive behaviour is performed and how unaware human beings usually are when it is performed. The friendly atmosphere probably contributed to this difficulty, as feelings of embarrassment or threat, which are pre-conditional for observing defensive behaviours, may not have been greatly stimulated by the participants (Argyris & Schön, 1996: 77).

Nevertheless, from the fourteen defensive strategies that have been identified by Ardon (2009: 245) the following seven could be observed during the meeting:

1. Compliance strategy: if your superior persuades you to commit, then say that you comply regardless of whether you really do;
2. Plan strategy: agree to make a plan and act as if you comply with the plan; this way you can contribute to change and stay in your comfort zone;
3. Reduction strategy: if things become threatening or embarrassing, reduce the problem until it is controllable again;
4. Distance strategy: if the discussion comes too close, change the subject to discuss 'other' parties or general observations, such as employees, middle management, or 'the organisation';

5. 'we' strategy: talk in terms of 'our responsibility' and 'what we should do'; as a consequence, no one has to feel personally responsible;
6. Joke strategy: if things become threatening or embarrassing, make a joke and change the subject;
7. Shirk strategy: shift the responsibility to an 'outsider' and avoid sharing your own opinion about the process or colleagues.

To illustrate these findings, Table 1 presents some slightly edited and shortened excerpts of the discussion that were taken from the meeting.

Table 1 Excerpts from the meeting of the project team managing an innovation project

Compliance strategy	
Team members discuss a proposal of higher management to enhance the knowledge position in a coherent way that is to have 'impact' in a practical sense, which seems to be in conflict with their own interests to realize stronger scientific embeddedness within universities.	
TM 1	"I feel this leads to a mismatch with our relation with universities".
TM 2	"You may be right, but it depends on how we explain things. If we do more than we have to, it could fit in well just as easily".
TM 1	"You mean, as long as it contributes to the value of the themes for higher management we are working on? Okay. That would work well for us".
TM 3	"Yes, let's just do both".
Reduction strategy	
Team members are discussing the target to produce a number of scientific articles. The norm that they discuss is that for each € 100,000- that is invested into the project so at least one scientific article should be published.	
TM 1	"Dissemination is an important issue. How do we proceed?"
TM 2	Trying to laugh it off: "It is not necessary to have peer-reviewed articles since our readers are mainly politicians".
TM 1	"I see what you mean. If we quantify the output, then it is easier to reach our targets".
TM 2	"Exactly".
Plan strategy and we strategy	
The project manager mentions four points of attention that the team should decide upon when choosing the direction in how to go forward.	
PM	"These points of attention ask where will be our focus, what we will contribute and what the role of cases that we study will be?"
TM 1	"I certainly agree we need to talk about this".
PM	"We need to be more clear about what we want to accomplish…"
TM 2	"Well I feel that there are more topics than you mention" [and mentions several other issues that demand a decision].
TM 3	"My opinion is we need to know more about those first".
TM 1	"Good idea….do we know enough of the details?"
TM 3	"We can't know it all, can we?"
TM 4	"No, no… not yet.".
TM 1	"Let's discuss this at the next meeting, okay?".
PM	Reluctantly: "Okay. I will put it again on the agenda. In the meantime, we should inform each other about all of the topics so we can quickly take a decision".

TM = team member; PM = project manager

Despite the fact that it was hard to detect, even for the trained eye, defensive behaviour was present during the meeting. We observed that the 'compliance strategy' entails a discussion about societal impact versus scientific importance (Table 1). It is an example of saying 'yes', but not acting accordingly. Another example was the 'reduction strategy', which was applied when downplaying the norms with regard to the standard of written scientific output, and in so doing a trade-off was made in which quantity won above quality. The third example concerns the neutralisation of an urgent point that needed to be decided upon in time. By applying the 'plan strategy' and the 'we strategy' the decision is subsequently postponed. When we briefed the team on our findings afterwards, they said that they had not even realised that they were acting defensively. Instead, the team members claimed that how they had acted 'felt natural'.

We assume that during their conversations team members make 'complex' matters 'simpler' in order to make it easier to deal with them. Taking decisions on difficult issues or having to choose between two options are examples of 'complex' matters. If one seeks unilateral control without wanting to lose any ground, then this does not necessarily make matters less complex. By avoiding discomforting confrontations and making their actions congruent with rational thinking, participants in a meeting create a 'pleasant atmosphere'. Without being aware of it, participants simply avoid dealing with 'complex' issues, as shown in the case of postponing a decision. If this is true, then complex issues can lead to defensive reasoning which goes unnoticed. In the case of embarrassing situations and mixed messages, such strategies are applied to reduce the experienced complexity of issues.

Human beings could learn to become more aware of these situations if they might learn to respond to 'weak signals', which is possible if an organisation creates a mindful infrastructure. In order to research if it would help team members to perform better as a team, a survey was carried out.

4.3 Mindful infrastructure and perceived team performance: survey

Table 2 presents descriptive statistics, correlations and Cronbach's alphas. All scales show sufficient internal consistency of .67 or higher. Basically, more mindfulness, safety and learning in teams coincide with better perceived outputs of teams. The correlation between innovation project and perceived project complexity indicates more perceived complexity when a project is more innovative. Innovation projects possess less internal team effectiveness, however, compared to routine projects.

Table 2 Means, standard deviations, N, Pearson correlations and Cronbach's α's

	M	SD	N	1	2	3	4	5	6	7	8	Cronbach's α
1. Team mindfulness (1=strongly disagree - 3=strongly agree)	1,91	,81	95	1								,76
2. Team psychological safety (1=strongly disagree - 3=strongly agree)	2,71	,52	98	,23*	1							,67
3. Team learning behaviour (1=strongly disagree - 3=strongly agree)	2,00	,76	99	,35**	,31**	1						,67
4. Perceived project complexity (1=strongly disagree - 3=strongly agree)	2,26	,82	107	,04	-,04	,24*	1					,74
5. Innovation project (1=yes - 2=no)	,36	,48	144	,28**	,05	,00	,21*	1				–
6. Team innovativeness (1=strongly disagree - 3=strongly agree)	2,29	,85	83	,44**	,46**	,55**	,18	-,07	1			,79
7. External effectiveness (1=strongly disagree - 3=strongly agree)	2,37	,71	83	,31**	,09	,29**	-,04	-,17	,42**	1		,83
8. Internal effectiveness (1=weak - 3=excellent)	1,99	,53	83	,49**	,50**	,51**	,01	-,22*	,49**	,31**	1	,89

* p<,05; ** p<,01 (2-tailed),

Separate regression analyses were performed with the three team performance output measures as dependent variables: team innovativeness, team external effectiveness and team internal effectiveness (Table 3).

Table 3 Multiple regression analyses

Variables	Team innovativeness β	Team external effectiveness β	Team internal effectiveness β
1. Team mindfulness	,295**	,211	,255**
2. Team psychological safety	,262**	-,034	,341**
3. Team learning behaviour	,345**	,250*	,327**
4. Innovation project	-,056	-,095	-,154
5. Perceived project complexity	,120	-,088	-,038
Model: R^2	,48**	,16*	,49**
F(5, 75)	14.047	2.802	14.839
N=83 (min.), 144 (max.)			

* p<,05; ** p<,01 (2-tailed),

Team mindfulness, team psychological safety, team learning behaviour, perceived complexity and innovation project explained a significant and large amount of variance in team innovativeness, R^2= .48, $F(5, 75)$ = 14.047, p < .01, and team internal effectiveness, R^2= .49, $F(5, 75)$ = 14.839, p < .01, and a moderate amount of variance in team external effectiveness, R^2= .16, $F(5, 75)$ = 2.802, p < .05. Team mindfulness, team psychological safety, and team learning behaviour showed the strongest effect. Although the factor 'innovation project' pointed to the expected direction - namely, being positively associated with project complexity -, it failed to reach significance in combination with these variables together. Perceived project complexity cannot be significantly associated with the team outputs in these models either.

5 Conclusion and discussion

The results of this explorative research indicate in the first place that there seems to be a relationship between complex projects and defensive behaviour. The face-to-face interviews that were held with project managers revealed that their projects contained aspects which increased the complexity of these projects. These aspects, such as structure characteristics, group dynamics in teams, and external factors, are all prone to mixed messaging. Such mixed messaging may, from a theoretical perspective, contribute to role ambiguity, groupthink, conformation bias, risk avoidance, a sense of losing control and underperformance. Although our research did not investigate these specific aspects, seven defensive strategies were observed from studying the footage of a project team meeting of individuals who were involved in a (complex) innovation project. The defensive strategies suggest that there might be an unconscious risk-avoidance (and maybe even downgrading) of quality standards in the examples that were discussed, namely with reference to the project's impact, written scientific output, and process of decision making. Human beings seem to be inclined to simplify complexity when seeking unilateral control, instead of reflecting on 'weak signals' in an alert and risk-taking manner (Weick & Sutcliffe, 2007). The findings point to a possible relationship between perceived complexity and defensiveness in innovation projects which deserves further inquiry.

In the second place, a clear relationship can be found between the aspects of a mindful infrastructure – team mindfulness, team psychological safety and team learning – and perceived project results, especially team innovativeness and team internal effectiveness. Team members of innovation projects may perform better and be more innovative when such a mindful infrastructure is facilitated.

The findings suggest that the three assumptions are worthy of being studied in more detail.[20] Suppose innovation projects are indeed relatively more complex than other projects, would this, in turn, explain why, more often than not, they fail to achieve breakthrough results? Due to perceived complexity, the project team members may be inclined to display more defensive behaviour, albeit subconsciously. This, however, may help to explain why risk-taking, innovative and entrepreneurial behaviour is subconsciously avoided. If a mindful infrastructure is facilitated, then this may aid in overcoming defensiveness by offering more productive options for innovative team results.

From a research design perspective, the triangulation of three methods – face-to-face interviews, team observation, and a survey among team members – has led to the enrichment of data that enabled us to approach the issue from different angles. The model that was developed in this article should be completed with a number of aspects that are worthy of consideration. Two of these are (1) the leadership of project teams and innovation projects (Burke, Stagl, Klein, Goodwin, Salas & Halpin, 2006; Müller & Turner, 2010; Clarke, 2012) and (2) the organisational politics and power relations related to decision making in teams (Buchanan & Badham, 2008; Stacey, 2012). Successful project teams are likely to be associated with certain types of leadership and participatory decision making. Perhaps another very promising extension of the model would be (3) to clarify the behaviour that results from facilitating a mindful infrastructure. Based on Weick and Sutcliffe (2007), we propose 'innovation resilience behaviour', a set of team competencies that can make a team bounce back on the right track once a team has chosen to take or is already taking an ineffective course (a mishap) with regard to its innovation goal. Moenkemeyer, Hoegl and Weiss (2012) reported that 'innovator resilience potential' may strengthen the innovative capabilities of project members after experiencing a setback such as project failure. Possible 'innovation resilience behaviours' which are in keeping with Argyris' Model II behaviour of productive reasoning (Argyris, 2010) are, a) to be alert of 'weak signals', b) to resist oversimplification by suggesting valid alternatives, c) to remain sensitive to what is done in the projects, why and for whom, d) to defer to expertise, e) to monitor vigilantly what the team does, f) to brief and debrief decision making during the project, and g) to learn from what you do by organising feedback loops (Weick & Sutcliffe, 2007). The field of organisational mindfulness and mindful organising is rapidly growing, but the concepts of mindfulness and resilience have not been widely applied to innovation (Vogus & Sutcliffe, 2012).

The practical implications for project management and project teams are such that team mindfulness, team psychological safety and team learning behaviour were found to be important when wishing to improve project results. Once defensive behaviour is better recognized and repressed, and project complexity is managed more effectively, then the fields of innovation in organisations, and project management in general, can benefit from having studied safety and crisis management so that team members and project managers can become more alert and resilient when managing and organising the 'unexpected' as they will have learned how to improve project results 'productively'.

Appendix 1 Questionnaire

Questionnaire 'Collaboration in teams in innovative ways' (2011)
(Abbreviated version)

Are you male or female?
1 Male
2 Female

To which of the following age categories do you belong?
1 30 years and younger
2 31-40 years
3 41-50 years
4 51 years and more

Are you working on a ETP project (Enabling Technology Project)?
This study seeks to compare ETP-projects (Enabling Technology Projects) and 'regular' RTO-projects (commercial / market projects for customers and knowledge developing projects other than ETPs carried out by this Research and Technology Organisation).
Please select your answer from the following:
1 Yes
2 Yes, but only for a limited amount of my working time
3 Yes, but I see my own role as very marginal
4 No

Are you working in project teams?
Project teams are teams whose member collaborate for the duration of a project. Team members may be working in more than one project team at the same time; or besides working in a project team they can have another job (for instance, in a fixed team or department, or in another organisation).
Please select your answer from the following:
1 Yes, I am (also) working in a project team
2 No, I am working in projects but only in a fixed team or department
3 No, I am not working in projects (ends the questionnaire)

Perceived Project complexity
To what extent do you agree or disagree with the following statements about the project
(1= strongly disagree – 5=strongly agree)
1 This is a very complex project, taking into account the number of involved team members, stakeholders, financial dimensions, throughput time, sub-activities and / or process of decision making
2 This is a project with much diversity, taking into account the involved disciplines, project team members, required knowledge / skills, interests of stakeholders
3 This project has many connections between persons, (information) systems, organisations / organisational departments, sub-projects and project phases, and / or between sub-products and results
4 This project has many contextual factors to be taken into account, like competitive targets, organisational cultures, rules / conditions / laws, and societal relevance / impact
5 This projects has a high degree of uncertainty, for instance by shifting goals, shifting interests, changing composition of project team members and / or changing budgets

Team Psychological Safety (item 1-7) / Team Learning Behaviour (item 8-14)
To what extent do you agree or disagree with the following statements about working in this project team
(1= strongly disagree – 5=strongly agree)
1 If you make a mistake on this team, it is often held against you (rc)[1]
2 Members of this team are able to bring up problems and tough issues
3 People on this team sometimes reject others for being different (rc)
4 It is safe to take a risk on this team
5 It is difficult to ask other members of this team for help (rc)
6 No one on this team would deliberately act in a way that undermines my efforts
7 Working with members of this team, my unique skills and talents are valued and utilized
8 We regularly take time to figure out ways to improve our team's work processes

[1] rc = reverse coding

9 This team tends to handle differences of opinion privately or off-line, rather than addressing them directly as a group (rc)
10 Team members go out and get all the information they possibly can from others – such as customers, or other parts of the organisation
11 This team frequently seeks new information that leads us to make important changes
12 In this team, someone always makes sure that we stop to reflect on the team's work process
13 People in this team often speak up to test assumptions about issues under discussion
14 We invite people from outside the team to present information or have discussions with us

Team mindfulness
To what extent do you agree or disagree with the following statements about dealing in an alert and flexible way with certain situations in the project team
(1= strongly disagree – 5=strongly agree)
1 We are highly susceptible for possible unexpected events and turns during the project
2 There is a widespread lack of agreement among team members about how things could go wrong in the project (rc)
3 (Sub) project leaders pay as much attention to managing unexpected events and turns as they do to achieving formal goals
4 Team members are constantly apprehensive for unjust and incomplete information and mixed messages
5 We do not spend time identifying how our activities could potentially harm all our stakeholders (rc)
6 Team members worry constantly about misunderstanding agreements and / or misidentifying relevant events
7 There is widespread agreement among team members on what we don't want to go wrong during the project
8 Not everyone feels accountable for the project to develop well (rc)

Team Innovativeness
To what extent do you agree or disagree with the following statements about the innovativeness of the project team
(1= strongly disagree – 5=strongly agree)
1 Team members implement new ideas to improve the quality of our products / services / knowledge
2 This team gives little consideration to new methods and procedures for doing their work (rc)
3 Team members produce new knowledge, services, products and / or procedures
4 This is an innovative team

External Team Effectiveness
To what extent do you agree or disagree with the following statements about the effectiveness of the project team
(1= strongly disagree – 5=strongly agree)
1 Specific objectives are met within budget constraints
2 Overall goals are accomplished
3 Customers / stakeholders feel the services of the organisation are necessary and valuable
4 Our project team maintains funding sufficient to continue at least its prior periods' level of services
5 Our project teams has made a difference in the quality of delivered services / products for our customers / stakeholders
6 Our funding agencies / agents believe our project team makes a difference in the quality of the services / products that we deliver
7 Team members consider the 'impact' of our provided services / products important

Internal team effectiveness
To what extent is the project team good at the following:
(1=poor, 2=fair, 3=good, 4=excellent)
1 Setting clear goals
2 Creating clarity of program activities / project plan
3 Executing goal setting tasks
4 Decision making
5 Performance assessment
6 Adjusting one's own working process
7 Communication
8 Adjusting decisions made earlier
9 Collaboration within the team
10 Collaboration outside the team
11 Long term decision making
12 Spreading 'risks' over various funding resources

Appendix 2 Highlights from face-to-face interviews

Highlights from face-to-face interviews with project leaders / managers about bottle-necks and risks in carrying out innovation projects

	Elements enhancing complexity (from the interviews)	Occasion for mixed messages (the researchers analysis of possible consequences)
1. Structure characteristics	• project definitions and project goals are abstract, general and partly undefined from the outset; regularly the composer of an initial project plan that is approved of for financing is not the same person as the eventual project manager; • a purpose to stimulate innovation is to compose teams consisting of members from diverse backgrounds of disciplines; • the composition of project teams is a matter of having expertise groups being represented, rather than selecting the best person available.	• expectations of the project manager, stakeholders and team members need to be clarified and need to be fine-tuned which is a process that is time consuming, and demanding great meticulousness and involves many individuals; • diversity in disciplines means incorporating differences in expertise, professional languages and a variety of standards and norms (paradigms) and demands clear role structures and tasks and fine-tuning the added value of all team members in each other's directions; it also demands fine-tuning of interests from stakeholders behind the scene and with departments of the RTO who are delivering manpower and investments implying the use of influence and power; • the project manager sometimes has very limited influence to compose a team according to his/her needs and wishes and has to address preferences from all kind of stakeholders; a project manager is a 'broker' in interests, which my lead to a division of a larger project in smaller parcels (addressing more needs but losing focus). All these factors may contribute to role ambiguity, conflict and less effective cooperation.
2. Group dynamics in teams	• team members are considerate of each other, avoiding conflicts, inclined towards consensus and conforming with commissioners; at the same time involved individuals operate in a political manner (playing politics) refraining from being too frank and open; team members have different backgrounds and organizational embeddings, therefore they incorporate different interests into the teams that may be conflicting; • team members work in several projects on different locations; they meet irregularly, spanning several weeks between meetings without face-to-face interaction, and not al-	• communication within teams is not always transparent and may be experienced as possibly unsafe resulting in ineffective and insufficient modes of exchanging views, knowledge, and expertise. • much time and effort is spend in realizing shared awareness about goals, results and the process, but it is not always successful or without tensions; • not everyone commits to the eventually decided upon goals, results and process; • to serve and please as many persons involved clear choices and setting boundaries proves to be difficult, and challenging ambi-

	Elements enhancing complexity (from the interviews)	Occasion for mixed messages (the researchers analysis of possible consequences)
	ways being able to meet each other in the same group composition, therefore team processes are fragmented, hasty, almost superficial at occasions; also for individuals being on a project it is fragmented if one has several projects at the time.	tions are eventually compromised; • many are inclined to accentuate their own interests and those of their organizational embeddings instead of the overall goals and societal impact; • due to the patchy character of meetings discussions are often repeated and decisions re-debated several times ('muddling through'); These factors may contribute to groupthink, shadow organizing and conformation instead of strong commitment, innovation and creativity.
3. External factors	• higher management steering mechanisms are strongly based on quantifiable outputs and financial control, and rewarding sticking to expectations while punishing deviating from rules and procedures; higher management is on many occasions not competent to evaluate the scientific aspects of highly specialized projects; • pressure from management from the 'expertise groups' is on billable performance and from management from 'thematic lines' is in innovativeness and societal impact leading to conflicting demands for the teams.	• the behaviour of higher management provokes avoiding risk taking and entrepreneuring, and may stimulate perverted effects (stay within budget lines but not being very innovating; performing billable hours but not maximizing client satisfaction); the behaviour of higher management is sometimes experienced as mixed messaging, e.g., urging to be innovative but at the same time urging being productive and realizing financial targets otherwise total budget cuts will be executed. External factors may lead to risk avoidance and a sense of losing control unless the team and the team manager enforce themselves to a clear assignment, which may inadvertently result in underperforming in excellent outcomes due to missed opportunities for synergetic outcomes.

Notes

1 Published, without the endnotes and Appendix 1 and 2 in this Chapter, as P.R.A. Oeij, S. Dhondt, J.B.R. Gaspersz & E.M.M. de Vroome (2014). Can teams benefit from using a mindful infrastructure when defensive behaviour threatens complex innovation projects? *International Journal of Project Organisation and Management*, *8*(3), 241-258.
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Steen, M., Oeij, P., Vos, P. (2012). *Effectief samenwerken in projectteams*. Delft: TNO Innovation for Life.(in Dutch).
Oeij, P.R.A., De Vroome, E.M.M., Dhondt, S. & Gaspersz, J.B.R. (2012). Managing teams performing complex innovation projects. Paper for *ICIM 2012, 9th International Conference on Innovation and Management*. Eindhoven, Netherlands, November 14-16.
Oeij, P.R.A., De Vroome, E.M.M., Dhondt, S. & Gaspersz, J.B.R. (2012). Managing teams performing complex innovation projects. In: G. Duysters, A. De Hoyos & K. Kaminishi (eds.), *Proceedings of the 9th International Conference on Innovation & Management* (pp. 680-694). Wuhan (China): Wuhan University of Technology Press.
Oeij, P.R.A., De Vroome, E.M.M., Dhondt, S. & Gaspersz, J.B.R. (2012). Team dynamics in complex innovation projects. Paper for "*Bridging Theory and Practice", 2nd International PhD Conference*. Nyenrode Business University, Breukelen, The Netherlands, November 3.
Oeij, P.R.A., De Vroome, E.M.M., Dhondt, S. & Gaspersz, J.B.R. (2012). Team dynamics in complex innovation projects. In R. Tuninga, T. Pasch & D. Von Bergh (Eds.), *Proceedings of 2nd International PhD Conference. Bridging theory and practice* (pp. 208-220). Breukelen: Nyenrode Business Universiteit and Open University of The Netherlands.
Oeij, P.R.A., De Vroome, E.M.M., Dhondt, S. & Gaspersz, J.B.R. (2013). Exploring links between complex innovation projects, defensive behaviour and mindful infrastructure of teams. Paper for *IWOT 17 – International Workshop on Team Working*. Leiden, The Netherlands, November 28-29.

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3 Gul and Khan (2011) develop a comprehensive model of project complexity which summarizes the discussion on the topic and consists of three elements: structural complexity, uncertainty and people uncertainty. 1] Structural complexity is founded on the two concepts differentiation and interdependency (Baccarini, 1996). Differentiation refers to the number of varied elements and interdependency to the degree of interrelatedness amongst those elements. 2] Uncertainty refers to the degree to which the two concepts of goals and methods are well-defined (Turner & Cochrane, 1993). Gul and Khan add to this the factor of environmental uncertainty. 3] Williams (1999) combined structural complexity and uncertainty into one model and contended that the former refers to the structure of the project and product, while the latter adds to the complexity of the project [Williams, T.M. (1999). The need for new paradigms for complex projects. *International Journal of Project Management, 17* (5), 269-273]. 4] Gul and Khan (2011) extend this model of Williams one step further by adding people uncertainty, which consists of social interactions and rules of interaction. Social interactions refer to relations between people and rules refer to schemas and strategies that, respectively, 'describe or predict others behaviour' and 'suggest to an individual what to do as the game unfolds'. The extended model combines the complexity of projects (people uncertainty) and complexity in projects (structural complexity). The uncertainty of goals, methods and the environment can be part of both, depending on the question if it relates to 'things' (goals and methods) or to 'people' (stakeholders making up the environment). Our purpose is to study how project members perceive complexity, instead of to theoretically describe complexity, because, in a later stage, we want to find out how team members deal with complexity as they experience it. Obviously, complexity of projects is related to the question how complicated it is to arrive at the desired results, and to what extent the process of events can be predicted and managed. Schlindwein and Ison (2005) make a distinction between descriptive complexity and perceived complexity, where the first refers to objective, intrinsic properties of a system, while the second considers complexity as subjectively understood through the perception of an observer [Schlindwein, S.L. & Ison, R. (2004). Human knowing and perceived complexity: Implications for systems practice. *E:CO, Emergence: Complexity and Organization, 6* (3), 27-32]. Observers in our study are the members of project teams conducting projects. Project complexity is the way team members experience the

complicatedness of their project, therefore, complexity is a property of the project, such as its structural characteristics, uncertainty, dynamics, pace and socio-political characteristics (Geraldi, Maylor & Williams, 2010). Observers such as team members in this case, may consciously or unconsciously distinguish between their own more distant description of the characteristics of a project and their own experiences of interactions with persons involved. Observers may combine a descriptive view of a project as something 'out there', while at the same time experience being 'in there' as part of the project. Their perceived complexity is a joint property of their distant view and their own experiences, which cannot be separated, because what is out there is what team members experience to a certain extent (Stacey, 2005). Research conducted by Azim, Gale, Lawlor-Wright, Kirkham, Khan and Alam (2010) indicates that in the perception of project managers the impact on project complexity is largest from people, compared to process and product. According to the authors this implies that people not only largely contribute to project complexity, but, consequently, that 'soft' skills may be of more importance than 'hard' skills: hard skills in the context of project management generally refer to processes, procedures, tools and techniques, whereas the soft skills refer to dealing with human issues, i.e. the 'people' part of the project, e.g., communication, teamwork, leadership and conflicts. Project failures are numerous in practice [Thomas, J. & Mengel, T. (2008). Preparing project managers to deal with complexity – Advanced project management education. *International Journal of Project Management, 26*, 304-315], for the reason that there are many risk factors whose outcome is uncertain, and at the same time the existing project management literature advocates partially conflicting approaches [Pich, M.T., Loch, C.H. & De Meyer, A. (2002). On uncertainty, ambiguity, and complexity in project management. *Management Science, 48* (8), 1008-1023]. According to several researchers our society as a whole has become an open web of many interacting elements which is changing constantly, and with a fast growing number of interconnections and interrelationships, while many of us hold on to the dominant project management approach of orderly planning and control which, in spite of that, is no longer suitable to complex projects and project management (Azim, et al, 2010, Baccarini, 1996; Williams, 1999; Pich et al, 2002; Jaafari, A. (2003). Project management in the age of complexity and change. *Project Management Journal, 34* (4), 47-57; Cicmil & Marshall, 2005; Vidal & Marle, 2008; Whitty, S.J. & Maylor, H. (2009). And then came complex management (revised). *International Journal of Project Management, 27* (3), 304-310; Geraldi et al, 2010; Antoniades et al, 2011; Gul & Khan, 2011). Therefore this contribution pays attention to group dynamics that are representing relevant elements of complexity of projects which demand soft skills.

[4] For example: 'John, be innovative, but be careful with the resources at your disposal'. Argyris illustrates how this works. The logic is: (a) send a message that is inconsistent; (b) act as if it is not inconsistent; (c) make steps (a) and (b) undiscussable; and (d) make the undiscussability undiscussable" (Argyris, 2004a: 392). Model II, the espoused theory, is usually expressed in the form of stated beliefs and values (people say what they would do when asked); Model I, their 'theory-in-use', is the one which can only be inferred from observing their actions, their actual behaviour. In practice this means that human beings craft their positions, evaluations, and attributions in ways that inhibit inquiries into and tests of them with the use of independent logic. Consequently, these strategies are likely to be defensiveness (and also misunderstandings, self-fulfilling and self-sealing processes). Defensive reasoning is required to keep premises and inferences intact, otherwise one loses control. Defensive reasoning prohibits questioning the defensive reasoning, a self-fuelling process that inhibits learning and reflection, but also reinforces the deception and frustrations that is associated with circular reasoning. Argyris gives the example that, when individuals have to say something negative to others (e.g., 'Your performance is poor'), they often ease in, in order not to upset the other. Other examples are non-directive questioning and face-saving approaches. These actions function like mixed messages. For these examples to work the individual must cover up that they are acting as they are, in order not to embarrass others, and in order for this cover-up to work, the cover-up must be covered up (making the undiscussable undiscussable) (Argyris, 2004a: 392). Defensive reasoning keeps us captured in circular, self-reinforcing processes, because we do not reflect on what we are doing and thus cannot learn other actions that are more effective. In the case of complex innovation projects complex group dynamics may trigger defensive routines. Innovation, however, urges for deviation of routine behaviour. Talking about creating new music, avant-garde musician Frank Zappa [Zappa, F. with P. Occhiogrosso (1989). *The real Frank Zappa book*. New York etc.: Poseidon Press] says "Without deviation from the norm, progress is not possible. In order for one to deviate successfully, one has to have at least a passing acquaintance with whatever norm one expects to deviate from" (Zappa, 1989: 185). For being innovative there is no such norm, except that routine projects may be a useful contrast for innovation projects. Routine projects do not intend to lead to innovation, therefore routine behaviour probably is not 'good enough'.

5 Natural behaviour refers to theory-in-use actions that help humans to unilaterally control their feelings and thoughts in complex and unexpected events that arouse anxiety and uneasiness.

6 More precisely: (a) track small failures (be preoccupied with 'weak signals'), (b) resist oversimplification (do not jump to conclusions unheeded), (c) remain sensitive to operations (create common awareness about what people are experiencing at the front line where the real work gets done), (d) maintain capabilities for resilience (being able to maintain or regain from errors, setbacks and disappointments, which allow to continue operational focus after a mishap and / or in the presence of a continuous stress or a fundamental conflict of interest) and (e) take advantage of shifting locations of expertise (cultivate diversity and flexibility in order to defer to expertise, i.e., having the most expert persons making critical decisions regardless of their position) (Weick & Sutcliffe, 2007: 2-17; 2006: 516; Weick, K.E., Sutcliffe, K.M. & Obstfeld, D. (1999). Organizing for High Reliability: Processes of collective mindfulness. In: R.S. Sutton and B.M. Staw (eds.), *Research in Organizational Behaviour*, Volume 1 (pp. 81-123). Stanford: Jai Press).

7 However, a team consisting of various individuals may not work as a well coordinated team should. At times when action is needed a team may fail to act, for example due to the fact that the team may not notice weak signals or team members get stuck in their theory-in-use. Instances like these may lead to 'dysfunctional momentum', when people continue to work toward an original goal without pausing to recalibrate or re-examine their processes, even in the face of 'weak signals' suggesting they should change course (Barton & Sutcliffe, 2009; Barton, M.E. & Sutcliffe, K.M. (2010). Learning when to stop momentum. *MIT Sloan Management Review, Spring*, 69-76). Momentum means team members are engaged in a particular course of action, usually aimed at a specific goal, which can become dysfunctional for various reasons, among them seeking for confirmation of expectations. Barton and Sutcliffe also point to reasons that are relevant for other than high-risk organizations such as business organisations and innovation teams (Barton & Sutcliffe, 2010). When a culture values action and decisiveness, for example, it can lead to ill-considered decisions if gut feeling dominates over reflection and evaluation. Organizations can get locked into courses of action by plan, when the repercussions of going off-plan are very high. Another example is 'the ripple effect', which states that managers are blind to weak signals when they assume that small variations of changes will remain small, which because of the interdependencies within an organization may lead to underestimating possible consequences. A last example is that people sometimes rely on the wrong persons, when they defer to perceived expertise of an experienced colleague of whom they believe he or she must know what is best, while this may not be the case at all.

8 The project teams of the RTO not only consist of team members who come from various locations and positions within the organization – especially regarding the innovation projects compared to the routine projects, the latter are more often location-based teams – , they also bring together different disciplines and backgrounds. Team diversity is sometimes significant as they differ in attributes like gender, ethnicity, professional status, educational degree and scientific discipline. Representing several expertise groups and thematic lines with different interests adds to the team diversity. Team diversity poses barriers to collaboration in teams, largely to impeding effective communication [Edmondson, A.C. & Roloff, K.S. (2009). Overcoming barriers to collaboration: Psychological safety and learning in diverse teams. In: E. Salas, G.F. Goodwin & C.S. Burke (eds.), *Team effectiveness in complex organizations. Cross-disciplinary perspectives and approaches* (pp. 183-208). New York, NY, Hove: Taylor & Francis]. "Superficial or ingenuous conversation may soothe in the short run but is likely to block progress in the longer run. This is especially true for teams engaged in innovation and involved in other work activities that call for behavioural and organizational change" (Edmondson & Roloff, 2009: 202). Although we will not study this, it seems plausible that team learning and effective collaboration and communication are associated.

9 The RTO under study is a 'hybrid' or 'dualistic' organisation in the sense that it combines opposing logics, namely operating efficiently in the present while innovating effectively for the future (Katz, 2004). A quarter of the funding of this RTO is allocated to its task to innovate. The purpose of the RTO is to develop innovative and applicable knowledge for the sake of the economy in general while at the same time acquiring commercial orders commissioned by private or public bodies. At the level of projects the RTO promotes larger projects combining several disciplines that could create as much societal impact as possible. Yet, in practice it can be observed that these projects are often actually organised within specific disciplines ('thematic lines') and within pooled expertise groups, hence reflecting a certain kind of specialized division of labour between natural sciences, technical science and social sciences. The point made is that the organisation unintentionally conveys a 'mixed message' or creates a paradoxical situation between on the one hand a concern for impact and innovation and on the other hand a concern for turno-

ver and feasible organising. Our study focuses on exploring the management of innovation projects which are carried out at the level of project teams. These teams consist of scholars from different disciplines selected from either natural science, technical science or social science expertise groups. For these teams and the overall management layer steering the projects of these teams the environment, i.e. the organisational opposing targets, is hardly if not changeable at all. The best the overall project management – in this case the management responsible for these innovation projects – can do is to intervene in the group dynamics of the project teams. The overall project management and the project managers have to deal with the mixed message of being innovative regarding the output of knowledge creation and being held accountable for efficiently deploying the means. The individual project team members, who must account their activities for both innovation managers (responsible for the impact and innovativeness) and capacity managers (responsible for capacity management of team members) have to cope with the same mixed message by being creative and innovative while taking care of staying within allotted budgets and making enough billable hours. The overall project management's ('programme management') basic assumption was that cooperation or collaboration between project team members might be a key variable for successful outcomes, both in terms of innovative knowledge and staying within the allotted budgets. The management problem, therefore, can be formulated as a concern for the proper steering of the projects to reach the desired 'opposed' results. The fact that the management puts much effort on team collaboration can be understood in a twofold way. Management realises that they cannot change the rules of the game and that the environmental conditions are more or less set; besides, they are dependent on the commitment and expertise of project managers and project team members. Facilitating and improving team collaboration wherever possible, therefore, seems to be a plausible way of steering the overall project. The RTO in this study is a project matrix organisation [Hobday, M. (2000). The project-based organisation: an ideal form for managing complex products and systems? *Research Policy, 29*, 871-893], where the project manager has authority over personnel, finance and other resources and partly over the content of the project. The project matrix organisation crosses functional groupings – here 'expertise groups' from natural, technical and social sciences – by projects that align with topics and as such are linked to client segments – here called 'thematic lines'. Projects may combine expertise from different 'expertise groups' and can combine several topics to serve specific client preferences. Each project that is developed and carried out preferably serves to support the strategic direction of the RTO as a whole. Managers and project managers in senior positions work on the one hand according to a division of labour, namely a functional division of tasks like capacity management, knowledge management and resource management, while at the same time being collectively responsible for strategic and functional tasks cutting across functional lines and across project interests and incentives, in order to resolve specific problems and help coordinate, monitor, and improve performance across the organisation as a whole. The RTO carries out 1] innovation projects and 2] routine projects. The experience of several managers and employees of this RTO is that their innovation projects could be more successful than they are, although this is not a representative image. The results of these projects are too often, in the view of these individuals, not the desired breakthroughs that were hoped for. The management of one cluster of innovation projects (there are six of such clusters), who regarded this situation as a management challenge, commissioned this research to explore in what way the cooperation among team members of innovation projects could be improved in order to enhance the chance that the outcomes of projects are truly innovative.

10 Although we tested the questionnaire among a small group of individuals of the same RTO other than the sample, the response rate was relatively low. This is partly explained by the desire to test several constructs in this exploratory step, which made the questionnaire quite extensive.

11 The scale was designed to be used as an audit instrument at the level of an organization to assess the 'mindful infrastructure'. Moreover, the items were domain-specifically targeted at high-risk organisations which had to be reworked to be applicable to project team members. The question formulated in our study was "To what extent do you agree or disagree with the following statements on dealing alert and flexibly with specific the project team situations?" From the original 9-item scale an 8-item scale was constructed including items such as "We are highly susceptible for possible unexpected events and turns during the project" and "There is a widespread lack of agreement among team members about how things could go wrong in the project" (reverse coding). As answering categories a 5-point scale was used ranging from 1='disagree very much' to 5='agree very much'. Although there are several variants of the scale (e.g. Vogus & Sutcliffe (2007) [Vogus, T.J. & Suttcliffe, K.M. (2007). The safety organizing scale. Development and validation of a behavioural measure of safety culture in hospital nursing units. *Medical Care, 45* (1), 46-54], constructed the 'safety organizing scale' as an operationalization of 'collective mindfulness';

Hoy et al, 2004, 2006 [Hoy, W. K., Gage, C. Q., & Tarter, C. J. (2004). Theoretical and empirical foundations of mindful schools. In W. K Hoy and C. Miskel (Eds.), *Educational administration, policy, and reform: Research and measurement.* Greenwich, CN; Information Age; Hoy, W. K., Gage, C. Q., & Tarter, C. J. (2006). School mindfulness and faculty trust: Necessary conditions for each other? *Educational Administration Quarterly, 42*(2), 236-255], constructed a 'school mindfulness scale', Tingle (2001) [Tingle. J.K. (2011*). The relationship between organizational trust and mindfulness: An exploration of NCAA Division III Athletic Departments*. PhD dissertation. The University of Texas at San Antonio], developed an 'organizational mindfulness scale' for athletic departments), test of the original organizational mindfulness scale – besides the existence of a whole range of individual mindfulness scales, e.g., Brown and Ryan (2003) [Brown, K.W. & Ryan, R.M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84* (4), 822-848] – were not found in the literature.

12 The scale was slightly adapted to the context of our study. The survey question was "To what extent do you agree or disagree with the following statements on working in the project team?" Both team psychological safety and team learning behaviour consisted of 7 items each. Examples of items of team psychological safety are 'If you make a mistake on this team, it is held against you' and 'team members are able to bring up problems and bottlenecks'; examples of items of team learning behaviour are 'we regularly take time to improve our team's work processes' and 'we invite people from outside the team for presentations and / or have discussions with us'. As answering categories a 5-point scale was used ranging from 1='disagree very much' to 5='agree very much'. Cronbach's alpha of both scales were .67 (.7 is often but not always used as a cut-off for an acceptable value), lower that those reported in Edmondson's study, who used a 7-point scale: respectively .82 and .78 (1999: 363).

13 The survey question is ''To what extent do you agree or disagree with the following statements about the project?', with answering categories ranging on a 5-point scale from 1='agree very much' to 5='disagree very much' (reverse coded afterwards), consisting of 5 items, like "This is a very complex project, taking into account the number of involved team members, stakeholders, financial dimensions, throughput time, sub-activities and / or process of decision making" and "This is a project with much diversity, taking into account the involved disciplines, project team members, required knowledge / skills, interests of stakeholders".

14 Innovation project (1) and routine project (0) formed a dummy variable based on the survey question 'Are you working in an ETP project?' ETP stands for Enabling Technology Project, directed at developing new knowledge and solutions, contrasted by regular projects for customers that are more like routine research projects. The first type refers to innovation projects and the second type to routine projects.

15 Team innovativeness was originally derived from Anderson and West (1998) [Anderson, N.R. & West, M.A. (1998). Measuring climate for work group innovation: development and validation of the team climate inventory. *Journal of Organizational Behaviour, 19*, 235-258], and was introduced by the survey question ''To what extent do you agree or disagree with the following statements about the innovativeness of the project team?', with answering categories ranging on a 5-point scale from 1='disagree very much' to 5='agree very much'. Examples of the items are 'Team members apply new ideas to improve the quality of our product / service / knowledge' and 'This is a innovative team'. Cronbach's alpha of the scale was .79. De Dreu reported .84 (De Dreu & West, 2001), .80 (De Dreu, 2002) and 0.82 (De Dreu, 2006) in earlier studies [De Dreu, C.K.W. (2002), Team innovation and team effectiveness: the importance of minority dissent and reflexivity. *European Journal of Work and Organizational Psychology, 11* (3), 285-298; De Dreu, C.K.W. (2006). When too little or too much hurts: Evidence for a curvilinear relationship between task conflict and innovation in teams. *Journal of Management, 32* (1), 83-107; De Dreu, C.K.W. & West, M.A. (2001). Minority dissent and team innovation: The importance of participation in decision making. *Journal of Applied Psychology, 86* (6), 1191-1201].

16 The scales are derived from Musallam (2011) who based them on the work of Espirito (2001) [Espirito, S.S.D. (2001). *Examining performance variables of nongovernmental organizations*. PhD dissertation. Florida Atlantic University]. The original scales were domain-specifically developed to establish the functioning of nongovernmental organizations, which were made applicable to project team members. The survey question of team external effectiveness was ''To what extent do you agree or disagree with the following statements about the effectiveness of the project team?', with answering categories ranging on a 5-point scale from 1='disagree very much' to 5='agree very much'. Examples of items are 'Specific objectives are met within the budget' and 'Team members find 'impact' of the services / products that we provide important'. Cronbach's alpha for the external effectiveness scale in the study of Musallam (2011) was .84; for the adapted team external effectiveness it was .83. The survey question of

team internal effectiveness was ''To what extent is the project team good in the following", with answering categories ranging on a 4-point scale from 1='weak', 2='fair', 3='good', to 4='excellent'. Examples of items are 'Setting clear goals', 'communication' and 'collaboration within the team'. Cronbach's alpha for the internal effectiveness scale in Musallam's (2011) study was .92, while the revised team internal effectiveness had an alpha of .89.

17 The questionnaire can be found in Appendix 1. This is an abbreviated version only including the results on the scales and items that are reported in this study.

18 From the face-to-face interviews with project managers and project leaders from innovation projects – hence not with representatives from routine projects – an inventory of bottlenecks and encountered difficulties was made, summarized in Appendix 2. Findings accentuate the events and issues that project managers experience which are complicating the performance of innovation projects.

19 "When someone is asked how he would behave under certain circumstances, the answer he usually gives is his espoused theory of action (…) However, the theory that actually governs his action, is his theory-in-use, which may or may not be compatible with his espoused theory".

20 There are number of limitations of the study that need to be mentioned. For one reason, not all expected relations were not found in the survey-data, which needs further clarification. First, the number of survey-respondents is limited as only 83 from the 150 respondents completed all the questions of the questionnaire. This implies that the possibility to apply multivariate analyses is limited. The limited number of respondents asks for replication among larger samples. Second, we analysed (but not reported) defensive behaviour on the survey-data, but we could not construct an internally consistent scale. A credible argument is that respondents may be inclined to give social desirable answers, hence the survey-data may be an underestimation of the real phenomenon. On the other hand, the answering pattern could be viewed as the ultimate affirmation of the presence of defensive behaviour: respondents 'cover up' their Model I behaviour. Defensive behaviour, however, may simply be unsuitable to be researched through a survey because the underlying psychological process is hard to operationalise and measure with survey items (Argyris & Schön, 1974; 1996). Third, the variable innovation project, although associated with project complexity in the expected direction, did not have strong and significant correlations with team performance output measure and team mindfulness and team psychological safety. Respondents in innovation projects and routine projects experience their project both as rather complex and do not discriminate strongly (means were respectively 2.47 and 2.13 on a recoded 3-point scale; Chi square test was not significant). Relevant to mention is that the programme under which the innovation projects reside was under way for only 10 months at the time of measuring. Maybe it was too early to expect salient results. Fourth, the survey-research assumed causal directions but in a cross-sectional survey directions of causality may be in different directions as expected or as found. Fifth, several measures are based on the perception of respondents, which can be biased. There are for instance no external measures of outputs, which is a weak point from a validity perspective. A more concise questionnaire and a time frame in which results of innovation projects may be expected, could solve a number of these limitations. The present results also ask for a follow-up study of a qualitative nature into the mechanisms of defensive behaviour and the characteristics of experiences with project complexity within project teams dealing with innovative goals as targets. One way of doing so is by a (already planned follow-up) research to study the explorative framework in different organizations with project teams working on innovation projects, and investigate how these deal with failures and success, thereby using conjoint analysis and compare cases.

Chapter 3

Mindful infrastructure as antecedent of innovation resilience behaviour of project teams: learning from HROs

Based on: P.R.A. Oeij, T. van Vuuren, S. Dhondt & J. B.R. Gaspersz (2016), Mindful infrastructure as antecedent of innovation resilience behaviour of project teams: learning from HROs. Submitted to *Innovation: Management, Policy & Practice,* 2016*.*

Mindful infrastructure as antecedent of innovation resilience behaviour of project teams: learning from HROs

Abstract[1],[2]

The purpose of this article is to investigate whether insights into High Reliability Organisations (HROs) are useful for innovation management. HRO-teams can keep failure to a minimum due to high alertness and resilience. Project teams working on innovation management could benefit from HRO principles and thus reduce their chance of failure.
A survey among 260 team members and team leaders of project teams in innovation management was conducted to study the relation between, on the one hand, organizational features of HROs ('mindful infrastructure' or MI) and HRO principles (adjusted as 'innovation resilience behaviour' or IRB), and on the other hand, between MI and IRB and project outcomes.
From the results it could be concluded that 1) MI associates with IRB, and 2) that IRB has a strong mediating role in the relation between MI and project outcomes. Innovation management project teams can thus learn from the practice of HRO teams.
To the authors knowledge HRO-thinking has not been applied to team behaviour in innovation management. A fruitful transfer of insights from the domain of safety and crisis management seems applicable to the domain of innovation.

Key words: teams, project management, mindful infrastructure, innovation resilience behaviour

1 Introduction

The limited success rate of projects (Mulder, 2012; Sauser, Reilly & Shenhar, 2009) and innovations (Castellion & Markham, 2013) has drawn attention to the 'soft side' of projects, such as managerial, social and organizational aspects, as a counterbalance of the 'hard side' of project management and its 'iron triangle' of time, budget and performance (Antoniadis, Edum-Fotwe & Thorpe, 2011; Azim, Gale, Lawlor-Wright, Kirkham et al., 2011; Sauser et al., 2009; Shenhar & Dvir, 2007). While this soft turn of project management might be helpful, still projects fail, which might be an indication for the need to dig deeper. One of the possible deeper issues is risk aversion in teams. Since there are many reasons why innovation projects go awry, such as the quality and receptiveness of a new product or service, decisions of investors and top management with regards to a project, difficulties to transfer an invention into an accepted innovation, in this study the focus therefore is limited to team behaviour in innovation projects. Risk aversion fits into this scope.

Due to their innate uncertainty, innovation projects may be perceived as more complex than highly plannable projects, which may evoke risk aversion in teams. Risk aversion is the behaviour of humans while exposed to uncertainty to attempt to reduce that uncertainty (Kahneman, 2011). Innovation demands teams to be creative and deviate from the norm, but uncertainty may drive teams towards conformity (Pech, 2001). Risk aversion may emerge when team members feel incompetent and threatened, which evokes organizational defensiveness routines (Argyris, 1990), such as confirmation bias. Confirmation bias is the tendency to ignore information that is inconsistent with expectations, like 'weak signals' that projects are going awry (Weick & Sutcliffe, 2007). Of course, innovation teams consist of members who are assumed to be selected to do the job. Risk avoidance, however, is not a conscious type of behaviour, and it is plausible that teams would like to perform successfully. There are many reasons and explanations for risk-averse behaviour. The psychological literature mentions heuristics and biases, which may subconsciously undermine 'complex' choices, decision-making and judgment (Kahneman, 2011), and different kinds of defensive behaviours that may be detrimental to the quality of performance (e.g. Ardon, 2009).

Conversely, High Reliability Organisations (HROs) successfully suppress risk avoidance and teach their teams to be highly alert for small risks that may have large consequences. The aim of this study is to investigate whether the HRO principles could be helpful for innovation teams to improve success and minimize failure.

For this purpose we describe the core HRO literature to highlight its relevance for innovation management and we discuss the evidence of its workings. Subsequently we elaborate on the implication of HRO teams for innovation teams, which results in a model of organizational facilitations - called mindful infrastructure - and team behaviours - called innovation resilience behaviour - that improve the functioning of innovation teams. Such teams should in the end become less risk avoiding, less defensive and better able to deal with smaller and bigger risks to keep their project on track. The model will be put to an empirical test, and the outcomes of this test will be discussed.

2 High reliability as a driver for mindful team dynamics

2.1 Why is the safety and crisis management literature relevant for innovation management?

High Reliability Organizations are operating under very trying conditions all the time and yet manage to have fewer than their fair share of accidents. HROs include power grid dispatching centres, air traffic control systems, nuclear aircraft carriers, nuclear power generating plants, hospital emergency departments, wildland firefighting crews, aircraft operations, and accident investigation teams. (Weick & Sutcliffe, 2007, pp. 17–18).

Based on a pre-study (Oeij, Dhondt, Gaspersz & De Vroome, 2016), our assumption is that knowledge about safety and crisis management, especially related to high reliability organizing and teamwork, is beneficial for teamwork in innovation projects. For HROs, perhaps the most essential performance goal is safety, especially for those HROs where safety errors come with great societal costs. Paradoxically, the delivery of energy and electricity by a nuclear power plant, for example, is its primary production goal, which can at times be made subordinate to the safety of lives and the environment. Therefore, the performance criterion of HROs in terms of organizational effectiveness is measured by its maximized reliability (Weick, Sutcliffe & Obstfeld, 1999). High Reliability Organizations have to deal adequately with situations that are conducive to mixed messaging and may, at first, look contradictory, paradoxical, or represent a dilemma: cost-effectiveness to the detriment of safety. The parallel with teams working in innovation projects is that such teams too have to deal adequately with cost-effectiveness, but here to the detriment of innovative solutions.

The normal accident theory, developed by Perrow (1999), states that major accidents in many hazardous technical systems are inevitable. High-risk systems in Perrow's definition are nuclear weapons, aircraft and military systems; whereas lower-risk systems are manufacturing plants, such as oil refineries and chemical plants. The problem with this theory is that human operations cannot prevent accidents from happening; it seems to be just a matter of time. Perrow's theory blames organizational design (tightly coupled complex tasks and processes), but not 'sloppy management' (Hopkins, 2014). The normal accident theory, however, does not explain how and why so many complex systems, like HROs, do not seem to fail (Weick et al., 1999). This is why Weick et al. (1999) reconceptualised the theory of high-reliability organizations (Hopkins, 2014). In the eighties three organizations were studied that had not experienced disaster – the US traffic control system, a company operating both a nuclear power station and an electricity distribution system, and US navy nuclear aircraft carrier operations. The objective was to establish why these organizations appeared to function without mishap (Hopkins, 2007). The basic answer was that certain hazardous organizations had enjoyed a record of high safety over long periods of time, while such organizations could have failed many times but did not, and thus were highly reliable (Roberts, 1990). According to Weick and colleagues the reason for their reliability is that these organizations have the characteristics of a 'mindful organization'. They describe the following five HRO principles that such HROs master (Weick et al., 1999; Weick & Sutcliffe, 2007):

1. Preoccupation with failure is to learn from events that seldom occur (errors, weak signals) and to convert them into improvements (report errors for learning).
2. Reluctance to simplify is to restrict simplifications in interpretations in order to enlarge the number of precautions and minimize surprises.
3. Sensitivity to operations is perceiving the integrated big picture of operations in the moment at a higher level than the operational level, and comprising the collective mind beyond the individual operator.
4. Commitment to resilience is anticipation and resilience. Anticipation is the prediction and prevention of potential dangers before damage is done, whereas resilience is the capacity to cope with unanticipated dangers after they have become manifest. Resilience is the ability not only to bounce back from errors, but also to cope with surprises in the moment, and to respond as they occur (Wildavsky, 1991).
5. Deference to expertise refers to loosening the designation of who is the 'important' decision-maker in order to allow decision-making to migrate along with problems.

These five HRO principles are what Weick et al. (1999, pp. 91–104) have derived from accounts of effective practice in HROs and from accident investigation. Hence, these can be regarded as the evaluation and assessment of indicators for successful HROs. A successful HRO is an organization characterized by the absence of failures and errors through maximizing its reliability.

The reason why the HRO literature is relevant for innovation management is its attention to the psychology of avoiding mistakes and putting effort into unnatural human behaviour. The psychological concepts of reliability and mindfulness take a central position in HRO thinking (Weick et al., 1999). The five HRO principles have a psychological basis, namely in the motivation to pursue cognitive effort in order to detect errors and act upon adapting the situation to effectively deal with (possible) errors. In this sense reliability refers to the stability of cognitive processes. The motivation to continuously be aware of unforeseen situations leads to stable cognitive processes for detecting possible errors, and to a variable pattern of activities for adapting to events that require revision. This stability of cognitive processes ensures continuous learning from events that each time unfold in slightly different ways, and eventually results in reliability. Therefore, reliability is grounded in adaptive human cognition and action (Weick et al., 1999, pp. 86-88).

2.2 Why should innovation teams act mindfully and be innovation resilient?

The first reason has already been mentioned: many projects and innovations are not successful. More success improves the competitiveness of organizations. Secondly, HROs who operate mindfully make almost no faults and have high safety statistics because their teams are very alert and resilient. Higher alertness and resilience makes teams more effective and efficient (Alliger, Cesaroli, Tannenbaum & Vessey, 2015). Thirdly, if innovating organizations were to make a business case for higher success rates of innovation processes it could save costs. Fourthly, there is evidence that suggests that organizational mindfulness is associated with the number of patents, as an indicator of innovation (Vogus & Welbourne, 2003).

Investing in HRO principles works for HROs where safety is of paramount importance. But is that also the case for non-HROs, for those situations where safety is less urgent? Weick et al. (1999) argue indeed that investing in HRO principles is relevant for non-HROs as well, because these organizations do not invest in safety, but in organizational learning. And although it is not easy to quantify the business case for organizational learning, it is plausible that learning capabilities enhance innovative capabilities, trust, motivation, collaboration and communication, and thus is suitable for non-HROs. For business organizations to remain competitive and for public organizations to remain cost-effective and provide high-quality products and services, several studies stress the importance of innovation being state-of-the-art, and of being able to act and react in a resilient way (see the meta-review by Alliger et al., 2015).

Apart from a business-driven sense of urgency there seems to be an organizational-driven sense of urgency as well. Teams are ubiquitous in the working world; many teams face challenges that can drain resources, adversely affect performance, and diminish team cohesion and team member well-being, according to Alliger et al. (2015).

2.3 What are the implications of HRO theory and practice for teams performing innovation projects and what are the key elements of team dynamics to investigate?

We differentiate between mindful infrastructure as a characteristic of the organization - the team environment - and innovation resilience behaviour (IRB) as team behaviour - what the team does. Weick et al. (1999), Weick and Sutcliffe (2007), Vogus (2012), Vogus & Sutcliffe (2012), and Vogus and Iacobucci (2016) state that reliability and safety are a consequence of 'organizing', the process of interaction between persons that constitutes sense and meaning, and, in this case, a collective capability for detecting and correcting errors and unexpected events. Organizing thus precedes IRB. If IRB is the team behaviour to deal with unexpected events, then the next step is to select the antecedents of IRB that constitute mindful infrastructure. From her literature study on HROs, Lekka (2011) made a mind map of the processes and characteristics associated with HROs. Three of these characteristics are that HROs:

1. foster strong learning,
2. have just cultures, and
3. have 'mindful' leaders at the very top of the organization.

The learning orientation is characterized by continuous (technical) training, root cause analysis of incidents, open communication, and reviewing procedures in line with the organizational knowledge base. Therefore we see team learning (Edmondson, 1999) - the ongoing process of reflection and action, by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions - as a relevant antecedent of IRB.

Just culture refers to the notion in which staff are not punished for actions, omissions or decisions taken by them that are commensurate with their experience and training, but where gross negligence, wilful violations and destructive acts are not tolerated. Just culture coincides with two team elements, namely team voice and team psychological safety. Voice refers to intentionally expressing relevant ideas, information, and opinions about possible improvements, even when others disagree (LePine & Van Dyne, 2001). Team psychological safety is the shared belief that the team is safe for interpersonal risk taking, and suggests a sense of confidence that the team will not embarrass, reject or punish someone for speaking up, implying mutual respect and trust (Edmondson, 1999).

'Mindful leadership' in HROs points to leaders who encourage the communication of 'bad news' and the proactive investigation of organizational flaws, and to leaders who balance the pressures of production and business with safety. Complexity leadership can connect such seemingly contradictory goals. Therefore, complexity leadership is another antecedent of IRB that enables leadership behaviour aligned with situational needs, and encompasses different styles: a competitive, cooperative, creative and controlling style (Lawrence, Lenk, & Quinn, 2009).

Team psychological safety, team learning, team voice and complexity leadership are regarded as antecedents of IRB. For example, Vogus (2012) explains that psychological safety is a function of management decisions to support front-line action - in his words 'a function of leader behaviours and discursive practice' that facilitate this - and, as such, belongs to 'potential antecedents of mindful organizing rather than analogies of it' (Vogus, 2012, p. 667). He argues in the same vein regarding safety climate. Elsewhere, Vogus and Sutcliffe (2012) point to the important role of transformational leadership for employees to participate and to learn. Such leadership creates a context and enables mindful acting. Other antecedents, according to Vogus and Sutcliffe (2012), are task interdependence and organizational size. If task interdependence is high, as in HROs, mindfulness is critical to make difficult and effortful work legitimate and acceptable. At a higher organizational level than the team level this interdependence also has a relation with organizational size, namely in larger organizations mindfulness is more 'fragmented' (Vogus & Sutcliffe, 2007), as parts of the organizations get more 'loosely coupled' when size grows. Task interdependence and the need to counter fragmentation are realized by providing teams with voice, a shared goal and relations that allow trustful communication (Baker, Day & Salas, 2006; Salas, Sims & Burke, 2005). Mindful infrastructure ensures the social-relational context of respect and trust, which encourages people to speak up and question interpretation, and counteracts tendencies to act defensively, due to feelings of threat, discomfort or feelings of incompetence (Sutcliffe & Weick, 2013). Team members, thus, must pay attention to the interrelating of their activities through heedful interrelating, a shared pattern built on individual actions in which individuals understand how their action fits into the larger action and the mechanism of the system as a whole (Sutcliffe & Weick, 2013; Weick & Roberts, 1993). Mindful infrastructure is a necessary but not sufficient condition for IRB - 'That infrastructure must be organised and enacted through conduct that enables organisational members to recognise emerging problems earlier and to manage them more decisively' (Sutcliffe & Weick, 2013, p. 151). Thus managing innovation projects by teams should establish team behaviours that are aimed at the five principles to anticipate critical events and to deal with them resiliently.

The four antecedents are enablers of IRB and together constitute the mindful infrastructure, defined as the organizational capacity to anticipate unexpected problems and the capacity to contain such problems by enabling organization members to act accordingly. To link these elements to a research model a final step is to describe its relation with the team literature (e.g., Mathieu, Maynard, Rapp & Gilson, 2008; Stewart, 2006).

1. Team psychological safety and team learning

Team psychological safety and team learning were positively associated with team mindfulness and perceived project outcomes in an earlier study (Oeij et al., 2016). Team psychological safety is meant to suggest a sense of confidence that the team will not embarrass, reject or punish someone for speaking up, implying mutual respect and trust among team members as a team climate (Edmondson, 1999, p. 354). Team learning at group level is an ongoing process of reflection and action, characterized by asking questions, seeking feedback, experimenting, reflecting on results and discussing errors or unexpected outcomes of actions (Edmondson, 1999). Team safety and team learning are both important for innovation processes, where team members may have to 'deviate from the norm', depart their comfort zones, and reflect critically on new and unexpected events. In the case of project teams, these elements of mindful infrastructure gain importance considering that project team memberships are fluid, short-lived and that roles, tasks and hierarchy may be more ambiguous compared to permanent teams. It is assumed that mindful infrastructure coincides with feelings of safety and options for learning, which are beneficial for creative and innovative processes in teams, because better use is made of the ideas and (critical) opinions of all team members.

2. Team voice

The function of decision-making in teams is omnipresent. Since decisions are inextricably bound up with interests, there are links with power and conflicts. Team voice provides team members with influence on decision-making. Power or organizational politics is considered to be a relevant element of mindful infrastructure. When the attitude to power is constructive it may enhance critical reflection and problem solving in teams when team members focus on (rational) task-related instead of (emotional) relation-related conflicts (De Dreu, 2006; De Dreu & Weingart, 2003). Avoiding relation-related conflicts may also diminish personal tensions and evoke interpersonal trust, which then can facilitate problem solving and mindful decision-making. Thus, power and conflicts are not necessarily negative aspects of organizations, because they can enhance innovation under certain circumstances, for example when dealing with task conflict rather than relationship conflict in the case of constructive problem solving. According to Buchanan and Badham (2008, p. 6), power is always present for a number of reasons, as it is rooted in:

1. Personal ambition of individuals;
2. In organization structures that create roles and competing departments;
3. In decisions that cannot be resolved by evidence and reason alone but which rely on the values and preferences of those involved; and
4. In the organizational changes that threaten to push people out of their comfort zones and challenge vested interests, which they then struggle to preserve.

It is assumed that mindful infrastructure goes hand in hand with constructive politics, problem solving and employee's voice in decision-making in project teams.

3. Complexity leadership

Leading innovation projects and project teams may at times be reconciling possibly incommensurable goals, such as innovativeness versus budget and time constraints, attuning the diverging interests of stakeholders, the diverging talents and backgrounds of team members. Leadership implies combining transformational and transactional goals, task orientation and people orientation. A meta-analysis of leadership behaviours and teams (Burke et al., 2006) concluded that both task- and person-oriented leadership behaviours (respectively transactional leadership, initiating structure, boundary spanning on the one hand and transformational leadership, consideration, empowerment and motivation on the other) explain a significant amount of variance in team performance outcomes (perceived team effectiveness and team productivity). The authors conclude that leaders need to be trained in both types of behaviour as they both contribute and are needed for teams to be effective (Burke et al., 2006). The literature on complexity leadership is helpful in this area. Organizations grow in complexity as places where people's actions interact with sufficient intricacy, so that what unfolds and develops cannot be predicted by standard linear equations but emerges out of the myriad of behaviours, and cannot be reduced to simplistic relations because the whole is more than just the sum of all of the parts and elements (Uhl-Bien & Marion, 2009). The essential point of leading teams in complex settings is that no one can fully predict and control outcomes, but some have more power over others to influence directions of decisions and the distribution of resources, rewards and so on (Stacey, 2012). Complexity leadership, in such instances, demands the performance of different leadership styles attuned to situational requirements. Leadership of project teams working on innovation projects requires the reconciliation of possibly opposing views, e.g. the project management's triangle of money, time and results on the one hand, and creative, innovative outcomes on the other. We assume that this kind of leadership of project teams and innovation projects is an essential part of mindful infrastructure.

2.4 The research framework

Mindful infrastructure consists of four elements, namely team psychological safety, team learning behaviour, team voice, and complexity leadership. Team psychological safety and team learning (Edmondson, 1999) allow team members to make mistakes without being punished and to explore and experiment. Mindful infrastructure assumes the possibility of adequately dealing with situations that are conducive to mixed messaging and may, at first, look contradictory, paradoxical, or represent a dilemma. Dealing adequately with such situations demands complexity leadership (Lawrence, et al., 2009; Uhl-Bien & Marion, 2009), which enables working towards constructive solutions and decisions. It enables a team and / or its leader to look for synergy, instead of choosing for 'cost-effectiveness to the detriment of innovative solutions' and thus synergizes transactional and transformational leadership goals. Team voice or participative decision-making encapsulates organizational politics and enhances problem ownership among team members. It encourages to constructively deal with diverse stakeholder interests. Mindful infrastructure presupposes the importance of the participation of project team members. They are functioning in a continuous flux of changes and challenges that ask for a sense of control in order to function properly, i.e. without too much stress, and with decision latitude (Karasek & Theorell, 1990). It is therefore important that project team members have a voice in decision-making (LePine & Van Dyne, 2001) and where conflicts or disagreements are being dealt with in a constructive manner (Buchanan & Badham, 2008). These elements, if absent, may induce defensive behaviour (Argyris, 1990), but if present, may evoke innovation resilience behaviour, which consists of the five HRO principles adapted to the context of innovation management. Innovation resilience behaviour (IRB) will contribute to an improved innovation process because teams make fewer mistakes, can better handle and prevent mishaps and keep a stronger focus on results. Mindful infrastructure, then, facilitates controlled risk taking, recovering from mistakes, space for experimentation and ways to communicate and cooperate constructively. Project outcomes and innovation processes will benefit from this.

Two related issues are relevant for carrying out innovative projects by teams, namely the role of defensiveness and risk avoidance, and the complexity of the innovation projects and project environment. Defensive behaviour or organizational defensive routines are any action, policy or practice that prevents organizational participants from experiencing embarrassment or threat and, at the same time, prevents them from discovering the causes of the embarrassment or threat (Argyris, 2004a, p. 392). We contend that defensive behaviour may lead to risk avoidance in project teams. Yet, innovation resilience behaviour may suppress defensive behaviour - as HRO principles do in HROs - and make project teams more conducive to risk-taking actions and seeking creative solutions. We are furthermore contending that complex projects are less predictable and controllable than routine projects. Vidal and Marle (2008) distinguish five aspects that make up the complexity of projects, namely:

1. Size of a project system;
2. Variety of the project system;
3. Interactions and interdependencies within the system;
4. Context and environment dependency of the project system; and,
5. Uncertainties and change propagation as consequences of complexity (pp. 1097–1098, 1105).

Innovation projects are not complex because innovation is working on ‘newness’ per se, while working on routine projects is working on ‘routineness’, but because the processes and outcomes are rather unpredictable and uncontrollable. When projects are being perceived as highly complex this may induce defensive behaviours. However, teams are selected to properly handle their projects, therefore we expect no significant effects of perceived project complexity.

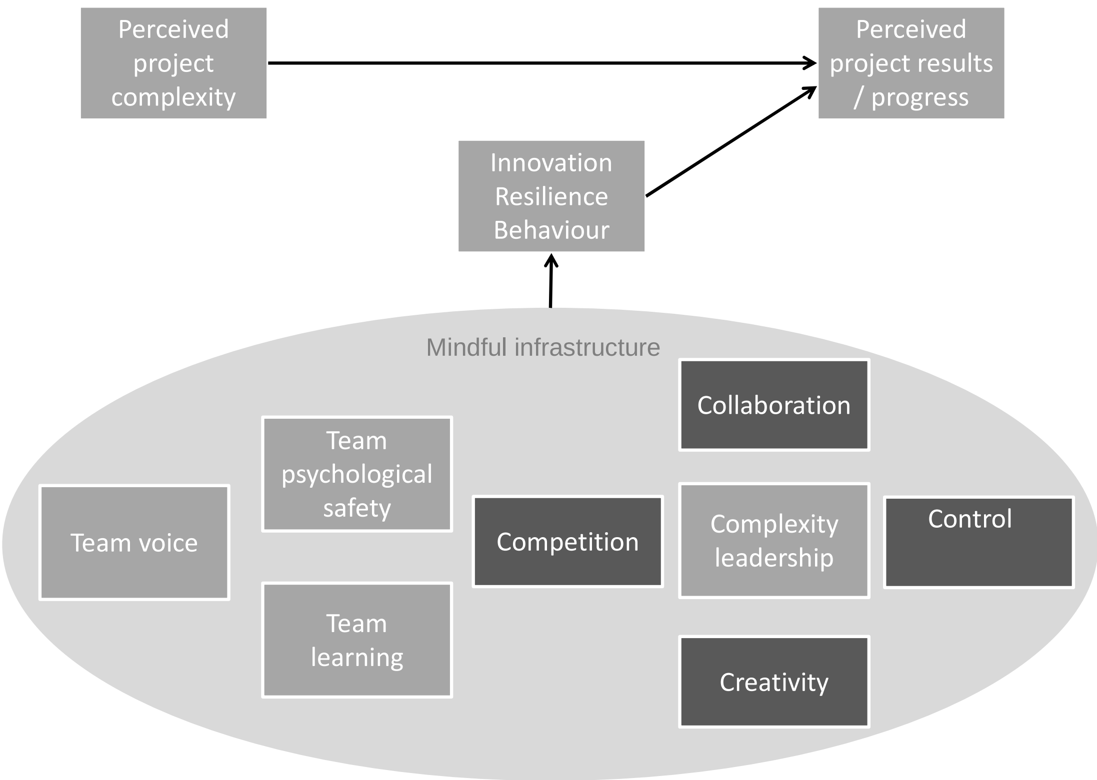


Figure 1 Research framework

The purpose of this study is to investigate whether in innovation teams a relationship exists between mindful infrastructure and IRB. We test this by means of a survey. Furthermore, the relations between team IRB and project outcomes, namely 'perceived project success' and 'perceived project progress', will be investigated. We expect a positive association, although we realize that project success and progress are influenced by many factors external to team behaviour that we cannot control for. Furthermore, the relations between team IRB on the one hand, and perceived project success and perceived project progress on the other, will be controlled for by perceived project complexity. We do not expect direct effects of perceived project complexity on perceived project success and perceived project progress, because innovation teams are supposed to be equipped with how to deal with complexity.

The former discussion results in three hypotheses to test the main model relations:

- H1: The presence of mindful infrastructure will be positively associated with innovation resilience behaviour.
- H2: Innovation resilience behaviour will be positively associated with perceived project progress and perceived project success.
- H3: The presence of mindful infrastructure will be positively associated with perceived project progress and perceived project success and mediated by team innovation resilience behaviour.

3 Methods

3.1 Data and research method

A survey was held among team leaders and team members of innovation projects in 11 organizations, which resulted in 260 fully completed questionnaires (65% response rate). These organizations are both profit (8) and non-profit organizations (3) and stem from both manufacturing (4) and services (7). Together, the 11 organizations provided 18 project teams (N=101) for in-depth study; the remaining respondents from the 11 organizations have similar jobs in other teams. From all 260 respondents, 38% are project or team leaders and 53% a team member, while 9% report having another function; 24% are female; 15% are <35 years, 40% are 36–45 years, and 45% are >45 years. The average team size is 5.9 persons, ranging from 3 to 16 persons. The project managers of the 18 teams also completed a survey including similar questions on project outcomes. Their answers on project outcomes will be used to compare them with the answers of the teams.

3.2 Measures

Mindful infrastructure was measured with four constructs, namely team psychological safety, team learning behaviour, behavioural complexity in leadership and team voice.

'Team psychological safety' and 'team learning behaviour' were measured by scales developed by Edmondson (1999) and also applied in our pre-study (Oeij et al., 2016). Team psychological safety is the shared belief that the team is safe for interpersonal risk taking, and suggests a sense of confidence that the team will not embarrass, reject or punish someone for speaking up, implying mutual respect and trust; team learning is the ongoing process of reflection and action, by asking questions, seeking feedback, experimenting, reflecting on results and discussing errors or unexpected outcomes of actions (Edmondson, 1999). Respondents were asked to evaluate statements on both topics on a 5-point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (5).

'Complexity leadership' is measured with an instrument to measure the capacity to exhibit a broad array of contrasting or competing behaviours, and based on the 'competing values framework' (Quinn, Faerman, Thompson, McGrath & St. Clair, 2010) and developed by Lawrence et al. (2009). The competing values framework is defined by two dichotomous (competing) values: flexible versus stable structure and internal versus external focus. Together they result in four leadership styles: collaborate, compete, control and create. These styles were measured by asking respondents how skilled they assess the project leader (or themselves if they are project leaders) in these aspects on a 5-point Likert scale, ranging from 'strongly disagree' (1) to 'strongly agree' (5), comprising 36 items.

'Team voice' is a construct that indicates constructive organizational politics, as it deals with the extent to which team members participate in decision-making, collaboration and commitment. 'Team voice' measures the participation of team members by examining voice and willingness to help and to what extent team members have a say in daily routines. We used the voice scale developed by Van Dyne and LePine (1998), with which respondents evaluate statements on a 5-point Likert scale, ranging from 'strongly disagree' (1) to 'strongly agree' (5).

'Innovation resilience behaviour' (IRB) was measured by a short version (18 items) of the five Audits of Resilient Performance of Weick and Sutcliffe (2007, pp. 94–102), consisting of 48 items, and an empirical application of these audits by Ray, Baker and Plowman, who developed one singular instrument from these five audits into their 'measure of organizational mindfulness', which comprises 43 items (2011, p. 201). The scale was made context-specific for teams, and respondents were asked to what extent the five HRO principles (Weick & Sutcliffe, 2007) are present in their project team on a 7-point scale ranging from 'not at all' (1) to 'to a very great extent' (7). The five HRO principles are preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience and deference to expertise.

'Perceived project complexity' was measured with the project complexity index from Vidal, Marle and Bocquet (2011), which consists of four elements, namely project size, project variety, project interdependencies and project context-dependence. Respondents were asked to evaluate the contribution of each factor to the complexity of the project on a scale of '1' (very easy) to '10' (very difficult).

'Project progress' measures how respondents evaluate the progress of the project's process, and not its end product. Items are, for example, staying within budget, performance and quality of content, and quality of project management. Respondents were asked to score the project's progress on a self-developed 10-item scale, which was inspired by Shenhar and Dvir (2007) and Mulder (2012), and ranged from '1' (very bad) to '10' (very good).

'(Expected) Project success' was measured using a scale from Müller and Turner (2010), by which respondents could assess the success of their project against ten criteria, and was then calculated into a composite measure (also Müller & Turner, 2007). Examples of items are 'the project was a success with respect to the (expected)': end-user satisfaction, supplier's satisfaction, and meeting the project's purpose'. Project success measures an end-state or expected-end-state of the project in terms of these criteria, and not the process of the project. Respondents were asked to score the project's success on a 5-item scale, which ranged from '1' (strongly disagree) to '5' (strongly agree).

3.3 Analyses

Reliability analyses to inspect internal consistency were carried out. Intraclass correlations (ICC, two-way random, average measures) were computed as estimates of the interrater reliability between the teams and their project manager with regard to the reports on perceived project progress and perceived project results. To test the hypotheses, multiple regressions to investigate model relations were executed first, and mediation analyses to research the significance of indirect effects were conducted in a next step.

4 Research results

4.1 Descriptive statistics

Table 1 presents descriptive statistics of respondents to the survey, from which can be seen that the Cronbach's alpha for the scales team psychological safety (0.67) and team learning behaviour (0.66) are not fully satisfactory, according to the usual threshold of 0.70 (Nunnally, 1978). Deleting items that show lower inter-item correlations hardly improved the alphas. Since these scales by Edmondson (1999) have been used in so many other researches, and the scores are, when rounding them off, within threshold limits, we decided not to change the scale composition for this exploratory analysis.

4.2 Intraclass analyses

The calculated interrater reliability of perceived project progress and perceived project success between the team and the project manager were both strong and significant; respectively ICC(2, 2) = .801 and ICC(2, 2) = .732 (Landers, 2015; Shrout & Fleiss, 1979). This can be seen as a proof of the validity of the self-reported project evaluations of the teams.

Table 1 Means, standard deviations, N, correlations, alpha scores of respondents (N=max. 260)

	Mean	Std. Deviation	N	Team Innovation Resilience Behaviour	Team voice	Team Psychological Safety	Team Learning Behaviour	Leadership Collaboration	Leadership Creativity	Leadership Control	Leadership Competition	Perceived project complexity	Perceived project progress	Cronbach's Alpha
Team Innovation Resilience Behaviour (18 items; 1=not at all – 7=to a very great extent)	4.82	.754	232											.926
Team voice (6 items; 1=strongly disagree – 5=strongly agree)	3.90	.543	238	.496**										.849
Team Psychological Safety (7 items; 1=strongly disagree – 5=strongly agree)	3.98	.479	260	.399**	.432**									.667
Team Learning Behaviour (7 items; 1=strongly disagree – 5=strongly agree)	3.38	.498	260	.478**	.490**	.455**								.664
Leadership Collaboration (9 items; 1=strongly disagree – 7=strongly agree)	3.69	.551	210	.356**	.308**	.310**	.320**							.823
Leadership Creativity (9 items; 1=strongly disa-gree – 7=strongly agree)	3.77	.610	231	.357**	.375**	.330**	.437**	.506**						.865
Leadership Control (9 items; 1=strongly disagree – 7=strongly agree)	3.68	.569	236	.475**	.299**	.220**	.188**	.449**	.339**					.844
Leadership Competition (9 items; 1=strongly disagree – 7=strongly agree)	3.47	.579	227	.314**	.185**	.148*	.167*	.197**	.485**	.481**				.825
Perceived project complexity (14 items; 1= very easy – 10= very difficult)	5.95	1.45	264	-.002	-.139*	-.211**	.065	-.003	-.035	-.081	-.098			.905
Perceived project progress (10 items; 1= very bad – 10= very good)	6.90	1.41	261	.385**	.244**	.222**	.309**	.202**	.260**	.274**	.164*	.047		.888
Perceived project success (10 items; 1= strongly disagree – 5= strongly agree)	3.99	.521	247	.459**	.265**	.203**	.336**	.212**	.318**	.422**	.264**	-.087	.586**	.845

Note: ** Correlation is significant with p<.01 (2-tailed); * significant with p<.05 level (2-tailed).

4.3 Correlations and multiple regressions

In order to test the validity of the framework the relations between the main variables will be investigated.

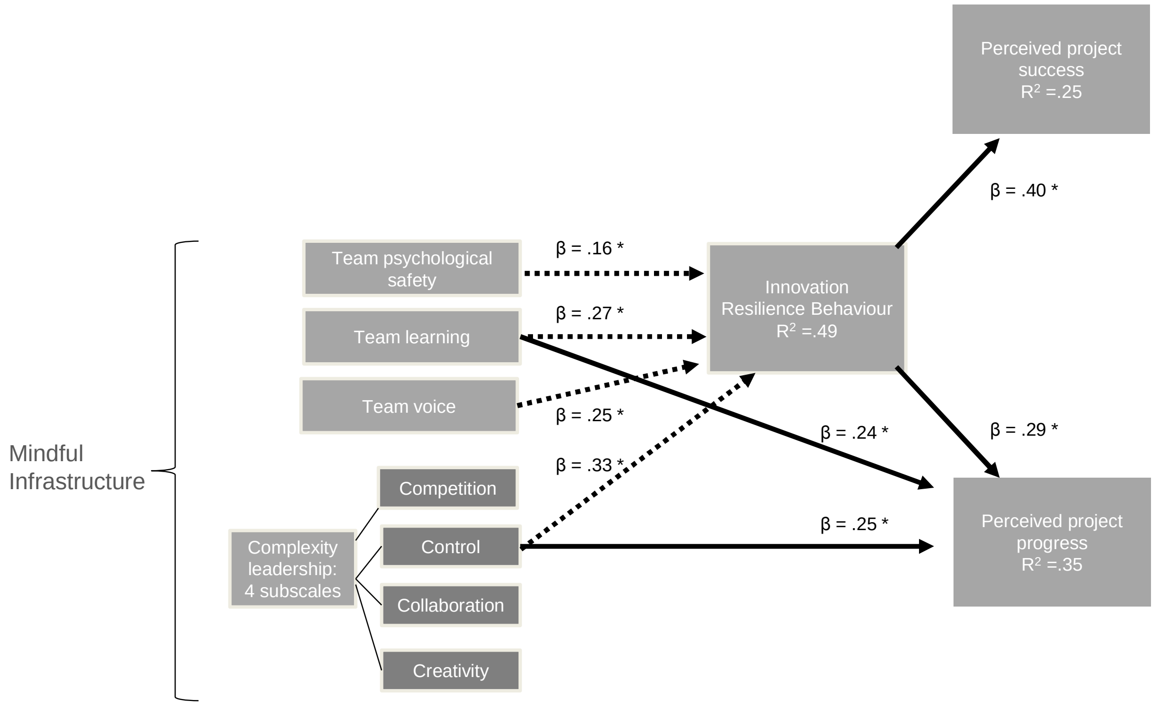
Table 1, which presents the Pearson correlations, shows that in the first instance all the mindful infrastructure variables have a positive association with team innovation resilience behaviour. Team voice, team learning behaviour and control leadership correlate almost by .5 with IRB, and team psychological safety, competitive leadership (i.e., the style compete), collaborative leadership (collaborate) and creativity leadership (create) correlate between .3 and .4 with IRB. Perceived project complexity does not seem to be associated with perceived project progress and results, nor with team innovation resilience behaviour.

In the second place we performed multiple regression analyses to investigate the model as a whole. To test the main relation of the model, we started with a regression with team innovation resilience behaviour as a dependent variable and included as the independent variables all mindful infrastructure variables, namely team psychological safety, team learning, team voice and the four complexity leadership subscales: collaboration, control, creativity and competition. Then we ran the same regression analysis where perceived project complexity was included as a control variable, followed by entering the above-mentioned variables as independent variables. Next, we regressed the mindful infrastructure variables, and team innovation resilience behaviour on both perceived project progress and perceived project success as the dependent variables (separate multiple regressions). Finally, we repeated the last regressions with perceived project complexity as a control variable.

Multiple regression to assess the contribution of mindful infrastructure to the presence of team innovation resilience behaviour resulted in a model with a total explained variance of 49%, F (7, 178) = 24.09, p < .001. The variables that delivered a significant contribution were leadership control (*beta* = .33, p <.001), team voice (*beta* = .25, p <.001), team learning (*beta* = .27, p <.001), and team psychological safety (*beta* = .16, p <.05) (see dotted lines in Figure 2). A multiple regression analysis with perceived project complexity as control variable resulted in a model solution with almost the same 49% explained variance. The beta of perceived project complexity was low and not significant. The two multiple regression analyses with respectively perceived project progress and perceived project results as dependent variables resulted in a model with 25% explained variance F (8, 176) = 7.20, p < .001, and with 35% explained variance F (8, 172) = 11.53, p < .001, respectively. The single variable that contributed to perceived project progress was team innovation resilience behaviour (*beta* = .40, p <.001). Therefore, mindful infrastructure has no direct effects on project progress. Perceived project results were explained by team innovation resilience behaviour (*beta* = .29, p =.001), and two aspects of mindful infrastructure: leadership control (*beta* = .25, p <.05) and team learning (*beta* = .24, p <.05) (see solid lines in Figure 2). Repeating the regressions with perceived project complexity did not change the results.

4.4 Mediation analyses

Following Baron and Kenny (1986) in further investigating the significance of the indirect effects and the mediating role of Team IRB, Sobel tests were carried out.[1] Results of the Sobel tests suggest that the association between the predictors of mindful infrastructure (team psychological safety, team learning, team voice and leadership control) and project outcomes (perceived project success and perceived project progress) is significantly mediated by team innovation resilience behaviour (all Z scores were significant, *p*< .001).



1] Dotted lines: regression on Team Innovation Resilience Behaviour
2] Solid lines: regression on Perceived project progress and Perceived project success

* = *p* < 0.05 (2-tailed)

Figure 2 Framework and multiple regressions results

5 Conclusion and discussion

5.1 Conclusion

The central assumption was that the presence of mindful infrastructure would associate with team innovation resilience behaviour (H1). This was confirmed by multiple regressions, which showed that in particular team psychological safety, team learning, team voice and leadership control have a significant association with team innovation resilience behaviour. Perceived pro-

1 Using software from: http://quantpsy.org/sobel/sobel.htm (accessed 16 March 2016).

ject complexity plays no determining role. The conclusion is that mindful infrastructure seems to enable innovation resilience behaviour, consonant with how HRO teams act mindful as a consequence of mindful 'organizing'.

As expected, there are positive relations between team IRB and perceived project progress and perceived project results (H2). The validity of the reported project results by the teams was supported by intraclass analyses that showed that their project managers evaluated the project results in a similar vein. In addition it was observed that the significant mediating role of team IRB in the association between mindful infrastructure variables on the one hand and perceived project progress and success on the other was supported by Sobel tests. Therefore, the hypothesis (H3) that the presence of a mindful infrastructure would be positively associated with perceived project progress and perceived project success, and mediated by team innovation resilience behaviour, was confirmed.

On the basis of the quantitative data it seems that the framework is valid. Mindful infrastructure enables innovation resilience behaviour, and innovation resilience behaviour associates positively with the outcomes perceived project progress and (expected) project results. We conclude that insights into safety and crisis management studies, i.e. HROs, are applicable to the domain of innovation management.

5.2 Discussion

Project teams in the realm of innovation can be meaningfully understood when the body of thought of safety and crisis management is applied to them. Innovation resilience behaviour and its antecedents, elements of mindful infrastructure, stemming from HRO thinking, are concepts that help to clarify the foundations of innovation management success. Team psychological safety, team learning, team voice and complexity leadership constitute a mindful infrastructure that enables team behaviour to effectively deal with critical incidents and to proactively anticipate events that could become critical. The findings of this study corroborate earlier results, which established a positive association between team mindfulness, team psychological safety and team learning behaviour on the one hand with how team members perceived the project results on the other (Oeij et al., 2016). The findings need to be replicated in larger samples of team populations in branches where innovation through project work is a key variable for organizational performance.

Limitations of the study were in the first place that the sample was too small to investigate team influence. The robustness of the constructs could not be assessed for the level of teams, because the number of respondents restricted the possibility of drawing conclusions on aggregated data to team level. The 18 projects under study might each have a different pattern of how mindful infrastructure variables enable team IRB.

In the second place some remarks about the high explained variance and correlations should be made. Although a theoretical distinction is suggested between mindful infrastructure and IRB, based on causal assumptions (time sequence of phenomena) and between the former as an organizational facilitation versus the latter as team behaviour, the concepts are not independent. The theoretical closeness of the concepts can be understood by the fact that mindful infrastructure not only contains structural features of the organization but also cultural, such as the leadership style, that HRO researchers regard as an antecedent (Vogus, 2012; Vogus & Sutcliffe, 2012). Team behaviour, on the other hand, is not only affected by such cultural features but may also, vice versa, influence the organizational culture. Reasons that explain the inflation of correlations, related to common method-bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), may also play a role; partly due to the lengthy questionnaire, respondents might be inclined to response bias and the social desirability to answer items consistently.

Thirdly, the analyses are based on a cross-sectional survey, therefore, strictly speaking, no causality can be inferred from the relation between variables. A fourth limitation is of a theoretical nature. For HROs the high sense of urgency to invest in mindful infrastructures and resilient team behaviour is obvious, as it saves lives and prevents disasters; the result of failure is directly visible. This is different for the business of innovation. The results of failure remain largely unnoticed and are, perhaps, legitimized by irate reasoning that render failures as 'normal accidents' in the vein of Perrow (1999): rather complex and for which human interventions hardly offer help to prevent. We hold that this reasoning is not valid, and that investments in organizational learning can bring down the failure rate of innovation projects.

Nonetheless, future research is needed to investigate whether the framework is also valid when it is applied to the level of teams and innovation projects by using multilevel analyses. Such studies could also consider studying how teams differ. In regression analysis the model adds up the contributions of all variables in a linear way. To distinguish different patterns of mindful infrastructures, other techniques that do not add up association effects but analyse how variables in conjunction associate with team innovation resilience behaviour, might be useful. Such techniques allow testing the assumption that different combinations of variables can all be associated with the dependent variable. Therefore the observation remains relevant that the bivariate association of all mindful infrastructure variables with team innovation resilience behaviour is present in the data set. The stipulated analyses are carried out applying qualitative comparative analysis (QCA) and findings are reported elsewhere (Oeij, Dhondt & Gaspersz, 2016; see Chapter 4).

For practitioners the results are in fact the emergence of a specific learning aim, namely to put much psychological effort and motivation in acquiring skill in the team behaviours associated with the HRO principles. Applied to an innovation project this implies balancing the expected and unexpected events (i.e. what the clients want and what they do not), to suppress confirmation bias and tunnel vision, and to overcome organizational defences. All this requires unnatural behaviour, which is effortful behaviour in situations in which individuals are naturally inclined to perform effortless behaviour. But to perform unnatural behaviour, people need to experience a sense of urgency to really become motivated and prepared to increase their effort (Kahneman, 2011).

Notes

1 Submitted as P.R.A. Oeij, T. van Vuuren, S. Dhondt & J. B.R. Gaspersz (2016), Mindful infrastructure as antecedent of innovation resilience behaviour of project teams: learning from HROs. *Innovation: Management, Policy & Practice.* This Chapter was presented as Peter Oeij, Tinka van Vuuren, Steven Dhondt & Jeff Gaspersz (2016), Mindful infrastructure as antecedent of innovation resilience behaviour of project teams at *IWOT 20 – International Workshop on Team Working. '20th edition - Team Learning and Resilience'.* Utrecht, The Netherlands, September 8-9.

2 The authors would like to thank Ernest de Vroome (TNO) for methodological advice and Fliss Bage (Proof-reading-service.com) for proofreading the English text.

Chapter 4

Mindful infrastructure as an enabler of innovation resilience behaviour in innovation teams

Based on: P.R.A. Oeij, S. Dhondt & J.B.R. Gaspersz (2016), Mindful infrastructure as an enabler of innovation resilience behaviour in innovation teams. *Team Performance Management: An International Journal*, 22(7/8), 334-353.

Mindful infrastructure as an enabler of innovation resilience behaviour in innovation teams

Abstract[1,2]

This article investigates the principles of High Reliability Organisations (HROs), present in safety and crisis teams, as applied to innovation teams. Safety and crisis teams cannot fail, as failure leads to disaster and casualties. Innovation teams cannot fail either, as this harms the organizations' competitiveness and effectiveness. Do HRO principles, rooted in mindful infrastructure, enable innovation resilience behaviour?
A study of 18 innovation projects performed by project teams was carried out. A survey by team members/leaders of these teams was completed; team members/leaders of other projects were added to achieve a larger sample. Mindful infrastructure consists of team psychological safety, team learning, complexity leadership, and team voice. The analyses assessed the teams' mindful infrastructures as a causal condition enabling innovation resilience behaviour.
Applying Qualitative Comparative Analysis (QCA), the findings indicate that mindful infrastructure enables team innovation resilience behaviour (IRB), which is a set of team behaviours indicating their resilience when encountering critical incidents. Teams apply different 'paths' to IRB.
The exploratory study's generalizability is limited. The findings nonetheless indicate the usefulness of non-linear techniques for understanding the different roads to successful innovation processes.
HRO principles are applicable by non-HROs. These require investments in organisational learning.
HRO studies fail to account for the antecedents of HRO-principles. This study groups these antecedents of team behaviour into a mindful infrastructure. QCA has not been applied within the domain of HROs before and only scarcely within the domain of innovation teams.

Key words: Innovation resilience behaviour, mindful infrastructure, team, innovation, HRO

1 Introduction: Why apply HRO principles?

Due to the continuous changes that confront companies, management is constantly faced with the need to innovate in order to remain competitive, and thus to guarantee the success of the company (Bessant & Tidd, 2007). But the literature states that, in too many cases, innovations and projects either fail or are not very successful. The failure rate of projects has averaged approximately 70% during the past two decades (Mulder, 2012). According to urban legends, the innovation failure rate is even higher - 80% or more. Castellion and Markham (2013), however, have reported that nineteen peer-reviewed research studies between 1945 and 2004 found failure rates in the range of 30-49%, depending on the industry surveyed. This, however, is still substantial.

Are there organisations that do not fail from which innovation processes can learn? High Reliability Organisations (HROs) are distinguished by their consistently near-error-free performance, despite operating in extremely complex and error-intolerant contexts, such as nuclear working in power plants, with air traffic control operations, on aircraft carrier flight decks, and as first responders (Weick & Sutcliffe, 2007). HROs are able to operate without error because they recognize that they need a workforce with the requisite skills and an organisational context that allows them to manage errors and unexpected events. Vogus and Iacobucci (2016) argue that HROs have institutionalized specific bundles of organisational practices to enhance organisational reliability. These practices enable team behaviours that result in errors being contained and prevented from becoming major disasters. Weick and colleagues have elaborated five 'principles' that are related to these team behaviours (Weick, Sutcliffe, & Obstfeld, 1999; Weick & Sutcliffe, 2007):

1. Preoccupation with failure: that is, to learn from events that seldom occur and to convert them into grounds for improvement;
2. Reluctance to simplify: that is, to restrict simplifications in interpretations in order to enlarge the number of precautions and minimize surprises;
3. Sensitivity to operations: that is, perceiving the integrated big picture of operations 'in the moment' at a higher level than the operational level, and to be sensitive and to try to catch errors as they happen;
4. Commitment to resilience: that is, anticipation of potential dangers before damage is done, the capacity to cope with unanticipated dangers after they have become manifest, and the ability to bounce back;
5. Deference to expertise: that is, to loosen the designation of who is the 'important' decision-maker in order to allow decision-making to migrate along with the problems that arise.

The development of these practices requires high investments in the selection and training of staff competences and in the organisational 'slack' in order to create space for manoeuvring, all for the sake of safety. Such investments pay off for HROs, since for HROs the trade off is against casualties and disaster; their main goal is to operate safely. For-profit organisations, those not involved in issues that carry a life or death urgency, the business case for investing in HRO-principles seems less obvious. Perhaps for organisations for which successful innovation is vital for economic survival the business case should be more compelling, as they lose a lot of money if they fail to innovate successfully (Castellion & Markham, 2013). A literature review of HRO concludes that there is evidence that HRO principles make organisations more reliable, although it says systematic, quantitative proof is lacking (Lekka, 2011). The evidence of individual cases of near error-free performance, however, is rich and persuasive (e.g. in Weick et al., 1999, Weick & Sutcliffe, 2007), and by now it can be observed that HRO-principles are slowly but surely taking effect in hospitals (Vogus & Iacobucci, 2016). But does this convince companies to improve their innovation management with HRO principles?

Weick and colleagues (1999), however, are of the opinion that HRO-principles should be treated with a sense of urgency by non-HROs as well. The sense of urgency for non-HROs should come not from the need to invest in safety, but from the need to invest in learning: "The piece that is missing in this tidy picture is that it is not just safety that costs money. Learning does too. And this is where the pragmatics of reliability and efficiency begin to blend. If we view safety as a process of search and learning, then the costs of building an infrastructure that induces mindfulness can be viewed as an investment in both learning and safety" (Weick, Sutcliffe & Obstfeld, 1999, 113–114). Having set the scene for the study, this article is structured as follows. First, the theoretical background is presented, followed by the formulation of the hypotheses. Subsequently, the research method is described, including the measures, data, and applied analysis technique, after which the results are presented. The article ends with implications and recommendations for further research.

2 Mindful infrastructure as an antecedent of innovation resilience behaviour

To transfer the insights of HROs from the crisis management and safety branches to innovation management requires the operationalization of HRO-principles to the innovation management domain. The main assumption of this study is that those HRO team behaviours are beneficial to innovation teams as well, for which we coined the term 'innovation resilience behaviour' (IRB) (Oeij, Dhondt, Gaspersz & de Vroome, 2016). IRB is a set of team behaviours that can help a team to detect signals that a project is getting off-track with regard to its innovation goal, and to bounce back on the right track after having chosen an ineffective course or experienced a mishap.

What form do the five HRO principles take when applied to project teams working on innovation? Preoccupation with failure for innovation teams implies a constant alertness to 'weak signals' that can get a project off-track. Reluctance to simplify concerns the innovation team's ability to systematically acquire fact-based data for funded, validated decision-making. Sensitivity to operations refers to continuously linking events and interactions at the team level with the organisation as a whole, and the relevant internal and external stakeholders, to attune the micro level (individual) situational awareness with these meso- and macro-situational (team and organisational) awareness. Commitment to resilience is the competency to act and be resilient when needed. Deference to expertise is an organisational rule to defer decision making to experts irrespective of their hierarchical position.

Weick et al. (1999), Weick and Sutcliffe (2007), Vogus (2012), Vogus and Sutcliffe (2012), and Vogus and Iacobucci (2016) have all argued that reliability and safety are a consequence of 'organising', the process of interaction between persons that constitute sense and meaning, and, in this case, a collective capability for detecting and correcting errors and unexpected events. Therefore, they speak of 'mindful organising'. Organising is thus preceding team IRB. . If IRB is the team behaviour to deal with unexpected events, what are the antecedents of this team behaviour? From her study of the literature on HROs, Lekka (2011) made a mind map of HRO-characteristics, pointing to possible antecedents of IRB. Three of these characteristics are that HROs:

1. Foster strong learning,
2. Just cultures, and
3. Have 'mindful' top-leaders.

The learning orientation is characterized by continuous (technical) training, root cause analysis of incidents, open communication, and of reviewing procedures in line with the organisational knowledge base. Therefore, team learning (Edmondson, 1999) - the on-going process of reflection and action, by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions - is seen as a relevant antecedent of IRB.

A just culture refers to a culture in which the staff is not punished for actions, omissions, or decisions taken by them which are commensurate with their experience and training, but where gross negligence, wilful violations, and destructive acts are not tolerated. A just culture coincides with two team elements, namely team voice and team psychological safety. Voice refers to intentionally expressing relevant ideas, information, and opinions about possible improvements, even when others disagree (LePine & Van Dyne, 2001). Team psychological safety is the shared belief that the team is safe for interpersonal risk taking, and suggests a sense of confidence that the team will not embarrass, reject, or punish someone for speaking up, which implies that there is mutual respect and trust (Edmondson, 1999).

'Mindful leadership' in HROs points to leaders who encourage the communication of 'bad news' and the proactive investigation of organisational flaws, and who balance the pressures of production and business with safety. Complexity leadership can connect such seemingly contradictory goals. Therefore, complexity leadership is another antecedent of IRB that enables leadership behaviour that is aligned with situational needs, and that encompasses different styles; it is a competitive, cooperative, creative, and controlling style (Lawrence, Lenk, & Quinn, 2009).

Team psychological safety, team learning, team voice, and complexity leadership are regarded as antecedents of IRB. For example, Vogus (2012) has explained that psychological safety is a function of management decisions to support front-line actions - in his words "a function of leader behaviours and discursive practice" that facilitate this - and, as such, belongs to "potential antecedents of mindful organizing rather than analogies of it" (Vogus, 2012, 667). He argues in the same vein regarding safety climate.

The four antecedents are enablers of IRB. These antecedents fall somewhere between structure and culture, and incorporate both structural organisational design elements and organisational behavioural norms. It is the type of characteristics for which Brown and Eisenhardt suggested the term semi-structure. Semi-structures are a combination of order, prescriptions, and rules (structure), and the decision latitude to move freely and make autonomous choices and decisions. Semi-structures "exhibit partial order, such that some aspects are prescribed and others are not" (Brown & Eisenhardt, 1997, 28). The term applied here for that type of semi-structure is 'mindful infrastructure', defined as the organisational capacity to anticipate unexpected problems and the capacity to contain such problems, by enabling organisation members to act accordingly. Therefore mindful infrastructure is an organisational attribute, while innovation resilience behaviour is an attribute of humans.[3]

Mindful infrastructure ensures a social-relational context of respect and trust, which encourages people to speak up and question interpretations, and counteracts tendencies to act defensively, due to feelings of threat, discomfort, or feelings of incompetence (Sutcliffe & Weick, 2013). Apart from trust, team members must pay attention to the interrelating of their activities through heedful interrelating - a shared pattern built on individual actions in which individuals understand how their actions fit into the larger action and the mechanism of the system as a whole (Weick & Roberts, 1993; Sutcliffe & Weick, 2013). Mindful infrastructure is a necessary but not sufficient condition for IRB. "That infrastructure must be organised and enacted through conduct that enables organisational members to recognise emerging problems earlier and to manage them more decisively" (Sutcliffe & Weick, 2013, 151). Thus, managing innovation projects by teams should establish team behaviours that are aimed at the five principles in order to anticipate critical events and to deal with them resiliently.

Hypotheses

In an earlier study (Oeij, Dhondt, Gaspersz & de Vroome, 2016), indications were found that project teams reported a positive correlation between perceived project results and the presence of team mindfulness, team psychological safety, and team learning behaviour. This led to the assumption that a mindful infrastructure can improve innovation projects, in the sense that such infrastructure suppresses risk-avoidance and defensive behaviours. This study aims to further investigate this assumption, and therefore addresses the question of whether the presence of mindful infrastructure facilitates innovation resilience behaviour, and what it is that constitutes mindful infrastructure. Following Weick et al. (1999) it is assumed that non-HRO organisations in innovation environments also feel the urgency of acting mindfully, be it in a different kind of way.

Teams that are responsible for innovation are under pressure to achieve results. An atmosphere of psychological safety and learning allows team members to make mistakes without being punished, to explore and to experiment - it builds trust (Edmondson, 1999). Complexity leadership enables a team and/or its leader to effectively deal with mixed messages, opposing logics, and seeming incompatibilities. A team with complexity leadership tries to look for synergy instead of choosing cost effectiveness, which is detrimental to innovative solutions (Lawrence, Lenk, & Quinn, 2009). Team voice encapsulates organisational politics and enhances problem ownership among team members, and it improves the constructive approach of diverse stakeholder interests (LePine & Van Dyne, 2001). Mindful infrastructure thus facilitates risk taking, helps organisations recover from mistakes, provide space for experimentation, facilitate ways to communicate and cooperate constructively, and to avoid defensive behaviour (Weick & Sutcliffe, 2007; Sutcliffe & Weick, 2013). Overall, mindful infrastructure creates an environment that consistently enables team innovation resilience behaviour (team IRB).

Based on this discussion, we expect that:

- H1: if innovation teams have mindful infrastructure, this will enable innovation resilience behaviour.

Innovation is a multi-causal phenomenon that is affected in many different ways. Teams working on innovations will differ in their internal dynamics as well. From the innovation literature it is well known that there are many organisational and team leverage factors for success (e.g., Bessant & Tidd, 2007), but it is impossible to predict with certainty which combination thereof will lead to success. Research (Jacobs & Snijders, 2008) has demonstrated that several combinations can be effective. Therefore:

- H2: if innovation teams show innovation resilience, this may be caused by different combinations of elements that constitute mindful infrastructure in varying ways (equifinality).

Teams can address issues in different ways, and how they do it is contingent on many factors. Problems are sometimes solved by strong guiding leadership, and sometimes by giving the team space to experiment. On other occasions solutions are developed through democratic dialogue, while in other situations a top-down approach proves to be successful. This implies that, in order for innovation resilience behaviour to emerge, there are no particular necessary conditions that can be determined beforehand. Necessary conditions imply that such conditions must be present in order for an outcome to emerge. Because no particular necessary condition constitutes mindful infrastructure, it is expected that multiple paths lead to innovation resilience behaviour. Multiple paths, however, do not imply that 'anything goes'. Some paths may be more likely to work than others, and that is exactly what this study is about. Namely, to explore possible paths and build knowledge about what the boundaries are of combinatory possibilities.

- H3: Mindful infrastructure that results in innovation resilience behaviour will not require any of its variables - team psychological safety, team learning, leadership styles, and team voice - to be present as a necessary condition.

In the study, mindful infrastructure is regarded at the level of a team. Thus, the research investigates whether (elements of) mindful infrastructure are present or absent at the team level, regard it as an organisational capability at the team level, and investigates how this affects innovation resilience behaviour as a form of team behaviour, not as a form of individual behaviour. The term team dynamics is employed to point to the interactions between team members, which have causes and consequences of their own, which we do not intend to specify in this contribution.

3 Research method

3.1 Measures

Mindful infrastructure was measured with four constructs, namely team psychological safety, team learning behaviour, behavioural complexity in leadership, and team voice.

Team psychological safety and *team learning behaviour* were measured by scales developed by Edmonson (1999) and were also used in our pre-study (Oeij, Dhondt, Gaspersz & de Vroome, 2016). Respondents were asked to evaluate statements on both topics on a 5-point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (5).

Behavioural complexity in leadership is based on the 'competing values framework' and is defined by two dichotomous (competing) values: flexible versus stable structure and internal versus external focus. Together they result in four theoretical quadrants of leadership behaviours: collaborate, compete, control, and create (Lawrence, Lenk, & Quinn, 2009). Several styles can be present simultaneously. The four complexity leadership styles, comprising 36 items, were measured by asking respondents how skilled they assessed themselves or their project leader to be in these aspects on a 5 point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (5).

Team voice measures the participation of team members by examining voice and helping and to what extent team members have a say in daily routines. We used the voice-scale developed by Van Dyne and LePine (1998), with which respondents evaluate statements on a 5 point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (5).

Team Innovation resilience behaviour, in short team IRB, was measured by a short version (18 items) of the five Audits of Resilient Performance by Weick and Sutcliffe (2007, 94–102), partly based on an empirical application of said audits by Ray, Baker and Plowman (2011, 201), who developed one singular instrument from the five audits into their 'measure of organizational mindfulness'. The scale was made context-specific for teams, and respondents were asked to what extent the five HRO-principles were present in their project team on a 7-point scale ranging from 'not at all' (1) to 'to a very great extent' (7). The five HRO-principles are: preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience, and deference to expertise.

3.2 Data

The analysis presented is part of a study in which 18 innovation teams were interviewed face-to-face and whose team members and project leaders completed an Internet survey. Project leaders are here equivalent to team leaders. The survey scores of the team members and their leader were aggregated to team level sum scores. The teams had on average 5,9 responding members (min. 3; max. 16). The 18 teams were each responsible for an innovation - that is, the development or implementation of a new or improved product, service, or working method. Fourteen teams came from private companies and four from non-private organisations; six teams were from an organisation with a dedicated R&D department, and twelve teams carried out the innovation as part of a market assignment, as part of a commercial project. The main criterion for the selection of the teams was theory-driven, namely to generalize towards theory and not towards populations of teams or branches. For the purpose of theoretical exploration the number of teams can be limited (Ragin, 2008). Teams had to be working on innovations in a project-based type of organisation.

The total number of responses to the survey was 260 fully completed questionnaires, of which 101 were respondents who were participating in the 18 teams. The response rate of the teams was high (M=94%; min. 67%, max. 100%). The 159 remaining respondents that did not belong to the 18 teams were from the same organisations but were working in other teams or on other projects than the 18 teams being studied (the overall response rate, including respondents not belonging to the 18 teams, was 65%). For this reason, there was a large enough group to perform multivariate analyses at an aggregated level, namely the preparatory analyses of the measures (e.g., reliability analysis). The process of researching the hypotheses was carried out at the level of the 18 teams.

Table 1 presents descriptive statistics at the level of the whole response group, from which can be seen that the Cronbach's Alpha for the scales *team psychological safety* (0.67) and *team learning behaviour* (0.66) were not fully satisfactory, according to the usual threshold of 0.70 (Nunnally, 1978). Deleting items that show lower inter-item correlations hardly improved the Alpha scores. Since these scales by Edmonton (1999) have been used in so much other research and the scores, when rounded off, were within the threshold limits, we decided to not change the scale composition for this exploratory analysis.

Table 1 Descriptives, means, correlations, alpha scores of respondents (N=min. 232, max. 260)

Variables	Mean	Standard deviation	N	Team Innovation Resilience Behaviour	Team voice	Team Psychological Safety	Team Learning Behaviour	Leadership Collaboration	Leadership Creativity	Leadership Control	Cronbach's α
Team Innovation Resilience Behaviour (18 items; 1=not at all - 7=to a very great extent)	4.82	.854	232								.926
Team voice (6 items; 1=strongly disagree - 5=strongly agree)	3.90	.543	238	.496**							.849
Team Psychological Safety (7 items; 1=strongly disagree - 5=strongly agree)	3.98	.479	260	.399**	.432**						.667
Team Learning Behaviour (7 items; 1=strongly disagree - 5=strongly agree)	3.38	.498	260	.478**	.490**	.455**					.664
Leadership Collaboration (9 items; 1=strongly disagree - 7=strongly agree)	.369	.551	210	.356**	.308**	.310**	.320**				.823
Leadership Creativity (9 items; 1=strongly disagree - 7=strongly agree)	3.77	.610	231	.357**	.375**	.330**	.437**	.506**			.865
Leadership Control (9 items; 1=strongly disagree - 7=strongly agree)	3.68	.569	236	.475**	.299**	.220**	.188**	.449**	.339**		.844
Leadership Competition (9 items; 1=strongly disagree - 7=strongly agree)	3.47	.579	227	.314**	.185**	.148*	.167*	.197**	.485**	.481**	.825

Note: ** Correlation is significant with p<.01 (2-tailed); * significant with p<.05 level (2-tailed).

3.3 Method: Qualitative Comparative Analysis (QCA)

There were two reasons why qualitative comparative analysis (QCA) was used to analyse the data.[4] First, from a theoretical perspective, it is stated that the team dynamics in innovation teams are multi-causal and that the same outcomes of team dynamics can be caused by different combinations of variables (equifinality). QCA tackles the problem because it is based on Boolean algebra, which enables us to assess the presence and absence of variables in order to explain a phenomenon (an 'outcome'). Cases, here the teams with projects, have either 'set-membership'

(1) or 'non-set membership' (0) in an 'outcome' variable. They are, for example, either 'in the set' or 'out of the set' of teams with innovation resilience behaviour. With this 'set-theoretic approach,' cases are analysed based on how they score on combinations of variables ('configurations').[5] Second, the limited number of cases (18 teams) does not allow the application of conventional multivariate statistics, as this will not lead to reliable, significant results. QCA can solve that problem, as it is equipped to be applied to small-N samples. With QCA one can research minimally sufficient variables and maximally necessary variables that explain phenomena with a limited number of cases.

Using the software of fsQCA (fuzzy set QCA) (Ragin et al., September 2008), the QCA analysis follows four steps in order to analyse which combinations of variables[6] are explaining the presence of IRB (Ragin, 2008). What fsQCA does is to calculate the necessity and sufficiency of the elements ('conditions') in the possible combinations of the seven variables that have IRB as an outcome.

Step 1 - Calibration: In fsQCA the original data must be transformed into an interval scale (ranging 0 = non-membership to 1 = full membership) using the 'calibration method' (Ragin, 2008). First, the values for the anchor points (.05, .5, and .95) must be determined. The fsQCA programme calculates new values for the scores, unless researchers choose to set them manually. Anchor points can be re-calibrated on the basis of substantial, theoretical arguments, e.g., after inspecting the cases. This is applied to team innovation resilience behaviour 'calibrated' (IRBC). Often, as we did, anchors are set using the 25th, 50th and 75th percentiles of each variable separately.[7] This is justified by the notion that for this explorative study we lack the theoretical or in-depth knowledge to do otherwise. Before the calibration, the mean distributions were checked for normality with the One-Sample Kolmogorov-Smirnov Test, which indicated that all but one variable were distributed normally (Annex Table 1). Next, the threshold values of the variables (uncalibrated or raw scores) for all 18 cases were calibrated.[*] QCA demands that the researcher moves back and forth between theory and data in order to retain the value of 'thick case descriptions' for the analysis. An inspection of the calibrated data led to the threshold for IRB being adjusted (manual recalibration); a re-inspection of the qualitative data (from the face-to-face-interviews) led to the decision to include three cases in the set-membership of IRB (Teams 02, 04, 18, see 'Legend'). After analysing the team scores on the other construct variables, there was no reason to recalibrate any of those.

Step 2 - Analysis of necessary causal conditions: Necessary conditions are variables that should always be present for the outcome to occur. That is, if the outcome is present, so is that condition, and if the condition is absent, the outcome is absent as well. In order to see whether the outcome had necessary conditions, a necessity analysis was performed with all the condition variables, for which a conservative consistency threshold of 0.90 was used (Schneider & Wagemann, 2012, 143; see also Ragin, 2008). The results of the analysis of necessary conditions showed that the consistency scores of all variables were even below .80, meaning that none of the conditions were a necessary condition for IRB to emerge.[8] This confirms H3.

[*] Tables containing uncalibrated and calibrated dataset, consistency values of causal conditions, and are (partial) truth table available on request by the authors [see Appendix of this Chapter: Annex Table 2 and 3].

Step 3 – Truth table analysis of sufficient causal conditions: A truth table consists of all the possible combinations of the seven condition variables (2^7 = 128 combinations)[9]. If all 18 cases were assigned to a unique combination (configuration or causal path) there would be at least 110 'empty' configurations ('logical remainders'). First, in each row the truth table analysis presents all the theoretically possible combinations of causal conditions that may lead to the outcome. All the (18) cases are assigned to logical configurations. For each path, the software calculates consistency and frequency scores. The theoretically suggested threshold to drop a case (from further analysis) is the 0.75 consistency value. Consistency is the proportion of cases that display the outcome, due to the fact that these cases reflect a consistent score on the combination of variables that together result in the outcome (the presence of IRB). By default, paths are included in further analyses by the software when there is at least one observed case for that path. The researcher studies the solutions presented and chooses the best solution. The purpose is for consistent paths to remain in the final solution. Six of the 18 cases were inconsistent and discarded by the software. For these cases there were no plausible, logical paths. The remaining rows represent sufficiency for the outcome: the combination of variables in this row suffices for IRB to emerge. In this step the software presents the solution with the least number of variables to be sufficient for the outcome, and best to interpret, the so-called intermediate solution.

Step 4 – Finalising solutions: The final step in the analysis is to select and interpret plausible solutions (configurations, paths) that lead to outcomes and to conclude which cases correspond to certain solutions. The aim is to find the solutions with the highest coverage score (cover as many empirical cases as possible, similar to explained variance), the highest consistency score, and the minimum possible number of conditions (most parsimonious solution). This solution will be interpreted in the results section.[10]

This study is exploratory and investigates which combinations of variables appear in the solutions. It is plausible that the interaction of the variables will produce multiple solutions. Therefore, a robustness analysis with a linear regression will be performed to show that linear techniques do not lead to multiple solutions, and thus cannot unveil the variegated reality (Vis, 2012).

4 Results

Table 2 showed eight configurations that are associated with team innovation resilience behaviour. The model consistency is high (0.96) and the solution coverage (0.76) indicates that 76% of the cases are covered by the model. Path 1 and path 4 are the most consistent paths (0.97 consistency). Path 4 is the most interesting path, as it represents most cases (3) and has the highest unique coverage, which means its contribution to the model solution is the largest. This means that team innovation resilience behaviour appears most often when team voice, team learning, and all four leadership styles (compete, create, control, collaborate) are present.

Table 2 Configurations explaining Team Innovation Resilience Behaviour (intermediate solution)

Solution	Casual conditions							Descriptives			
	Team voice	Leadership competition	Leadership control	Leadership creativity	Leadership collaboration	Team learning	Team psychological safety	Raw coverage	Unique coverage	Consistency	Number Cases >0.5 membership
1	●	●	○	●	○	●		0.143396	0.022642	0.974359	2
2	●			○	●	○	●	0.139623	0.086793	0.942675	2
3	●		○	●	○	●	●	0.173585	0.083962	0.934010	2
4	●	●	●	●	●	●		0.319811	0.221698	0.971347	3
5	○	●	●	○	○	○	○	0.122642	0.051887	0.902778	1
6	○	●	○	○	●	○	○	0.079245	0.003774	0.875000	1
7	●	○	○	○	●	●	○	0.100943	0.057547	0.922414	1
8	○	●	●	●	○	○	●	0.100943	0.045283	0.946903	1
Model	Solution coverage: 0.763208										
	Solution consistency: 0.960808										

Model: IRBc = f(tvoicec, leadcomc, leadcontc, leadcrec, leadcolc, tlearnc, tpsysafc)

Applied consistency cut-off value: 0.875000; rows is 12 [12 cases are within the cut-off value; the other 6 are discarded from further analysis]

Raw coverage: proportion of cases covered in the outcome by a (combination of) condition(s)

Unique coverage: proportion of cases covered in the outcome by a (combination of) condition(s) to that path

* =AND, ~=negated, indicating the 'absence' of a condition (versus 'presence' in a solution)

Consistency: proportion of cases within the configuration [(combination of) condition(s)] that display the outcome, i.e. reflect a consistent score on the [(combination of) condition(s)] that result in the outcome.

The other seven solutions or configurations will also enable IRB, but follow another path; they contain another combination of elements that constitute their mindful infrastructure. In paths 5, 6, and 8, for example, we can see that *team voice* is absent, but that does not lead to the absence of IRB; likewise, in paths 5, 6, and 7 *team psychological safety* is absent, but still IRB is enabled, which means that other conditions compensate for the absence of *team psychological safety*. All other paths, besides path 4, signify the absence of one of more leadership styles, yet this is not to the detriment of IRB being enabled. This implies, based on the limited number of studied cases, that:

- There is no one best way to design mindful infrastructure that enables IRB (equifinality - H2);
- Teams with the same purpose can follow different strategies (organisational choice); there are no necessary conditions (H3);
- Mindful infrastructures are always constituted out of more than one element, as there are no sufficient conditions.

All twelve cases† were successful in achieving IRB.[11] Out of the 128 theoretical combinations of conditions, eight paths resulted in IRB. These eight paths can be said to be more plausible than the others, based only on the 18 cases in the analysis. Should more cases be included in the analysis, it is expected that the re-emergence of those eight paths have a higher possibility than the others, but at the same it is plausible that extra paths will emerge as well. Part of the relevance of this exploratory study is that multiple solutions appear and that this is plausible given that complex innovation projects and team dynamics guarantee the interplay of many factors. Multiple solutions for favourable outcomes are therefore commonsensical. In principle there is room for strategic choice.

Linear regression analysis was performed as a robustness test, with the same variables as in the QCA. Applying the backward elimination procedure (because it is an explorative analysis), the results showed that conventional statistics, looking for symmetry, identified only one "path" of variables; they therefore do not produce the multiple outcomes that are more commonsensical to complex projects and team dynamics.[12]

The QCA analyses resulted in a model with high consistency and coverage scores. H2 is supported, as the twelve innovation teams applied eight different paths to achieve IRB. Equifinality means that different configurations can result in the same outcome. H3 states that there are no necessary conditions present for IRB to emerge, which proved to be the case. Combinations of differing variables were sufficient to achieve the outcome, and there is no condition variable that is present in all configurations.

5 Discussion: What do the paths reveal about the cases?

In the study, eight combinations of variables constituting mindful infrastructure ('configurations' or 'paths') proved to be consistent with explaining the presence of team innovation resilience behaviour. Consistency means that cases exhibiting a given combination of causal conditions also exhibit the outcome of interest.[13] Interestingly, teams chose different combinations of mindful infrastructure elements and yet, all 12 teams achieved IRB. The findings are summarized in Table 3, which depicts the same eight paths to innovation resilience behaviour in a way different from Table 2 (see 'solutions' in column 1).

† Table 2 and 3 show 13 cases based on 12 teams. The reason is that one team fits in two paths (namely 1 and 3) and is counted twice by the software.

Table 3 Mindful infrastructure elements leading to innovation resilience behaviour

Solutions (paths)	Elements of mindful infrastructure		Cases
	Present	Must be absent	
1. Team dependent goal-orientedness	Team voice Team learning Leadership compete Leadership creativity	Leadership control Leadership collaboration	2
2. Trusted and focused team work	Team voice Team psychological safety Leadership control Leadership collaboration	Team learning Leadership creativity	2
3. Team driven resourcefulness	Team voice Team psychological safety Team learning Leadership creativity	Leadership control Leadership collaboration	2
4. Team-minded and balanced leadership	Team voice Team learning Leadership compete Leadership control Leadership creativity Leadership collaboration		3
5. Goal and task driven leadership	Leadership compete Leadership control	Team voice Team psychological safety Team learning Leadership creativity Leadership collaboration	1
6. Goal and process driven leadership	Leadership compete Leadership collaboration	Team voice Team psychological safety Team learning Leadership control Leadership creativity	1
7. Team-minded collaboration	Team voice Team learning Leadership collaboration	Team psychological safety Leadership compete Leadership control Leadership creativity	1
8. Goal driven problem solving	Team psychological safety Leadership compete Leadership control Leadership creativity	Team voice Team learning Leadership collaboration	1

Each path can best be understood looking at a significant part of the innovation process of the teams, namely the occurrence of critical incidents and critical recoveries during the project. These critical incidents and recoveries were events during the project that were either associated with setbacks or resilience (Oeij, Dhondt, Gaspersz & Van Vuuren, 2016). How the teams dealt with critical incidents is of interest, as it gives insight into their innovation resilience behaviour. Did they overcome these critical incidents, and if so, how?‡ By way of showing how paths can be meaningfully interpreted with in-depth case study data, one example of a case of path 4 will be presented.[14]

The path of 'team-minded and balanced leadership' (4) reflects the presence of all four leadership behaviours (compete, control, create, collaborate), with teamwork featuring ample opportunities for learning and voice. Three teams chose this path, of which team 07 will be described. Team 07 was a project team in an R&D department that deploys hair products. The team experienced a cluster of critical incidents that interacted with each other. The innovation team worked with a client from abroad for whom the new hair products were extremely crucial to keeping its market share; within their own organisation the R&D-teams had to deal with differing interests from other departments, like local test sites (located abroad), marketing & sales, but also management. A process of restructuring and changing positions within management caused unrest. These external factors caused delays. The critical recovery consisted of constantly being alert and monitoring the process and anticipating what may come. The project leader put much effort into communicating with all stakeholders (leadership collaborate) and closely monitored arrangements, research results, and personal relations (leadership control). With her team she anticipated the desires of the clients and stakeholders (leadership creativity and collaboration) and together they developed new ways of meeting these demands (team voice, team learning, leadership creativity).

6 Conclusions and implications

In conclusion, it can be observed that mindful infrastructure enables team innovation resilient behaviour (confirmation of H1) and that several paths of varying combinations of mindful infrastructure elements lead to team innovation resilience behaviour (confirmation of H2, about equifinality). Their differences imply that different paths can have similar results. There is room to choose what to do as an organisation to achieve IRB.[15]

Despite the different paths to IRB, the number of viable options when composing a mindful infrastructure seems limited, given that, in this sample, eight paths were consistent with the outcome and 120 were not. The way in which an innovation team becomes innovation resilient may differ. Projects have their own unique path dependencies, stakeholders, market conditions, team resources, and so on, which make innovation trajectories multifaceted. In designing teams and projects it is important to note that none of the seven elements of mindful infrastructure are a

‡ Annex Table 2 presents the average sum scores by each team on the variables that are included in the QCA-analysis, namely team innovation resilience behaviour (the outcome variable), team psychological safety, team learning, team voice, and the leadership behaviour sub scales collaborate, create, control and compete. Due to lack of space here, the eights paths and cases are described more elaborately in the forthcoming PhD. thesis of the first author. Six of the twelve teams had lower values than the threshold value of team IRB and had no set membership in the group of cases where IRB was present (Teams 02, 03, 05, 10, 11, 13). Five of these six teams, namely, have lower than average scores on five or six of the seven condition variables: their mindful infrastructure was rather weak (see Annex Table 2).

necessary condition per se (confirmation of H3). Necessity would mean that certain elements must be present in order for innovation resilience to emerge. At the same time, one can state that none of the seven elements alone is a sufficient condition for innovation resilience to be enabled. There must always be a number of variables acting in conjunction to enable innovation resilience.[16]

Some limitations of the study are that:
1. The room for making generalizations to populations remains limited (though the goal is to generalize not to populations but to theory (Ragin, 2008));
2. The sample of innovation teams and their projects was not homogeneous, which meant that many factors could not be held constant (innovation resilience behaviour can be affected by other factors as well); and
3. Although fsqca does not aim to express the contribution of individual causes to the outcome, as betas do in regression analysis, further research is needed in large-scale datasets to confirm the associations found in this study.

The main contribution of this study is the application of theoretical concepts from safety and crisis management to the domain of innovation management. The research supports empirically the claim that mindful infrastructures enable innovation resilience behaviours in teams responsible for an innovation or improvement. The six teams that were out of the 'set' of teams with high team innovation resilience behaviour scored relatively low on the means of the constituting variables of mindful infrastructure. It seems plausible that the level of urgency to invest in innovation resilient behaviour is not always present. Safety and crisis management teams have obvious reasons. Such reasons seem far removed from innovation teams, unless their organisations take a longer term perspective. Weick et al. (1999) has namely suggested that non-HROs would do well to invest in organisational learning, as this will enhance the organisation's innovative capability in general. In elaborating this argument, we add that non-HROs carrying out innovation projects could consider job and organisational interventions to enhance competencies and possibilities for mindful team behaviour. The conditions for innovation resilience are largely embedded in how work is organised, either within the (team) tasks of jobs (autonomy, skills, voice) or in the semi-structure (leadership, trust, organisational slack) that enable resilient behaviours. The practical advice would be to better integrate organisational design with how to develop mindful infrastructures. The appropriate organisation attunes organisational structure to innovative behaviour, bearing in mind that "Too little order and structure may be as bad as too much" (Bessant & Tidd, 2007: 432-433).

A final contribution is that the QCA method can be applied to address social phenomena that are 'causally complex' in a coherent, sense-making, and meaningful way, and as such is in accordance with how people experience reality (Stacey, 2010). Maybe outcomes cannot be predicted completely, but this study hopes to provide insights that serve as a guide to making teams more resilient. Moreover, this contribution is among the first wave of research that has applied QCA in the domain of innovation management.

Appendix 1

Legend (team numbers and the team acronyms): see Appendix 3 of this thesis

Table 1: Descriptives, means, percentile scores, and K-S test of *teams* (N=18)

Descriptives of causal and conditional variables					Percentiles			Normality K-S test (+)
Variable	Mean	SD	Min	Max	25%	50%	75%	
IRB Innovation Resilience Behaviour#	4.86	0.40	3.96	5.61	4.65	4.93^	5.09	.119
TVOICE Team voice	3.88	0.23	3.44	4.42	3.69	3.88	4.06	.104
TPSYSAF Team psychological safety	3.99	0.23	3.68	4.52	3.81	3.91	4.15	.172
TLEARN Team Learning	3.36	0.32	2.86	4.10	3.05	3.38	3.56	.091
LEADCOL Collaborate leadership	3.78	0.33	3.12	4.61	3.65	3.74	3.93	.218*
LEADCRE Creativity leadership	3.80	0.38	3.17	4.51	3.47	3.74	4.11	.121
LEADCONT Control leadership	3.65	0.45	2.72	4.61	3.29	3.57	3.91	.117
LEADCOM Compete leadership	3.47	0.41	2.61	4.29	3.12	3.56	3.73	.155

(+) One-Sample Kolmogorov-Smirnov Test, *p<.05 (N=18); # equivalent to Team IRB (Team Innovation Resilience Behaviour) throughout the thesis; ^ threshold value changed into 4.80

Table 2: Team scores on main model variables: means (by team members and project leader of the 18 teams)

Team	IRB	TPSYSAF	TLEARN	LEADCOL	LEADCRE	LEADCONT	LEADCOM	TVOICE
Range	1-7	1-5	1-5	1-5	1-5	1-5	1-5	1-5
Team02	4.32	3.74	3.07	3.67	3.32	3.58	3.00	3.74
Team03	4.31	3.81	3.00	3.65	3.49	3.53	3.14	3.67
Team09	5.15	3.68	3.54	3.92	3.69	3.31	3.04	3.95
Team10	4.68	3.71	3.49	4.16	4.04	3.54	3.29	3.85
Team11	4.75	3.98	3.57	3.95	4.27	3.22	3.57	3.62
Team01	5.13	3.86	3.71	3.91	4.16	3.86	3.66	4.07
Team16	4.94	3.90	3.16	3.19	3.40	3.89	3.87	3.81
Team06	4.81	3.89	3.25	3.74	3.69	3.56	3.56	3.67
Team05	4.56	3.86	2.86	3.77	3.33	3.89	3.19	3.69
Team07	5.39	4.33	3.71	4.61	4.51	4.61	3.85	4.00
Team04	4.83	3.80	3.46	3.73	4.09	3.51	3.89	3.90
Team13	3.96	4.08	2.92	3.12	3.17	3.13	2.98	3.44
Team14	5.00	3.92	3.29	3.74	3.69	3.74	3.56	4.05
Team18	4.91	4.16	3.37	3.64	4.06	4.14	4.29	3.81
Team17	5.07	4.14	3.00	3.92	3.64	3.97	3.36	4.10
Team15	5.61	4.29	3.55	3.95	3.87	4.26	3.69	4.42
Team08	5.01	4.14	3.39	3.65	3.78	3.23	3.66	3.96
Team12	5.00	4.52	4.10	3.63	4.28	2.72	2.61	4.11

Table 3: Calibrated dataset [not published in *Team Performance Management*]

Team	IRBc	TPSYSAFc	TLEARNc	LEADCOLc	LEADCREc	LEADCONTc	LEADCOMc	TVOICEc
Team01	0	0.01	0.06	0.09	0.01	0.52	0.02	0.1
Team02	0	0.05	0.03	0.05	0.06	0.39	0.05	0.04
Team09	0.97	0	0.94	0.94	0.36	0.06	0.03	0.76
Team10	0.08	0	0.86	1	0.92	0.42	0.14	0.38
Team11	0.27	0.71	0.96	0.96	0.99	0.02	0.54	0.02
Team01	0.97	0.18	1	0.94	0.97	0.93	0.85	0.96
Team16	0.81	0.43	0.12	0	0.02	0.94	1	0.25
Team06	0.53	0.35	0.23	0.51	0.36	0.47	0.51	0.04
Team05	0.01	0.18	0.01	0.62	0.01	0.94	0.07	0.05
Team07	1	0.99	1	1	1	1	0.99	0.88
Team04	0.58	0.04	0.79	0.42	0.94	0.34	1	0.58
Team13	0	0.89	0.02	0	0	0.01	0.02	0
Team14	0.89	0.53	0.31	0.51	0.36	0.82	0.51	0.94
Team18	0.76	0.96	0.48	0.03	0.93	0.99	1	0.25
Team17	0.94	0.95	0.03	0.94	0.25	0.97	0.2	0.98
Team15	1	0.99	0.94	0.96	0.74	1	0.91	1
Team08	0.9	0.95	0.54	0.05	0.58	0.03	0.85	0.79
Team12	0.89	1	1	0.02	0.99	0	0	0.98

Note: A ‘c’ is added by the software to each variable after ‘calibration’
The uncalibrated dataset (‘raw scores’) is similar to Annex Table 2.

Table 4: Consistency of the necessity of causal conditions [not published in *Team Performance Management*]

Causal conditions for IRBc	Consistency values for necessity
TPSYSAFc	0.69
TLEARNc	0.70
LEADCOLc	0.63
LEADCREc	0.68
LEADCONTc	0.69
LEADCOMc	0.69
TVOICEc	0.79
TCLIMc	0.75

Threshold Consistency value for necessity 0.90
(note: TCLIMc was included to check on necessity, which is not the case (see endnote 8)).

Table 5: Truth table (partial) [not published in *Team Performance Management*]

TPSYSAFc	TLEARNc	LEADCOLc	LEADCREc	LEADCONTc	LEADCOMc	TVOICEc	Number cases	Outcome TIRBc	Raw consistency	PRI consistency	SYM consistency
1	1	1	1	1	1	1	2	1	0.982979	0.980100	0.980099
0	1	0	1	0	1	1	1	1	0.962617	0.866667	0.866667
1	1	0	1	0	1	1	1	1	0.959596	0.931034	0.931034
1	0	0	1	1	1	0	1	1	0.946903	0.823530	0.823530
0	1	1	1	1	1	1	1	1	0.946237	0.909910	0.909910
1	0	1	0	1	0	1	1	1	0.939189	0.926229	0.926229
0	1	1	0	0	0	1	1	1	0.922414	0.883117	0.883117
1	1	0	1	0	0	1	1	1	0.913907	0.877358	0.958763
1	0	1	0	1	1	1	1	1	0.911765	0.869565	0.869565
0	0	0	0	1	1	0	1	1	0.902778	0.730769	0.730769
0	0	1	0	0	1	0	1	1	0.875000	0.250000	0.250000
1	1	1	1	0	1	0	1	0	0.701923	0.031250	0.031250
0	1	1	1	0	0	0	1	0	0.641026	0.282051	0.282051
0	0	1	0	1	0	0	1	0	0.496644	0.038462	0.038462
1	0	0	0	0	0	0	1	0	0.375000	0.047619	0.047619
0	0	0	0	0	0	0	1	0	0.358974	0.038462	0.038462
0	0	0	0	1	0	0	1	0	0.338462	0.022727	0.022727

Appendix 2 What do the paths reveal about the cases?

[not published in Team Performance Management]

1. Team-dependent goal orientedness

There are two cases that use the same path to IRB, consistently showing the same combination of variables in their strategies to innovation resilience behaviour (Technically phrased 'team dependent goal-orientedness' states that 97 percent of the companies with the characteristics of team voice, compete leadership, the absence if control leadership, create leadership, the absence of collaborate leadership and team learning in conjunction, are members of the set 'teams with team innovation resilience climate'), namely the innovation team of an ICT consultancy firm – Team04) - and of a learning and training organisation specialising in organisational change and change management - Team08.

Team08 is a training firm for change professionals and their project entailed developing a MOOC, or massive open online course, for its clients. The project leader was the one who was driving the project (leadership compete) by trying to make it work for test users of the MOOC and by solving many issues on her own initiative (leadership create, absence of leadership collaborate). The team members had their own tasks and specific contributions based on their expertise and preferences (team voice). Each team member was trusted to carry out their task on their own (absence of leadership control). Developing the MOOC was labelled as a learning experience for the team and the organisation (team learning). The project knew no critical incidents, other than little setbacks that the team saw as rather normal and easily fixable.

Team04 is an ICT-consulting firm and their project was to develop new services with Big Data. The project saw too little progress after an exploration phase. In order to design the exploitation phase that follows the exploration phase of an innovation, a new project leader was appointed and some of the team members were replaced. Like in the project just mentioned, the project leader placed a strong focus on realising commercial targets (leadership compete) and solving many emerging problems himself (leadership create). Members in this project were assigned separate tasks as subprojects, which implied that there was much opportunity to learn (team learning), but not really as a team (absence of leadership collaborate). There was little coherence for project members about the overall clarity of the project, such as what other project members were doing (absence of leadership control). Though not clearly acknowledged as such by respondents, the project's lack of progress in this phase marked a potential critical incident, but was largely resolved by installing the new project leader.

The path of 'team dependent goal-orientedness' focuses on achieving goals by the project leader and for which the separate contributions of team members are crucial for the project's progress.

2. Trusted and focused team work

This path was chosen as a strategy by Team17, the innovation team of a transport systems manufacturer, and Team14, the innovation team of a medical equipment manufacturer.

Team17 is a project to develop a camera detection system for living objects that end up in parts of a transport system where they do not belong. Part of the project, which was to design camera software, encountered several technical setbacks, which we classified as critical incidents. The project leader developed an alternative plan (leadership control) by consulting technical specialists and team members (leadership collaborate) and by convincing the project manager and management team in a number of presentations, which were prepared in close cooperation with the team (team voice). The team felt safe enough to make mistakes and stick out their necks (team psychological safety) but experienced it as quite a struggle (absence of team learning) and, apart from the project leader himself, not as an adventure (absence of leadership create). The initiative of the project leader and the close cooperation with others and application of their expertise proved, in hindsight, to be a critical recovery.

Team14 worked on a project to develop medical equipment for the incubation of samples, like tissues and bacteria. The critical incidents that were encountered by this team consisted of a cluster of events. The company was acquired by a multinational which introduced her own procedures and working methods. Due to the acquisition the products were to be launched in the home market of the new mother company, which implied that the products had to meet legal requirements, for example concerning safety and certification according to quality systems. As a consequence many modifications to the medical products were needed. To achieve the technical and regulatory requirements the team joined forces, for example in SCRUM meetings (team voice, team learning, team psychological safety). Scrum (in rugby football, a scrum refers to a tight-packed formation of players with their heads down who attempt to gain possession of the ball) is a technique by which teams work as a unit to reach a common goal by going back and forth in analysing and solving emerging issues. It stems from software development [https://en.wikipedia.org/wiki/Scrum_(software_development)]. Leadership in this team was distributed among a new leader and experienced team members and focused on meeting targets (leadership control) together, with the use of everyone's expertise (leadership collaborate). There was a long list of modifications that needed to be processed, which resulted in a high workload (absence of team learning and leadership create). The critical recovery, like the critical incidents, involved a clustering of events. Supported by SCRUM and agile problem solving the team systematically chewed away at the long list of issues until the products were certified and ready to be launched.

The path of 'trusted and focused team work' expresses coherent team work and a type of (joint) leadership that involves team members in order to gain results step by step.

3. Team-driven resourcefulness

Two non-profit teams have taken this path to innovation resilience behaviour. Team12 is a team responsible for the implementation of lean trajectories in a municipality. Team08 is the same team as in path 1, which demonstrates that the same case can fit more than one combination of causal conditions. [N.B. All eight paths combined comprise a full solution that leads to the outcome Innovation Resilience Behaviour. Satisfying conditions of any path in the solution ascribes a case (a team) to that path, however, if paths are not conflicting with each other, it is possible that (the scores of) cases satisfy conditions of more than one path. It is exactly the situation with Team08 as it satisfies conditions of two paths. It should be mentioned that the paths show resemblance, and this is of course not a coincidence: they both have present Team voice, Leadership creativity and Team learning, and negated Leadership control and Leadership collaborate; in path 1 Leadership competition has to be present (and it does not have to be present in path 2) whereas in the third path Team psychological safety has to be present (and there is no such a condition in the first path). One could say that team Team08 shows features of two different yet partly similar ways to reach Innovation Resilience Behaviour. Technically speaking: Team08 fits in two successful paths, one (path 1) with leadership competition (being productive, competitive) and another one (path 3) with team psychological safety. Therefore, in conjunction with the other conditions (TVOICE, absence of LEADCONT, LEADCREc, absence of LEADCOLc and TLEARNc) this team can acquire TIRB either with leadership competition OR team psychological safety].

Team12 implements lean six sigma practices in one municipality's departments, and is a fixed team dedicated to this function. The municipality gives its own twist to achieving leanness, by simultaneously introducing a culture of efficient cooperation and leadership, which are intended to go beyond sheer austerity measures. The team's critical incidents reflected a cluster of events, set in motion by organisational restructuring, changes in leadership positions and resistance to change towards lean practices in a number of departments. The project leader started to mobilise support from department heads that were willing and framed the lean philosophy as not just cutting costs but also as a trigger for better cooperation across departments (leadership create). He focused on low-hanging fruit to achieve quick wins. For this purpose he introduced managers to lean thinking, and organised company visits for them with private organisations that worked with lean. The balance eventually shifted to a receptive attitude when organisational leaders embraced lean thinking as the guiding principle for the organisation. Within the team the members were invited to bring their ideas and explore ways to best serve departments (team voice, team psychological safety, team learning). The project leader was convinced that lean thinking was good for the organisation and the people and communicated it strongly, like an ambassador (absence leadership collaborate), without forcing others (absence leadership control). He firmly resisted the idea of merely cost-cutting operations. The critical recovery was to a certain extent embedded in the substitution of persons in leading positions who were not supportive of lean thinking. It could have gone easily in the opposite direction, the project leader said, if these changes had not taken place.

Team08 in this path differs with the same team in path 1, namely with respect to the presence of team psychological safety and the absence of leadership compete in this third path. How can that be explained in plain language? Team08 is a training firm for change professionals and their project was to develop a MOOC. In path 1 it was stated that the project leader was driving the project (leadership compete). That point was less pronounced in this solution; there seemed to be a role for working together in a psychologically safe environment. The team members could do their own tasks in their own way (team psychological safety). The fact that the project leader was solving many issues herself (leadership create, absence of leadership collaborate) remained manifest. Team members also still had their own tasks and specific contribution based on their expertise and preferences (team voice), and each member was trusted to do so on their own (absence of leadership control). Developing the MOOC was still the same learning experience for the team and the organisation (team learning). As said, the project knew no critical incidents, only limited setbacks that were easily fixable.

The path of 'team driven resourcefulness' shows a psychologically safe and learning-friendly environment with a mature team role and creative leadership to solve practical, process-related problems.

4. Team-minded and balanced leadership

Three teams chose this path, namely Team07, an innovation team delivering hair products, Team01, an innovation team from the food process industry, and Team15, the innovation team of a semiconductor manufacturer.

Team07 is described in the main text.

Team01 is a team in an R&D department operating in dairy products and the purpose of their innovation project was to deliver an ingredient for a food product. The project was a co-innovation with another company operating in the food industry. The critical incidents they encountered were related to conflicts of interest with the partner, such as IP-rights and the fact that the business side of the partner had not yet given its approval to developing the ingredient, thus causing delay. To propitiate this external business department, the partner repeatedly redefined the end goal. The critical recovery was only partially successful, as the business department of the partner can hardly be influenced by Team01. The project leader was a driving force in paving the road for the project. He brought together the right people to make decisions in a timely fashion (leadership control) to exchange ideas (leadership collaborate), jointly reframe the project and build a plan (team voice, team learning, leadership create), and to sell the plan to the steering committee (leadership compete). Production was waiting on joint partner agreement at the close of the study.

Team15 is the innovation team of a semiconductor manufacturer and their innovation project was to create new packaging for microchips. The critical incidents that occurred in this project were due to technological setbacks. One of these setbacks was located at a foreign supplier who proved to be unsuccessful in solving a technical issue for a crucial part. Critical recoveries started to take place during a business review meeting, with the decision to reverse the plan and start with solving the easy problems instead of the toughest ones. The last problem-solving method was based on 'structural similarity' thinking, which states that if the most complicated issues are solved first, the remaining ones will go smoother. But the opposite proved to be true in this case. As in the other two cases, the project leader played an active role. His leadership focused on results (leadership compete), and involved consulting team members and managing by 'walking around' (leadership collaborate), making sure that everyone did what needed to be done (leadership control), and solving practical issues and managing stakeholder interests along the way (leadership create). In addition there was room for team learning and team voice as team members were acknowledged as experts who all had relevant input to the product.

The path of 'team-minded and balanced leadership' reflects the presence of four leadership behaviours, with team work featuring ample opportunities for learning and voice.

5. Goal- and task-driven leadership

One team chose this path in becoming innovation resilient, namely Team16. This is another innovation team of the earlier mentioned manufacturer of semiconductors and their project involved to deliver a new generation of transistor (performance), and ensure this technology is ready for production. The critical incidents they encountered were several technical setbacks or issues that had to be resolved, while contending with the time pressure to launch the product. There was much external pressure to deliver on time, which pushed leadership into a transactional role, namely to put results and task orientation first (leadership compete, leadership control). To resolve issues 8D teams were deployed relatively extensively. This method, 'Eight Disciplines Problem Solving', is a standard procedure of the company, and brings together a team of specialists that is dedicated to solving a specific issue. Meanwhile, the innovation process is not disturbed and can continue. The solution of the specific issue is to be implemented on the go. Although the team was very experienced, mature and quite self-managing, the path indicates that leadership compete and control were so dominant, that they drove back other elements of mindful infrastructure (absence of team voice, team psychological safety, team learning, leadership create and leadership collaborate). It would probably do injustice to the team's work, however, to conclude that the process was undemocratic and that people had no voice. On the contrary, team members experimented with ideas and exchanged and shared knowledge extensively. However, it could also be argued that the market-driven forces simply overruled the priorities of time-consuming research at a critical phase in this project. The result was that the product that was launched was 'just good enough,' to the frustration of many of the researchers in the team.

The path of 'goal & task-driven leadership' presents a type of transactional leadership that is pushed by market-driven priorities.

6. Goal- and Process-driven leadership

This path is applicable to Team06, an innovation team of the earlier discussed producer of hair products. Their project involved delivering a new line of hair products for a certain brand. The project consisted of a relatively large number of products and had a timeline about one-third shorter than the average time given for a product launch. The marketing strategy was 'aggressive'. Due to this pressure there was a high risk of critical incidents occurring, but none of them happened. The obvious explanation for this success was, besides being lucky, the work of the project leader who combined a competitive working environment with acknowledging the needs of team members and stakeholders (leadership compete, leadership collaborate). He believed that he and the team could do this job despite 'impossible' time limits. The team anticipated possible issues, performed continuous impact management to monitor the possible consequences of risks, and communicated these consequences to management in order to manage expectations continuously. Here, as in the former path, one can observe the dominance of leadership behaviours that push back mindful infrastructure elements (absence of team voice, team psychological safety, team learning, leadership control and leadership create). Yet this team functioned like a well-oiled machine. The time pressure, however, was so high that team members experienced high workloads and pressure to not fail during the project. Afterwards, when it had turned out to be a great success, team members voiced that they enjoyed the kick brought to them by this project. Looking back on the process, the project leader stated that they could have only done this once, because it was very demanding for everyone involved.

The path of 'goal & process driven leadership' expresses charismatic leadership that is pushed by market-driven priorities and can be successful by closely monitoring the antecedents and consequences of every step in the process.

7. Team-minded collaboration

One team developed this path to innovation resilience behaviour. Team09 is an ICT-team within a large educational organisation. Their project's task was to deliver a management information system, based on a new combination of existing software and hardware technologies. The team was faced with several critical incidents. Some were personal, involving for example situations in which steering group members attacked the project leader and questioned his competencies, and where team members were confronted with illness or family problems. Some were a combination of personnel shortage in manpower and technical factors, for instance when planned ICT-releases failed to happen or did not work well (absence of team psychological safety). Other setbacks were purely technological and relate to suppliers who delivered incompatible applications and hardware. This made the project leader feel insecure and the team demotivated (absence of leadership compete, leadership control and leadership create, and absence of team psychological safety). The critical recoveries were twofold. Firstly the project's steering committee was reduced to improve efficiency, project management was embedded in a new methodology (Prince 2), and the project team was enlarged with more and competent manpower. The steering committee was now more socially supportive (implementing Prince 2 can be seen as an act of management control; but the project leader asked for help; and Prince 2 was genuinely meant to help the project leaders structuring the tasks). Secondly the project leader implemented team-building techniques, which are a passion of his, which improved the cooperation and mutual understanding within the team (leadership collaborate, team voice, team learning). This restored the self-confidence of the team members and project leader alike.

The path of 'team minded collaboration' describes an environment where team building and team cooperation can be conducive to restoring the progress of a project.

8. Goal-driven problem solving

Team18, a team in the earlier mentioned manufacturer of transport and warehousing systems, followed this path. Their project entailed recovering installed automated material handling systems for the post and parcel process of sortation on site. These systems were having too many breakdowns and were not functioning reliably. Basically, it was not an innovation project but a recovery project, although applied improvements were partly based on new research. Essentially, therefore, the project was not an innovation project being confronted with critical incidents; it was a recovery project meant to recover critical incidents that had taken place. Critical incidents in this case involved systems that malfunctioned after their implementation at client locations. The cause of these failed implementations was overconfidence and over-ambition during the sale and rolling-out of these systems, due to market pressure. The recovery was marked by appointing an experienced project leader, who possessed both the technical expertise and social sensitivity needed for the technical aspects and stakeholder and client demands. The project leader was a very hard worker (leadership compete) who closely managed what needed to be done (leadership control) with an open attitude about how ideas and insights of team members could be connected and made synergetic (leadership create). The recovery was an extremely costly operation for the company, whose top management backed the operation and allocated the necessary means. The necessary means in this case involved the installation of a Kanban-team with all the best people, despite the company's scarce resources. This Kanban-team processes all the snags, the unexpected issues, by doing research on location and back at the home company. They proved to be highly resourceful, though they were confronted with a high work load. The recovery assignment meant hard work with clear objectives (absence of team voice, absence of team learning), but also doing so together as a team (team psychological safety for the core team specialists). Getting the job done was more important than taking care of individual team members, of whom two even left the company (absence of leadership collaborate). It was a tough and profit-losing process where only results counted because these clients had to be satisfied in order to not lose market share (leadership compete).

The path of 'goal driven problem solving' is a rigorous goal-oriented leadership approach focusing on results for the client with a psychologically safe environment for core team members only.

Notes

1 Published, without the endnotes and Table 3-5 in Appendix 1 and Appendix 2 in this Chapter, as P.R.A. Oeij, S. Dhondt & J.B.R. Gaspersz (2016), Mindful infrastructure as an enabler of innovation resilience behaviour in innovation teams. *Team Performance Management: An International Journal, 22*(7/8), 334-353. This Chapter is based on the following conference papers and proceeding:
Oeij, P.R.A., Dhondt, S. & Gaspersz, J.B.R. (2015). Mindful infrastructure as an enabler of innovation resilience behavior in innovation teams. Paper for *IWOT 19 – International Workshop on Team Working*. Leuven, Belgium, September 7-8.
Oeij, P.R.A., Dhondt, S & Gaspersz, J.B.R. (2015). Variations of mindful infrastructure in team innovation resilience. Paper for *"The human factor in a sustainable society"*, the Fifth International PhD Conference, PhD Program School of Management, Open University of the Netherlands, Heerlen, The Netherlands, October 14-17, 2015.
Oeij, P.R.A., Dhondt, S & Gaspersz, J.B.R. (2015). Variations of mindful infrastructure in team innovation resilience. In: H. Krikke & J. Roemer (eds). *Research in a sustainable society: Fifth International PhD Conference*, PhD Program School of Management, Open University of the Netherlands, Heerlen, The Netherlands, October 14-17, 2015 (pp. 50-67).

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3 In this article, we reason that mindful infrastructure enables team innovation resilience behaviour: in other words, that certain semi-structures are conducive to certain risk-taking, entrepreneurial or innovative behaviours. Teams that are responsible for innovation are under pressure to achieve results. To deal with these pressures, teams need a degree of decision latitude to gain a sense of control and the freedom to act autonomously. To a large extent this decision latitude stems from job design and the division between managing and executing tasks, which are rooted in organisational strategies and design choices. The semi-structure, as a combination of practices, habits and norms, results from those strategies and choices, and will, conversely, influence future developments within the organisation. HROs develop semi-structures (mindful infrastructure) that largely follows from the extent to which top administrators enact practices and structures that work to ensure more mindful ways of thinking, acting and organising. This stems from top administrator's philosophies on business models, strategy and management, and humans. Therefore mindful infrastructure (1) results from top-down decisions, (2) creates the context for thinking and action on the front line, and (3) is a relatively enduring property of an organisation (like semi-structure is) (Vogus & Sutcliffe, 2012: 724). In contrast, innovation resilience behaviour represents a dynamic and social process, comprising specific ongoing actions, that relies on extensive and continuous real-time communication and interactions that occur in briefings, meetings, updates, and in teams' ongoing work. IRB (or 'mindful organizing' in the terminology of HROs) (1) results from bottom-up processes; (2) enacts or forms the context for thinking and action on the front line, and (3) is relatively fragile and needs to be continuously re-established, according to Vogus and Sutcliffe. As such, it is a function of the behaviours carried out by organisational members, especially those on the front line (of a disaster or high risk situation) (Vogus & Sutcliffe, 2012: 725). The HRO-literature (especially Vogus and Sutcliffe, 2012) points to the fact that the mindful infrastructure is partly determined by the top-down behaviour of management and that innovation resilience behaviour is bottom-up and influenced by team members. But these authors do not clarify how exactly this mechanism works (Lekka, 2011). In our framework, therefore, we investigate whether (elements of) mindful infrastructure are present or absent at the team level, and investigate how this effects innovation resilience behaviour as team behaviour, not as individual behaviour. The term team dynamics is employed to point to the interactions between team members, which have causes and consequences of their own, which we do not intend to specify in this contribution.

4 "QCA is a case-based approach that searches for minimally sufficient terms and maximally relevant necessary terms. This definition basically works backwards from the term and common practice in empirical research. The attribute "case-based" is needed because of the "Q"; "minimally sufficient" implicitly introduces an algorithm to the definition; and "maximally relevant" refers to conjunctions ("wholes") in analyses of necessity" (Rohlfing, 2014)." (Rohlfing, I. (16 July 2014). *What is QCA? Simple question, many answers*. Retrieved at 8 June 2015 from: https://ingorohlfing.wordpress.com/2014/07/16/what-is-qca-simple-question-many-answers/).

5 Boolean algebra applies the logical AND and logical OR operator to assess which combinations of independent variables ('condition variables') determine whether cases are 'in the set' of team innovation resilience behaviour or not; it also assesses which combinations of condition variables form a configuration that leads to being in the set of team innovation resilience behaviour (the 'outcome'). QCA thus helps to identify the presence of variables in a population. QCA also enables the assessment of necessity and sufficiency of these variables for an outcome to appear in a population.

6 For crisp data (with binary values 1 or 0) the advice based on so-called benchmark tables is to apply an upper-limit of five condition variables when 18 cases are included. With too many condition variables the 'probability of generating results on random data are too high' (Marx, A. & Dusa, A. (2011). Crisp-set qualitative comparative analysis (csQCA), contradictions and consistency: benchmarks for model specification. *Methodological Innovations, 6*(2), 103-148); see also Marx, A., Cambré, B. & Rihoux, B. (2013). Crisp-set qualitative comparative analysis in organizational studies. In: P. Fiss, B. Cambré and A. Marx (eds.), *Configurational theory and methods in organizational research*. Research in the Sociology of Organizations Volume 18 (pp. 23-47). Bingley (UK): Emerald). In other words, based on simulation results one cannot always assume that a model is consistent if there are too many condition variables (although the software may give the indication that it is). It is thinkable that for fzQCA there may also be upper-limits to the ratio of conditions to cases (but this has not been assessed until now). A caution for far reaching conclusions is at place as no such benchmark tables are available yet for fuzzy sets (fuzzy variables have continuous values).

7 An original score of the variable that represents 25th percentile gets a new calibrated value of .05 (non-membership), 50th percentile score gets a new calibrated value of .5 and 75th percentile score is re-evaluated to .95 (full membership). As the software cannot interpret the score of .5 (it is neither in, nor out of the set), this score is manually changed into .51 because cases that score exactly .5 are excluded from the analysis by the programme.

8 Because team innovation resilience behaviour (TIRB) and team climate (TCLIM) correlated strongly, we wanted to inspect whether TCLIM might be a necessary condition. Team climate is a measured variable that was later excluded from analyses, but for the reason to show how QCA can be useful, we mention it here. From the necessary condition analysis it proved that TCLIM was not a necessary condition, which can be seen from Annex Table 4. This illustrates that high correlations function different than set-relations, which are based on Boolean algebra. In set-relations research there does not need to be one dominant relation based on high correlations. There can be more than one.

9 The first 17 rows are depicted in Annex Table 5.

10 The software can calculate three solutions: in the complex solution logical remainders are treated as if the outcome is '0'. This leads to many configurations and is hard to interpret; in the parsimonious solution the software calculates what would be the best outcome ('1' or '0') for the logical remainders. This is helpful for interpretation in the case of many condition variables, but can lead to oversimplification in the case of a limited number of conditions variables (below 8); in the intermediate solution the software determines the outcome value for logical remainders based on additional instructions of the researcher. These instructions are ways to minimize the number of logical remainders. This entails deleting pairwise conjunctions that are redundant and is called assessing 'prime implicants'. Prime implicants are the end product of a process of minimizing the number of pairwise conjunctions in order to come to more elegant and parsimonious solutions. Compared to the intermediate solution, the complex solution was very hard to interpret as it contained 17 configurational paths. The parsimonious solution was too much of a simplification of reality as it consisted of only two paths.

11 As said, Table 2 and 3 show 13 cases based on 12 teams. The reason is that one team fits in two paths (namely 1 and 3) and is counted twice by the software. How is that possible? All paths combined comprise a full solution that leads to the outcome Team Innovation Resilience Behaviour. Satisfying conditions of any path in the solution ascribes a case (a team) to that path, however, if paths are not conflicting with each other, it is possible that (the scores of) cases satisfy conditions of more than one path. It is exactly the situation with one team as it satisfies conditions of two paths. Not surprising, both paths show quite some resemblance: they both have present Team voice, Leadership creativity and Team learning, and negated Leadership control and Leadership collaborate; in the 1st path Leadership competition has to be present (and it does not have to be present in the 3rd path) whereas in the 3rd path Team psychological safety has to be present (and there is no such a condition in the 1st path). One could say that this particular team shows features of two different yet almost similar ways to reach Team Innovation Resilience Behaviour.

12 A robustness analysis with a linear regression analysis can support the decision to apply QCA as an asymmetrical technique (Ford, L. R., Seers, A., & Neumann, J. (2013). Honoring complexity: Set-theoretic analysis as a complementary method in leadership research. *Management Research Review, 36*(7), 644-663; Vis, 1012; Woodside, A.G. (2013), Moving beyond multiple regression analysis to algorithms: Calling for adoption of a paradigm shift from symmetric to asymmetric thinking in data analysis and crafting theory. *Journal of Business Research, 66*(4), 463-472). Linear regression analysis was performed with the same variables as in QCA. The dependent variable was IRB and TPSYSAF, TLEARN, LEADCOL, LEADCRE, LEADCONT, LEADCO, and TVOICE were the independent variables (backward elimination procedure). The final (not significant) solution covered 87% of explained variance, and included TLEARN ($\beta1$=.22, n.s.), LEADCOM ($\beta2$=.31) and TVOICE ($\beta3$=.69) in predicting IRB. The point of this robustness check is not that the outcome showed that conventional statistics looking for symmetry identify only one "path" of variables. We knew that beforehand. The point is that these approaches do not produce multiple outcomes that are more commonsensical to complex projects and team dynamics. These variables explained almost all the variance in the outcome variable, but the number of cases (18) is far too low to draw any general conclusions. That is one reason why QCA is needed. Regression is very sensitive to outlying values of cases. Three of the seven variables were namely excluded in the final model. In QCA a combination of outlying values with other values can still lead to set-membership in the outcome, which is another reason why QCA can be useful in such situations.

13 Consistency is a measure that reflects the degree to which the cases (teams) have a logical fit with a combination of variables. Consistency is the degree to which empirical evidence supports the claim that a set-theoretic relation exists. A condition is a subset or superset of the outcome. Because QCA is grounded in set theory, it is easy to illustrate the idea of consistency thinking of Venn Diagrams. Low consistency indicates that many cases (teams) that exhibit a causal condition (one of the seven MI-elements) are not members of the set of cases that exhibit the outcome (IRB). High consistency indicates that many cases that exhibit a causal condition are also members of the set of cases that exhibit the outcome.

14 All eight paths are described in 'Appendix 6: What do the paths reveal about the cases?', safe the example provided in the article.

15 The room to manoeuvre and choose what to do strongly depends on external factors, such as market demands and stakeholders. Market pull played a strong role in the cases Team04, 06, 15, 16, 18, while stakeholders were highly influential in Team01, 07, 09 and 12. Sometimes this propelled a team leader to adopt a certain leadership style, in which they take initiative and steer the project. In other situations there was more team building and team member dependencies.

16 This finding aligns with the literature on High Performance Work Practices, which states that there must always be 'bundles' of HR-measures present, as opposed to single measures, to effect better performance and job quality (see e.g., Boxall, P. & Macky, K. (2009), 'Research and theory on high-performance work systems: progressing the high-involvement stream', *Human Resource Management Journal, 19*(1), 3-23; Vogus & Iacobucci, 2016). A relevant finding in this context of high performance and job quality is that team innovation resilience behaviour does not require 'democratic' ingredients per se, such as team voice, team psychological safety and leadership styles conducive to collaboration and participation. Contrary to the dominant normative notion that team success depends on employee engagement and involvement (as, for example, in the High Performance Work Practices literatures), there are cases where control- and competition-oriented leadership can lead to innovation resilience as well.

Chapter 5

Defensive behaviours in innovation teams - how project teams discuss defensiveness and its relationship with innovation resilience behaviour and project success

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Defensive behaviours in innovation teams - how project teams discuss defensiveness and its relationship with innovation resilience behaviour and project success

Abstract[1,2]

Project team members and project leaders of innovation projects were interviewed about the possible presence of defensive behaviours within the team. While investigating defensive behaviour can be done validly by observation techniques, to talk about defensiveness within a team often leads to socially desirable and therefore biased information. However, applying discourse analysis reveals how intentions to discuss defensiveness in itself leads to defensive behaviour. The study demonstrates how individuals use pauses, apply humour, make external attributions and devaluate the importance of defensiveness. This suggests that even meta-discussing defensiveness is quite hard.

The study also found indications that defensiveness is associated with lower team innovation resilience behaviour and reported project success. Resting on the assumption that defensiveness may lead to risk avoidance, the study argues that defensive behaviours in teams working on innovation projects might be detrimental to the innovation goals. This implies the need to develop socially safe team climates that encourage open and ongoing dialogue on defensiveness in order to avoid defensive behaviours.

Key words: innovation, project, defensiveness, team, discourse

1 Introduction

Innovation matters. The logic is simple. If organisations do not change what they offer the world, products and services, and how they create and deliver this, they risk to be overtaken by others who do, and fail to survive (Bessant & Tidd, 2007). Innovation projects can contribute to competitiveness. However, innovation projects can be rather complex and failure of such projects is more common than not. In many instances, innovation is subject to strong technical and commercial uncertainties and failure rates are high; judging from the work of the late Edwin Mansfield, economist, about half of all US private business R&D is dedicated to projects that ultimately fail (cited in Tidd & Bessant, 2009). Other sources report that projects have a success rate of approximately 30% in the past twenty years (Mulder, 2012). However, based on scrutinizing empirical data Castellion and Markham (2012) report that the failure rate of product innovations is between 35 and 50%. Yet, still substantial. Teams responsible for innovations should avoid defensive routines as this may threaten to reach the goal of the innovation process. Organisational defensive routines are 'any action, policy, or practice that prevents organisational participants from experiencing embarrassment or threat and, at the same time, prevents them from discovering the causes of the embarrassment or threat' (Argyris, 2002: 214). The key research question is: as innovation team members are supposed to know how to deal with complex projects effectively, are defensive behaviours still to be observed? This article reports on a study among innovation teams in the Netherlands that are selected from different sectors (private and non-private; industrial sectors and services).

The immediate inducement to study defensive behaviour was the unexpected defensiveness of teams that were being interviewed by the interviewer (the first author). During the interview with the project leader the critical incidents of the innovation projects were identified. At a later stage the researcher asked whether any defensive behaviours had occurred during the project. To the researcher's surprise, several teams responded with organisational defence mechanisms, such as remaining silent for a relatively long time before answering the question, making jokes, and straightaway denial. Without having a clearly defined problem in advance, and encountering this situation more than once across the studied cases, the need gradually emerged to confront the data with the question: 'what is going on here?' (Silverman, 2011: xiv). What seemed to be the case was that teams, confronted with making defensiveness discussable, responded in ways trying to make defensiveness undiscussable (Noonan, 2008) as if some kind of 'meta-defensiveness' was taking place. Argyris (1999) has observed this paradox on many occasions that persons, confronted with their defensive reasoning, tend to become defensive and downplay or deny its presence, which he sees as a clear example of the 'skilled incompetence' of those persons, namely that they are not aware of their own defensiveness and tend to make it undiscussable. This is important in the context of innovation teams, because defensiveness can lead to risk avoidance which is detrimental to the controlled risk taking that is required to innovate successfully. Innovation projects are likely to be non-routine during which situations emerge that threatens the feelings of competence, confidence, comfortability and certainty of team members to engage these situations. When team members, even those selected to perform innovation tasks, subconsciously become risk averse, the real risk, namely limiting the chance of innovation success, gets easily overlooked. Moreover, when corporate cultures discourage risk taking, such issues will not be made discussable at all (Ashkenas & Bodell, 2014). We argue that innovation team members are no less likely to develop defensive behaviour as do non-innovation team members. Innovation team members face non-routine issues due to the complexity of their projects. However, they are selected to perform complex jobs. So, while one might argue that innovation team members are less inclined to behave defensively, one may overlook that complex projects and non-routine issues could contain relatively more ambiguity, uncertainty and conflicting interest than routine issues. Mixed messages like these are among the best feeding grounds for defensive behaviours (Argyris, 1999). There is thus reason to believe that innovation team members are also inclined to defensiveness in such occurrences, leading to risk avoidance. But in the case of innovation it is exactly opposite to the desired behaviour: creativity and controlled risk taking are paramount to innovation success (García-Granero, Llopis, Fernández-Mesa & Alegre, 2015).

We believe that teams with defensive behaviour will prevent to lose face and control. Furthermore, we assume that defensive behaviour is associated with less innovation resilient behaviour and with lower project success.

We will first explain the mechanism of organisational defensiveness. We will then discuss a new measure for defensiveness that we needed to develop, together with the presentation of the research methodology. Subsequently, we will present the research findings and end with the conclusion and discussion section.

2 The mechanism of organisational defensiveness

What triggers organisational defensive routines is the theory-in-use that all humans apply, argues Argyris (1990). Regardless of gender, race, culture, education, wealth, and type of organisation, he says, people apply a 'Model I theory-in-use' that is composed of four governing variables; (a) be in unilateral control; (b) strive to win and not lose; (c) suppress negative feelings; and (d) act rationally (Argyris, 2002). As humans we learn these theories early in life, and the actions they produce are highly skilled. Model I teaches individuals to craft their positions, evaluations and attributions in ways that inhibit inquiries into them and test of them with the use of independent logic. In other words, to prevent to lose face (Goffman, 1967). The consequences of Model I strategies to advocate one's position and unilaterally face saving behaviour, are, apart from misunderstandings, to a large extent defensiveness and defensive reasoning. When everyone is skilled at face saving behaviour of oneself and others, people avoid confrontations unnoticed, and learn to distance themselves from risk taking and feelings associated with embarrassment, threat and incompetence.

Organisational defence routines have certain logic, because defensiveness always follows the same pattern. Sending mixed messages are among the best examples. For innovation teams the clearest of such mixed messages are perhaps: "be innovative, but watch the budget", or "be the fastest, but also the most thorough one". The logic is (Argyris, 2002):
1. Send a message that is inconsistent;
2. Act as if it is not inconsistent;
3. Make steps 1 and 2 undiscussable;
4. Make the undiscussability undiscussable.

In other words, people make face saving remarks, but often they are ambiguous. However, they are not aware of it. As a consequence nobody checks if it is fact-based. And in the next step it becomes self-sealing, a self-fulfilling prophecy, or an escalating error. Argyris calls this a cover-up (do not upset another), that needs to be covered-up itself (made undiscussable) through by-passes (deny or ignore one is inconsistent) and cover-ups of the cover-ups (neglect the denial and act as if nothing happened at all).

Strangely, many people have an 'espoused' model that is rather in contrast with their theory-in-use, namely Model II. The values governing Model II are to (a) acquire valid information, (b) make informed choices, and (c) vigilant monitoring of the implementation of the choice to detect and correct error (Argyris, 2002). Advocating one's position is, as in Model I, still a central action strategy, but not solely directed at control. It is transparent and based on inquiry and public testing to validate the information on which choices are grounded. Minimizing unilateral face-saving is another action strategy, because transparency demands confrontations if needed, albeit respectful and constructive. The consequences of Model II theory-in-use behaviour is a reduction of defensive behaviours: less self-fulfilling, self-sealing and error-escalations, less misunderstandings, and more effective problem-solving. For innovation teams it would mean less risk avoidance.

Following the Model I theory-in-use by team members would imply that those who perform organisational defensive routines would be crafting the actions of advocating, evaluating and attributing in ways that do not include illustrations of their meanings, will not encourage inquiry into them, and will not encourage robust testing of the claims being made by the actors. Whereas Model II crafting would include the opposite, namely apply illustrations, inquiry and encourage testing (Argyris, 2002: 216).

Our research enters unclaimed territory, due to which additional methodological questions arise in, at least, two ways:

1. How can we investigate defensive behaviour with audio recorded data when we know that this behaviour is indirect and subconscious?
2. If we interpret our findings in terms of observed defensive behaviour, how can we be sure of its validity?

3 Research methodology: Combining existing new methods

This Section discusses the overall study as the context for these analyses, the methodology of analyses embedded in the branch of discursive pragmatism, the operationalised method of analysis, and the data and the data collection. While some quantitative data are presented, the main analysis is based on qualitative data. The first aim was to study team dynamics, especially the team dynamics in the way how teams deal with critical incidents in their projects. To partly understand why projects can fail, the concept of defensive behaviour is introduced in relation to critical incidents. It was expected that defensive behaviour and discourse could emerge during critical incidents. When making defensiveness a topic during the interview we unexpectedly experienced that interviewees became defensive in their responses. Trying to understand what actually happened became another aim of this study.

3.1 Overall study as context for the secondary analyses

The interviews were part of a study into team dynamics during innovation projects. Eighteen teams that are responsible for innovation projects were interviewed. The study addressed the question whether certain organisational facilitations, called a mindful infrastructure (Weick & Sutcliffe, 2007), enabled those teams to deal in a resilient manner with critical incidents during their project, which is called innovation resilience behaviour. A mindful infrastructure is a combination of team psychological safety, team learning, team voice and leadership that enable teams to act, therefore it is an organisational characteristic. Innovation resilience behaviour is a set of team behaviours by which a team is able to prevent and recover from a critical incident and maintain or regain a course that leads to the goal of the innovation project (Oeij, Dhondt, Gaspersz & De Vroome, 2016). Critical incidents (Flanagan, 1954) are occurrences or conditions that interrupt the normal procedure of the project. Critical incidents are deviations from the project plan resulting in setbacks, delays or terminating of the project, whereas critical recoveries imply getting back on track toward the intended or adjusted goal caused by a 'speeding up' activity, such as significant solution, decision or a serendipity. The word 'critical' refers to events that are significant for success or failure of a project. These teams were purposively sampled to study what mindful infrastructures look like, if these mindful infrastructures could help teams to prevent and recover from critical incidents by performing innovation resilience behaviour, and, what contribution could be made to the theory of project team dynamics working on innovation projects.

During the interviews the topic of defensiveness within the project teams was addressed. In those cases where respondents confirmed the presence of defensive behaviours, it sometimes occurred that they talked about defensiveness in defensive terms. These striking examples of 'meta-defensiveness' triggered our attention. The relevance of such behaviours is foremost of an indirect nature, we argue. Namely, if teams respond defensively when just talking about possible defensive behaviours, would it be plausible to assume that those teams will also behave defensively when defensive behaviour is not being made discussable (Noonan, 2008)? Obviously, when teams are unaware of defensiveness they will not discuss it, which in itself may not be a problem. But in this case we were studying project teams working on innovations. Would it be thinkable that their unresponsiveness towards defensive behaviours could possibly harm the innovation process, for example, by consequential risk avoiding behaviours? While it is not possible to answer this question based on the interviews we took, it is feasible to assess the presence of defensiveness during the interviews. In such instances it is argued that the presence of defensiveness might be an example of 'mindlessness', namely ignoring weak signals of mixed messages, miscommunication, self-fulfilling prophecies, self-sealing processes and escalating error with unforeseen negative effects (Argyris, 2002; Weick & Sutcliffe, 2007).

The key research hypothesis is that teams without innovation resilience behaviour, when questioned about defensive behaviours, trigger action strategies to advocate being in control, not to lose, and save face. Furthermore, we hypothesize that defensiveness is associated with lower project success.

3.2 Discursive pragmatism as a methodology of analysis

Defensiveness is difficult to assess. Humans are skilled to overlook it, and are socialised to ignore it (Argyris, 2002). Methods to grasp defensiveness are observations by trained investigators or clinical conversations by trained therapists. Interviewing people who are not patients - the team members - is therefore unsuitable as it runs the risk of acquiring social desirable feedback because persons will avoid to openly discuss embarrassing or threatening situations. Argyris and Schön have stressed that it is impossible to derive people's defensive theory-in-use from interviews (Argyris & Schön, 1974: 6-7). Therefore, we needed an alternative method to study the interviews and so discursive pragmatism was applied to investigate the teams' conversations with the interviewer.

Discursive pragmatism is a variant of the study of discourse - i.e., verbal interactions or written accounts - and is a strategy to understanding organizational phenomena informed by 'the linguistic turn' (Kärreman, 2014). The linguistic turn indicates a growing acknowledgement that language, communication and linguistics play a significant role in social science in understanding and explaining social phenomena (Alvesson & Kärreman, 2000). Discourses provide the possibility to study issues close to talk such as "the espoused values of corporate cultures or organizational taboos (as indicated, perhaps, by people being reluctant to make statements about certain issues)" (Alvesson & Kärreman, 2000: 147). Studying talk about defensive behaviours in teams aligns with discursive pragmatism for two reasons. First because defensiveness is related to mental or cognitive states - i.e. intrapsychic states such as perceptions, motives, thoughts, meanings and emotions - that cannot be observed but demand interpretation to make sense of it. Second, the values on which defensive behaviours are grounded imply that defensiveness also has effects on how team members consequently behave in embarrassing and threatening situations and how that constitutes the organisational culture. Discursive pragmatism incorporates the analysis of information at three levels, namely practice, talk and meaning, or, to acquire observational, conversational and ethnographic evidence (Kärreman, 2014). At the level of practice, attention is paid to what people do to accomplish their tasks, for example, how teams take decisions. In the ideal situation, this level demands participative observation or longitudinal contacts with persons being researched, which was unfortunately not possible. This was however partly compensated by being able to discuss behaviours in retrospect during interviewing those persons. The second level is that of talk, which, for example provides ideas pointing to how organizational members speak in certain situations and what they achieve with these forms of speak. The level of meaning concerns sense making of what people are saying or doing by interpreting what is happening.

3.3 The operationalised method of analysis

An instrument to analyse interview conversations has been developed by Argyris himself (2002: 217). When persons apply Model I behaviour, in order to avoid embarrassment, they will make negative evaluations, advocate their position and make attributions without using convincing illustrations, inquiries to validate information, or perform any robust testing. However, to assess these defensive behaviours requires a certain tension to be present in the conversation: in our case during the interview. This tension is not always likely to happen as the interviewer and the respondents have a relation that lacks conflicts of interest. In addition to Argyris' instrument, another way to observe defensiveness was conceptualised, namely by trying to consider how humans avoid feelings of embarrassment, shame and incompetence in the presence of relative strangers. Four defensive behaviours are derived from the literature for this purpose. First, in order to organise the narration when being asked a question that may trigger anxiety, people tend to take long pauses at the beginning and ask the interviewer about details (Soroko, 2014). This gives them more time to organise their way of addressing the question and reducing anxiety. Second, to neutralise the tension respondents may react with humour, jokes or laughter that helps to shift away from an arousing topic (Bovey & Hede, 2001a; Larsen et al., 2010). Third, persons may be inclined to not critically reflect on their own behaviour, which might be too threatening, but prefer blaming the others (psychological projection), often outside the team (Bovey & Hede, 2001b; Larsen et al., 2010; Trevithick, 2011). Fourth, and final, on certain occasions, people minimize the issue raised by denial, trivialisation or devaluation of those issues, which again reduces feelings of anxiety (Larsen et al., 2010). Model I behaviours (negative evaluation, advocacy and attribution without illustration, encouragement of inquiry, or testing) are thus operationalised as pausing, humour, external blaming and devaluation.

These behaviours, like pausing, joking and humour, are of course not always defensive behaviours. We, therefore followed the advice of Silverman (2005) who says that one should not analyse instances but sequences, by which he means that what respondents say can be best understood when a researcher takes the context into account, that is, the situation in which talk is produced. In our analysis it is important to exactly report how the question of the interviewer was formulated to understand the response of the interviewees. Especially concerning the study of situations of embarrassment, threat and incompetence, it makes sense to properly understand the scene. From such enriched contexts it can be validly understood when humour is defensive behaviour and when it is not, because it not only informs the reader on what was being said, but also how the contextualised interaction produced meaning.

3.4 Data and data collection

The teams are recruited from eleven Dutch and multinational organisations. Three of them are non-profit organisations. The remaining eight profit organisations stem from manufacturing, process industry, and commercial services and consultancy (Oeij, Dhondt & Gaspersz, 2016). In each team a first round of interviews were held with the team leader and team members in two separate interviews; and a second round with the team leader and members together (in total 54 interviews, apart from 18 interviews with project managers who supervised those teams). The number of cases (18) is limited from the perspective of applicability of conventional statistics. The purpose of this study, however, was not to acquire findings that can be generalised to populations, but that can be generalised to theory, namely to team dynamics. Purposive sampling was applied to find cases of innovation projects and project teams with the likelihood of critical incidents to emerge during their process. The analyses for this article focussed on defensive behaviours and what these imply for the targeted innovation in terms of possible risk avoidance due to the dominance of Model I values and strategies. Additionally, the 101 team members of the 18 teams also completed a survey and these data are applied for statistical analyses. The average team size is 5.9 persons, ranging from 3 to 16 persons.

The teams and projects were selected on the basis of the following characteristics: teams had to be working project-based; they had to be working on an innovation project; and the project they were working on should have progressed to have enough ‘history’ (i.e., chances for incidents to have emerged) and not being concluded to long ago (to avoid retention effects). Moreover, the projects had to be complex instead of routine, otherwise not much new could be learned. An innovation project is an assignment to develop new or improved products, services or processes within a limited scope of time, money and resources.

The teams were responsible for carrying out an innovation project. During the interviews critical incidents were identified and discussed. Critical incidents for delay and critical recoveries for speed-up situations and getting back on track were assessed with the project team leader, and later checked with the team. Subsequently teams and team leaders were asked about the presence of defensive behaviours in the team. Thereupon it was investigated how the teams dealt with critical incidents and whether or not innovation resilient behaviour was performed.

Each team represents an innovation project and with regard to each project a set of face-to-face interviews took place, namely with the project- or team leader, thereupon with the team members, and with the manager to whom the team leader was accountable; at a later stage a second interview was held with the team leader and the team members together. The selection of interviews for the analysis excluded the manager interviews. While each interview lasted about 90 minutes, the part in which defensiveness was discussed covered on average roughly 20 minutes. All interviews are audio recorded. We had the verbatim speech at our disposal. In addition, survey data was collected among these respondents, added with respondents from the same organisations but working in different teams and projects.

The analysis is made on the basis of self-reports, interpretations and observations and follows three steps:

1. Based on a list of 14 examples of organisational defensive behaviours, teams were asked to mention which of those occurred in their project. A total of 96 instances were named by the 18 teams as self-reported examples;
2. Critical incidents, critical recoveries, and self-reported project success were discussed to assess the presence and role of innovation resilience behaviour. From the interview data the researchers made interpretations on the presence of manifest or latent defensive behaviours in relation to IRB performance of the teams in dealing with critical incidents;
3. While 2 and 3 concern reported defensive behaviours, here focus is on observed defensive behaviour.

During the interviews a number of teams showed defensiveness in their response to the question whether any of the 14 examples had occurred in their team. For these observed defensive behaviours the discursive pragmatism methodology was applied.

3.5 Measures

Defensiveness was measured in three ways, specifically as self-reports, as interpretations and as observations (talk-conversational, meaning-ethnographic and practice-observational, Kärreman, 2014). The context was the interviewer-interviewee interaction during the interview. When studying discourse it is important to describe the context in order to be able to understand interactions between the interviewees and the interviewer, called sequencing (Silverman, 2005; 2013: 63). During the interview the topic of critical incidents was discussed first and then followed by talking about defensive behaviour. The respondents thus were 'primed' with reflecting on their own project regarding possible critical incidents. The question about defensive behaviour was phrased in the following way.

> *"Next I am going to show you a card with forms of behaviour when people are communicating with each other. These are called defensive strategies, and there are 14 of them on the card. I would like you to take a look at them. My question is: do you recognise any of these behaviours to have appeared in your project, either within the team or in interaction with persons outside of the team?"*

The card was a paper hand-out that interviewees could read and contained 14 defensive strategies. The list is developed by Ardon (2009), who studied the behaviour of managers during organisational changes processes, and is based on the theory of organisational defence mechanisms of Argyris (see notably, Argyris, 1990). We used the list for the purpose of self-reports by the teams, as a first descriptive measurement on the prevalence of defensiveness. The second measurement was to interpret how teams dealt with critical incidents and critical recoveries, and whether or not this was associated with defensive behaviours. The researchers interpreted the responses and information of the interviewees in terms of manifest or latent defensiveness. Manifest defensive behaviours referred to self-sealing behaviour, cover-ups, and risk-avoiding instead of confronting ambiguities and mixed messaging to achieve transparency and valid information. The researchers interpreted how the teams responded to critical incidents, and whether or not this had negative effects on the innovation project. The third measurement concerned the analysis of observed talk with the mentioned defensive behaviours of pausing, humour, external blaming and devaluation.

The place of the interviewer-interviewee interactions is as follows. The interviewer[3] asks questions to which the interviewees respond. Interviews were one-to-one interactions and group interactions. In both situations the researcher observed and interpreted the responses and reactions of the interviewee. In the group interactions the interviewees also reacted to one another. The researcher's role was to observe what happened. It is stressed that sequencing in this context means to analyse the sequence of utterings (here question and answer) and not the interaction between interviewer and interviewees. The focus is on content.

Two other measures were taken from survey-data retained from respondents of the teams and reported in Oeij, Van Vuuren, Dhondt & Gaspersz (2016). Innovation resilience behaviour (IRB) was measured with survey-items based on the Audits of Resilience Performance of Weick and Sutcliffe (2007) and measuring:

1. The preoccupation with failure,
2. Reluctance to simplify,
3. Sensitivity to operations,
4. Commitment to resilience, and
5. Deference to expertise at team level.

The threshold for being a high of low IRB-case is the mean score of 4.8 on this 7-point scale, called Team innovation resilience behaviour (TIRB), and was calculated on the basis of the collected survey data. Project success was measured with ten items, such as satisfaction of end-users, suppliers and stakeholders, meeting project goals of functionality, budget and timing, and the project team's self-defined success factor, and developed by Müller and Turner (2010).

Figure 1 offers a process diagram of the research and presents the main results. How the methodological parts are connected to the analysis is visualised to support the reasoning in this article.

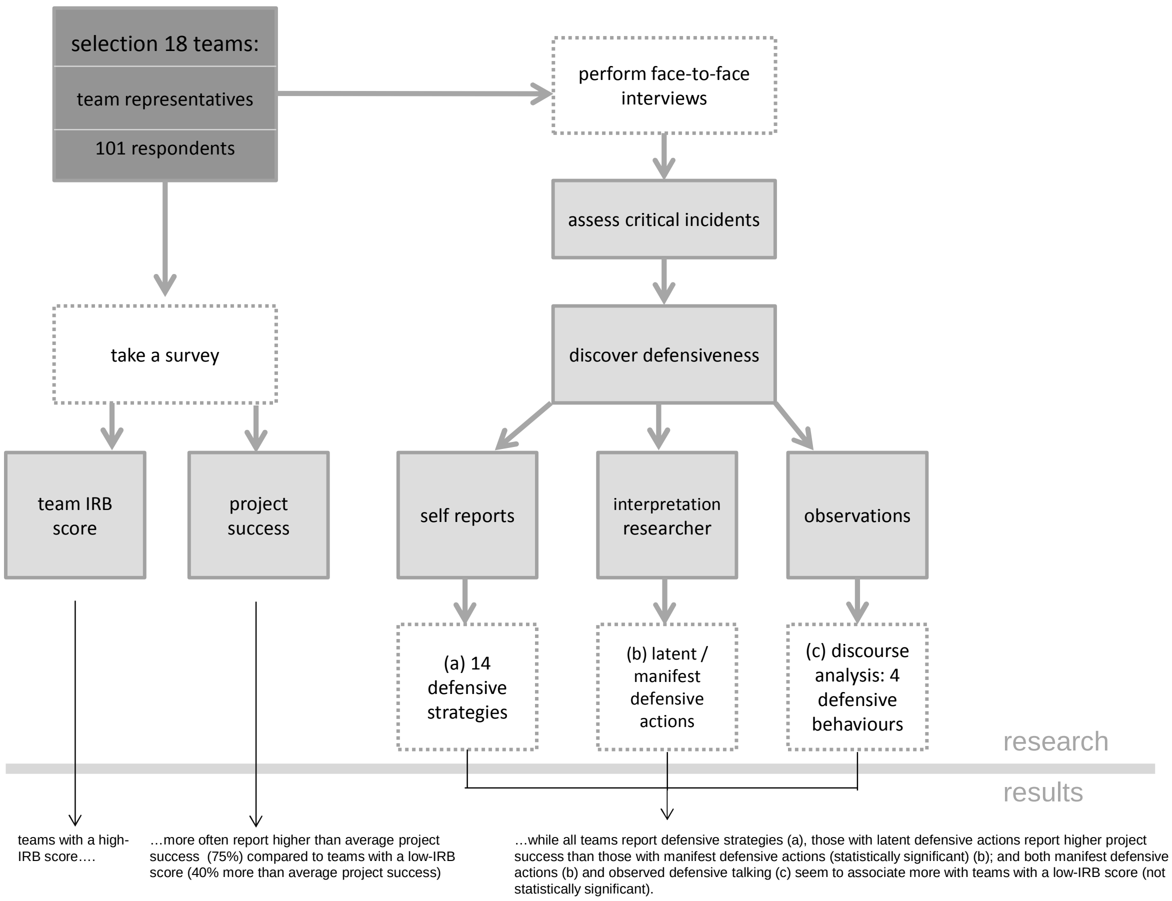

Figure 1 Process diagram of the research and outline of results

4 Results: Self-reported, interpreted and observed defensive behaviours

4.1 Self-reported defensiveness

Table 1 is based on the first step of the analysis, which shows that the 18 teams together self-reported 97 times that defensive strategies occurred, distributed across the 14 examples of defensive strategies (N=number of times that defensive strategies were present). The three defences most often mentioned were compliance strategy (#1), undergo strategy (#2) and shirk strategy (#14). The plan, distance and joke strategies (#3, #10, #13) were mentioned least. The average number of applied strategies is 5.39 (97/18 teams or cases). On asking teams whether they would think that making defensiveness discussible would be supportive for team cooperation most answered affirmative. One team reported that a stakeholder had a hidden agenda which hampered transparent communication and caused irritation. “If she had told us what the problem was, then we could have helped her to look for a solution”, a respondent told (Team01). Many teams, although not all, acknowledge that defensiveness can be related to risk-avoidance.

Table 1 Self-reported defensive strategies by 18 teams

		N	Mean	SD
(1)	compliance strategy: if your superior persuades you to commit, say that you comply regardless of whether you really do;	14	,72	,461
(2)	undergo strategy: if your superior initiates a change process, just undergo the interventions passively and do not make debatable that you don’t think this is going to work;	11	,61	,502
(3)	plan strategy: agree to make a plan and act as if you comply with the plan; this way you contribute to change and stay in your comfort zone;	3	,17	,383
(4)	blame strategy: if changing does not succeed, blame others and attribute negative intentions to them (scapegoating);	9	,50	,514
(5)	assume strategy: keep your negative assumptions about other individual’s intentions and situations private;	7	,39	,502
(6)	withdraw strategy: in case of difficulties in the communication, do not make this debatable with the persons who are involved; rather, withdraw and think up a new initiative or discuss the difficulties with peers;	4	,22	,428
(7)	ignorance strategy: if you observe patterns that are difficult to deal with, e.g. that your employees are not really committed, do not inquire; rather, increase pressure on them to comply (disregarding);	9	,50	,514
(8)	reduction strategy: if things become threatening or embarrassing, reduce the problem until it is controllable again;	6	,33	,485
(9)	denial strategy: if things become threatening or embarrassing, deny the problem until it is controllable again;	4	,22	,428
(10)	distance strategy: if the discussion comes too close, change the subject to discuss ‘other’ parties or general observations, such as employees, middle management, or ‘the organisation’;	2	,11	,323
(11)	‘we’ strategy: talk in terms of ‘our responsibility’ and ‘what we should do’; as a consequence, nobody has to feel personally responsible;	8	,44	,511
(12)	non-intervention strategy: keep quiet/not confront others with their behaviour so they do not confront you with yours;	6	,33	,485
(13)	joke strategy: if things become threatening or embarrassing, make a joke and change the subject;	3	,17	,383
(14)	shirk strategy: shift the responsibility to an ‘outsider’ and avoid sharing your own opinion about the process or colleagues	11	,61	,502
N (number of occurrences)		97		
Total (min=1, max=9)			5,39	2,06

4.2 Latent and manifest defensiveness and critical incidents, recoveries, IRB and project-success

Because these 14 defence strategies were reported as present during the project in general, it is difficult to assess how it affected the way teams were dealing with critical incidents. For that purpose we investigated the presence of (any of the 14 forms of) defensiveness in its contexts, namely the process of dealing with critical incidents and critical recoveries, where we divided the 18 teams in two groups with high-score IRB-cases (12) and low-score IRB-cases (6). We further linked survey data of self-reported project success to each team. Table 2 presents the 18 cases[1] - a case is a project team carrying out an innovation project. The presence of manifest defensive behaviours (column 4) was assessed on the basis of the face-to-face interviews (verbal and non-verbal information). Manifest means that teams reported they were confronted with mixed messages and ambiguities and that teams were experiencing limited progress at certain moments. These mixed messages were sometimes explicitly associated with limited progress, sometimes this relation was tacit.

The findings of the second step of the analysis in Table 2 indicate the following:

- Teams that performed lower on innovation resilience behaviour (IRB) more often performed 'interpreted manifest defensive behaviour' than teams with higher scores on IRB (5 out of 6 vs. 8 out of 12). Three teams that were not confronted with critical incidents showed no manifest defensive behaviours (Team08, Team05, Team06).
- Eight high score IRB-cases showed defensiveness but were able to contain negative consequences by leadership, transparent co-operation, team building and close monitoring; in none of the cases defensive behaviours seem to negatively affect the course of the project in such a way that these projects fail.
- Six low score IRB-cases showed defensiveness and had difficulties to effectively deal with mixed messaging and ambiguities, i.e. lack of consensus and commitment of management. The low-IRB cases seem to have a stronger negative impact of defensive behaviours on the team processes. One team was confronted with conflicts of stakeholders and no clear support of top management (Team11). Another team faced serious internal resistance to the changes that came with the innovation, although this seemed to have improved in the latter phase of the project (Team10). A third and fourth team suffered from difficult or stiff team co-operation and limited commitment of top management as well (Team02, Team03). The fifth team lacked smooth cooperation between team and team leader, which only changed after a reorganisation (Team13).
- The critical incidents seem to emerge in three clusters: technical issues; decision making; clustered incidents. The critical recoveries cluster in another way: there is an active side where we see team initiative (adjust plan and outcome, monitor, team building, clustered measures), management initiative (new project leader, new steering group, Kanban team, management support), and project management tools (8D team, risk management methods); there is a passive side where we see limited resilience and limited management com-

[1] For the sake of confidentiality the names of teams and organizations are kept anonymous. In Appendix 3 of the thesis a short characterization is given of each case.

mitment, or reactive responsiveness to market demands. The passive actions seem to dominate the low-IRB cases, while the active actions reside more with high-IRB cases.

- High-IRB cases report project success more often than low-IRB cases (75% resp. 40% has a higher score than the mean score of 3,9). From those teams within the group of high-IRB who performed manifest defensive behaviour 33% had a project success score lower than average; for those within the low-IRB group this was 80%.

Manifest defensive behaviour seems to associate with lower IRB-scores[2] and lower project success scores[3].

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[2] Chi-square test for independence indicated no significant association (due to the low number of cases) between IRB and interpreted defensive behaviour, X^2 (1, *n*=18)= .04, *p*= .84, *phi*= -.18. Nonetheless, the correlation showed a between small and medium effect size into the expected negative direction (phi coefficient value).

[3] A Mann-Whitney U test revealed a significant difference in self-reported project success levels of teams with absent or latent defensive behaviours (*Md* = 4.4, *n* = 5) and teams with manifest present defensive behaviours (*Md* = 3.7, *n* = 13), *U* = 7.00, *z* = -2.54, *p* = 0.11, *r* = 0.60. The effect size of the r-coefficient is large. This means that teams with less interpreted manifest defensive behaviour significantly report higher project success.

Table 2 High and Low IRB-cases and the presence of critical incidents, critical recoveries, (interpreted) manifest defensive behaviour and project success (source: Oeij, Dhondt, Gaspersz & Van Vuuren, 2016)

Teams	Critical incident(s) present	Critical recovery(ies) present	Manifest defensive behaviour (yes / no) Interpretation by researchers as manifest (yes) or latent/absent (no)	Project success (self report by team) (1=low; 5=high) Mean= 3,9
High score IRB-cases				
Team15	several technical setbacks	adjust plan and outcome	No to hardly manifest; small team; clear leadership; much trust in team; no significant negative effects	4,0
Team07	clustered small incidents adding up to a critical situation	close monitoring of the actual facts and good working relationship	No; There was a tense relation with external stakeholders, but clear communication prevented defensiveness	4,4
Team09	several technical setbacks	install new steering group and team building	Yes, but only in first half of project; lack of team cohesion, painful relation with steering group and stakeholders, risk avoidance. After recovery more trust and self-confidence	3,6
Team01	several conflicts of interest	close monitoring on the process to be alert for weak signals; strong focus on targeted outcome	Yes; due to limited transparency regarding co-innovation partner, distrust emerged; caused irritation	4,1
Team17	technical setbacks	adjust plan and convince management to make a shift	Yes; but no significant negative effects; small transparent team	4,0
Team08	none	none (not needed)	No; no ambiguities; longstanding cooperation in team; no critical incidents	4,5
Team14	clustered small incidents adding up to a critical situation	clustered measures to recover	Yes; but no significant negative effects; team cohesion is strong; distributed leadership is present in the team	3,7
Team12	clustered small incidents adding up to a critical situation	management support to go along with project	Yes; but no significant negative effects reported; some tension with external stakeholders	4,0
Team16	several technical setbacks	8D teams is a method to deal with issues that enable the process to continue	Yes; but no significant negative effects; distributed leadership is present in the team	4,4

Teams	Critical incident(s) present	Critical recovery(ies) present	Manifest defensive behaviour (yes / no) Interpretation by researchers as manifest (yes) or latent/absent (no)	Project success (self report by team) (1=low; 5=high) Mean= 3,9
Team18	technical setbacks	new project leader, formation of kanban team to settle issues	Yes; but no significant negative effects; clear leadership	4,0
Team04	no progress of the innovation	new leadership, bringing focus on results	Yes; possible effect of defensiveness is trivialised; some tension with external stakeholders	3,6
Team06	no serious CI's because risky situations did not escalate	close monitoring on risky situations to steer when needed	No; strong team cohesion; clear leadership; pro-active communication with stakeholders	4,5
Low score IRB-cases				
Team11	resistance of top management	hardly, due to doubt / resistance by management, delayed decision making	Yes; clear conflicts of interest among external stakeholders; no clear commitment of top management	3,7
Team10	feasibility setbacks	new project leader	Yes; limited commitment outside the core team and resistance to changes; risk of job loss	4,1
Team05	none	none (not needed)	No; project was routine; team was small; no critical incidents	4,1
Team02	dissenting opinions about directions within team	limited because an impasse remained	Yes; team co-operation is difficult / stiff; external attribution towards lack of commitment of top management	3,3
Team03	decision vacuum at team level due to wavering management	limited because an impasse remained	Yes; team co-operation is difficult / stiff; external attribution towards lack of commitment of top management	2,9
Team13	clustered small incidents adding up to a critical situation	market demand forced team to be productive	Yes; suboptimal co-operation within team and with team leader; high workload limits commitment	3,1

4.3 Observed defensiveness: Analysing the discourse

We then analysed the interview recordings on the above mentioned four defensive strategies as the third step of the analysis. These behaviours are often an element or overlap of the 14 organisation defence strategies. Since we do not have operationalisations of any of these 14 strategies at our disposal in order to analyse audio recordings, we constructed a new measuring instrument. The analysis proved to find:

1. Long pausing by eight teams;
2. Joke strategy by five teams,
3. External attribution by eight teams, and
4. Devaluation by five teams.

Sixteen out of eighteen teams performed one or more of these four behaviours. There were 11 out of 12 high IRB-cases that performed one or more of such behaviours and 5 out of 6 low IRB-cases. Low score IRB cases relatively have the most occurrences on the four behaviours, except for joking behaviour. The case with the lowest IRB-score (Team13), for example, was the only one to perform all four defensive behaviours. A similar view emerged related to project success, where lower success associates with more observed defensiveness. We performed Chi-square tests which showed substantial effect sizes in the expected direction but, likely due to the limited number of cases, no significant results[4].

4.4 Pausing

Pauses and hesitancy are linked with fear control when respondents organise their narration (Soroko, 2014). Pausing was measured in time after the question about the 14 defensive strategies was formulated (see above). In the absence of a standard from the literature, a duration of 60 seconds is regarded as reading time needed to understand the 14 defensive strategies as a self-defined norm. There were eight teams that took more time than 1 minute before they responded, which is considered as a pause or hesitancy related with control and to avoid or suppress anxiety. On four occasions respondents requested to repeat or to clarify the question. Apart from this natural response if the question was not clear or too lengthy in first instance, this is a strategy to claim some extra time to carefully consider what to answer.

Examples of asking questions and details are the following taken from four teams (R = respondent of a (team)):

1. R (Team13) : *"What is your point?"*
2. R (Team02) : *"What now is the question?"*

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[4] Chi-square test for independence indicated no significant association between IRB and interpreted defensive behaviour, X^2 (1, n=18) = .04, p= .84, phi= -.18. Nonetheless, the correlation showed a between small and medium effect size into the expected negative direction (phi coefficient value); Chi-square test for independence indicated also no significant association between project success and interpreted defensive behaviour, X^2 (1, n=18)= 2.43, p= .12, phi= -.50. Again, the correlation showed a large effect size into the expected negative direction (phi coefficient value).

3. R (Team11) : *"Shall we read them out loud?"*
4. R (Team15) : *"What was the question again exactly"*

Example 1, 2 and 4 are strategies to gain time to organise the narration, as if the question was not fully understood. In line 1 the respondent asks for the 'point' and in line 4 another respondent wants to hear what is meant 'exactly'.

4.5 Humour

Humans deal with stressors by emphasizing amusing and ironic aspects (Bovey & Hede, 2001b). Laughter, jokes, or making something 'ridiculous', helps to accept that a topic can be taken less serious, thus less threatening. If topics become threatening or embarrassing the application of jokes causes a change of subject as a tension reducing consequence (Ardon, 2009) and as an adaptation to a stressful situation (Larsen et al., 2010). Five teams applied this strategy in the interviews and four of them did so as a first response to the questions about the presence of defensive strategies in the innovation project (see earlier).

1. R (Team13) : While turning to reading the card with 14 defensive strategies, a respondent said:
   "this is gonna be a short withdraw strategy… [ha ha ha..]"
2. R (Team14) : *"It does not look very positive ! [laughing] .. as if we have a culture of blame here [laughing]"*
3. R (Team16): : *"Can I have a copy of this (card), would be very handy! [entire team bursts into laughter]"*
4. R (Team15 : *"Is it allowed to copy these, it is a neat list" [chuckling]"*
5. R (Team18) : While discussing a specific strategy, shirk strategy, making a joke about that strategy in a particular situation, leading on to collective laughter, and then moving on to another issue.
   "what I do myself sometimes is apply number 14, to shift the responsibility to someone else, but that is out of self-protection" Other team members start laughing, and make joking remarks like *'yes, when things go wrong on your side, you shift the problem..'*

These examples illustrate the subtleness of defensiveness as ways to make an issue not discussable or as actions that alleviate the 'heaviness' of the issue.

4.6 External attribution

Projection is a defence when people falsely attribute undesirable actions to others and not to themselves (Trevithick, 2011). Blaming others is regarded as external attribution, i.e. not taking responsibility, not being reflective, and seeing undesirable behaviour as something outside oneself.

Teams differentiate to the extent in which they are either referring to defensive behaviours of their own team or of their environments. In the first place, looking at the list of 14 behaviours, most teams indicate that they recognize and acknowledge that all or most strategies are being applied, albeit not strictly in the project that is under discussion. Respondents also happen to refer to other projects where they recognize these behaviours. In the second place it is observed that eight teams say that those strategies are not performed in their team, or by their team, but in their environment and caused or performed by others. Basically these eight teams say, we see all those defences happening, but not in our team.

Examples are the following:

1. R (Team13) : When discussing the critical incidents the team has to deal with: *"the problem is setting the priorities. This should be done by the management. But they don't do it"*.
2. R (Team02) : Indicating that the organisational structure hampers solutions: *"the problem lies in how it is organised. Apart from that we are all know-it-alls, have our own interests, it is all superhuman, but this organisational background prohibits us from being more transparent"*.
3. R (Team03) : On defensive strategies: *"I do not recognise this in the team. I do however see it in the organisation"*.
4. R (Team11) : *"Yes, I have noticed these behaviours….in our environment.."*
5. R (Team12) : *"No, we do not apply these strategies ourselves. But it happens in other projects."*
6. R (Team17) : *"They all occur. It is mainly political behaviour. But it takes place outside our team. And in other projects"*.
7. R (Team06) : *"I recognise that stakeholders sometimes have ulterior motives. But that does not occur in our team."* Another team member: *"I do not recognise them in this project. It is apparent in the political playing field around us"*.

4.7 Devaluation

Sometimes persons deny defensiveness from happening at all or they downplay its importance by devaluating it. Denial and devaluation or trivialisation is a defence where information or events are rejected or blocked from awareness if considered threatening or anxiety provoking (Trevithick, 2011; also Larsen et al., 2010). Five teams were applying this defence mechanism during the interview on the topic of defensiveness.

1. R (Team13) : After being asked if it is beneficial to teams to make defensiveness discussable, a respondent said: *"When you are in a technical environment, like ours…. it is inconvenient to talk about it. But, suppose, when you are in an alpha-environment, where these issues are more often talked over, it is different. Making defensiveness discussible in our environment means that you make it very uncomfortable for those people. And that is not good for the productivity nor for the process of innovation"*.
2. R (Team13) : After having sketched the critical incidents of the project on a time-line: *"I do not see the link between the figure and the 14 defence strategies. Although I probably can give an example of any of those"*.

3. R (Team02) : Having just read all 14 defensive strategies:
"These are all negative things, but nobody is really into those".
4. R (Team02) : In the third interview feedback was given on self-reported defensive behaviours. Hardly believing this was being said, and as if the researcher had made it up:
"How did you arrive at these results?"
5. R (Team09) : *"Aren't these behaviours that we all have? It is so like how people of this region behave…"*
6. R (Team04) : *"I do not recognise these mechanisms, we are very open. I am not sure what you can get out of these. I don't see it as an issue. I see it as behaviour that I have seen before"*. Another team member: *"This behaviour is not exclusive for innovation processes. It is behaviour (…) Defensive behaviour is human behaviour; we do not see any pros or cons when it comes to innovation"*.
7. R (Team18) : *"I do not think we have these attitudes. For example saying 'yes' and doing 'no', that is not who we are and how we work. (…) Or postponing a topic to be discussed in another meeting. No. If it's up to me, never!"*.

The devaluations differ in their degree of denial. The first one (1) is a defensive reaction towards making defensiveness discussable. The respondent states that defensiveness should be covered-up, otherwise productivity and innovation become threatened. The second example (2) is a straight forward denial of a link between critical incidents and defensive mechanisms, while the fourth one (4) casts shadows of a doubt over defensiveness mechanisms that were discussed in an earlier interview with the team. It implicitly questions whether certain behaviours were really performed by the team. Example 3 and 7 seem to state that it is very unlikely that team members would use any of these defensive mechanisms because their attitude, character and professionalism would prevent them from doing so. Perhaps the respondents interpreted the defensive behaviours as conscious strategies. One respondent said "Luckily we remained free from any such skulduggery" (Team04) as if defensiveness is conscious behaviour and chicanery. The examples, nonetheless, indicate that teams underestimate the unconscious or subconscious workings of defensive mechanisms.

5 Conclusion and discussion

5.1 Inferences

The article researched whether organisational defensive mechanisms could be observed during face-to-face interviews with team members and team leaders of innovation projects in which defensive behaviour in their own projects was made discussible. The main hypothesis that teams with defensive behaviour are more conducive to being in control, to tend to not lose but win, and to try to save face, is partly confirmed. As was shown teams with less innovation resilience behaviour performed more interpreted manifest defensive behaviour and relatively had the most occurrences of observed defensive behaviours. In other words, low-IRB teams might have lower thresholds to perform defensive behaviour in accordance with Model I theory-in-use values. Statistical tests pointed into the expected direction with substantial effects, but with no significant associations due to a limited number of cases, except in one situation, where the degree of IRB seemed to associate positively with the degree of project success. Hence, our second hypothesis, that more defensiveness is associated with less innovation resilience behaviour and lower project success is also partly confirmed.

The main research question 'as innovation team members are supposed to know how to deal with complex projects effectively, are defensive behaviours still to be observed?' results in an affirmative answer. The analyses were triggered by the curiosity that innovation teams responded defensively when the topic of defensiveness during the projects that the teams worked on, was made discussable. There is no reason to think that innovation teams are no different from other types of teams, in the sense that they react similar to situations of threat, discomfort, and embarrassment. Despite the fact that projects of innovation teams might be conducive to more non-routine events, team members are selected to deal with non-routine tasks. Therefore, embarrassing situations probably do not occur more or less compared to non-innovation teams. Yet, the fact that organisational defence mechanisms do occur in innovation teams requires extra attention, because such behaviours could provoke unintended and undesired risk-averse behaviours. A follow up research question that emerges, is whether unintended defensive behaviour partly explains the failure of innovation projects. An indication of the findings that this is a plausible reasoning is the significant association between the presence of team IRB and project success. After all, low-IRB scores not only seem to point to manifest defensive behaviour, but also to lower project success and more occurrences of the defensive strategies pausing, humour, external attribution and devaluation. However, we can draw no final conclusions based on the analysed data.

Another conclusion is that the applied instrument to measure defensive behaviours gives promising results. It can make defensive behaviours tangible, albeit necessary to keep caution in drawing inferences. The approach of using sequencing, thus making the interaction between interviewer and interviewee visible, is to our opinion helpful to enhance the validity of reported results.

5.2 Discussion points

The assumption that respondents are defensive when they are questioned about the defensiveness in their projects could be invalid if respondents are defensive because of the presence of the interviewer. The observed defensiveness would then be some kind of spurious relation where the interviewer functions as a third variable. An open culture in which respondents trust the interviewers and where they feel safe to express themselves, as if they were 'off-stage' - which means speaking without defences contrasted by 'on stage' talk which implies using defences to stay in control, not being transparent, and avoid tension (Pieterse, Caniëls & Homan, 2012; Pieterse, 2014) – was not self-evident. The respondents had not met the interviewer before. Although there was no established rapport, there was also no reason to fear the interviewer, because the interviewer and respondents have no conflicts of interest. It was explained before the interview that the purpose was to learn from critical incidents and not to blame individuals; moreover, respondents were guaranteed that data processing and reporting would be anonymous.

Despite the application of sequencing (Silverman, 2005) to present a more complete picture of the scene, it can be questioned whether certain behaviours are classifiable as defensive or not. For example, it cannot be excluded that the aspect of pausing, which we regarded as fear control, could also arise from the fact that respondents had difficulty finding examples because there are few. We neither paid attention to the opposite of defensive behaviours, controlled risk taking, which perhaps could have brought about balance between both types of strategies.

A specific construct validity issue, pointing to how accurate our observation of reality is made, might be linked by using the term 'defensive' in the interviews. Some respondents associated defensiveness with negative connotations, such as skulduggery or underhandedness. In other words as human behaviour that is unwanted in their teams. While, remarkably, this triggers utterances about Model II values such as an espoused preference for transparency and honesty, the term defensiveness at the same time may evoke defensive responses to deny that the associated sneaky behaviours are not present in the team, as an unaware cover-up strategy.

Defensiveness is to a significant extent intrapsychic behaviour which is not observable and runs the risk of interpretivist behaviour beyond 'low-inference descriptors' (Silverman, 2013). Reliability, arriving at the same insights if other researchers conducted the study in the same manner, comes under pressure when the researchers' own high-inference summaries of the data are preferred over detailed data presentations that make minimal references. Although no observation can be free from the underlying assumptions that guide it (Silverman, 2013), we intended to minimize this high-inferencing by presenting verbatim accounts of what people said, and by including sequencing.

The intrapsychic character of defensiveness that is studied may also be applicable to the main researcher (who did the interviews), in the case of blocking inquiry and learning by defensive strategies. The researcher, when doing the interviews and analysing the data does not openly share his beliefs and reasoning at all times. Moreover, the researcher can be a victim of self-defensiveness in at least three ways (Ardon, 2009): the ignore-strategy in the case of ignoring possible inconsistencies in the argumentation or in the data; the distance strategy can cause distancing from the situations being discussed and focussing on interpreting what is happening, without being part of what actually happened, and turning an abstract analysis into an interpretivist sense making event of others ('thinking for other persons'); a self-censoring strategy could be at play when the researcher keeps his beliefs and thoughts private that could contribute to more inquiry and learning, in order to face saving.

Although we should be very careful in drawing firm conclusions, the research main result is its opening up of an issue not much researched among innovation teams and innovation projects. It is not surprising that defensiveness appears in innovation projects - it occurs in almost all teams -, but that it occurred during the interviews on defensiveness raised the question: 'what is going on here?' A manner to measure organisational defence mechanisms was applied by combining the instrument to assess Model I behaviours by Argyris with defence strategies derived from the psychological and psychiatric literature that could be used for non-patients in non-survey settings. The observed defensive behaviours of pausing, humour, external attribution and devaluation, along with the self-reported defensive strategies, allow for the conclusion that making defensiveness discussible can trigger defensive responses.

In this contribution defensiveness is regarded as detrimental to innovation. Other literatures, like critical management approaches, discuss defensiveness in a less negatively loaded way, and view this less as an organizational problem per se and more as a rational response to repressive managerial practices. Defensiveness is thus a form of resistance, for example pointing to differences in power and status between management and team members that can lead to a conscious and rational wariness and reluctance to consider alternative company policies (Trevithick, 2011). In some of the cases such political conflict or conflicts of interest is plausible, for instance, where business interests and research interests may clash. This form of resistance, however, is not relevant for our argument because such defensive behaviour is a conscious political act, whereas this article deals with subconscious defensiveness.

Despite the indications that high score IRB-cases report higher project success than low score IRB-cases, the data does not allow concluding that defensive strategies significantly hamper innovation success, such as not achieving the innovation project's target. It would be 'high-inference interpretation' to go much further than the observation that there indeed is something going on. After all, some respondents state that defensiveness is just normal behaviour for everyone, and occurs outside the innovation process everywhere. It does not seem self-evident for respondents how defensiveness detection can inform them to improve the innovation process. Argyris (2010) has written about such defensive responses. His answer is in this vein: 'now you know, and you have the choice to so something about it.' Respondents confirmed this as they agreed that team co-operation would enhance when defensiveness could be made discussable.

The study concentrated on Dutch organisations. Although Argyris (1999) contends that defensive behaviour is universal in order to prevent embarrassment or losing face, contextual differences may be an influencing factor. The Dutch working culture, namely, is relatively egalitarian and not strictly hierarchical, and therefore conducive to a relatively open way of communication. Dutch people are known for being rather direct. Perhaps defensive behaviour is less present compared to hierarchical cultures.

Future research could inform on effects of defensive behaviours for projects. This would require a dynamic approach to include the time aspect. Following the model of Argyris and the causal link he makes between governing values, action strategies and outcomes would imply that we should be able to predict the result of behaviours if we can assess what model is 'on': model I or II. Obviously the course of innovation projects would gain tremendously from such insights. Observations and continuous monitoring would be necessary to gather valid and factual data.

A recommendation for practitioners is that it is likely that psychologically safe environments support to make embarrassing events discussable. Perhaps teams with a better developed mindful infrastructure, that enable innovation resilience behaviour (as was confirmed in earlier research, Oeij, Dhondt & Gaspersz, 2016), can better handle emerging defensiveness, because low-score IRB-cases seem to more often bear negative consequences of defensiveness (Weick & Sutcliffe, 2007; Oeij, Dhondt, Gaspersz & Van Vuuren, 2016). Making defensiveness discussible means that it is possible to do something about it. It does not solve defensiveness in the sense that it gets eliminated once and for all, but organisational and team members can learn to bypass these organisational traps (Argyris, 2010).

5.3 Coda: future research

Our effort to understand defensive behaviour during interviewing is novel, as we are shifting from 'validating research' (tied to testing predetermined hypotheses) to 'discovery research' (capitalizing on the emergence of new variables and approaches in the course of research) (Jordan, 2014). The study of defensiveness may need a more comprehensive, interdisciplinary turn to grasp its surprising appearances, as we have experienced. Defensiveness is hard to detect, but might play a significant role in innovation teams and probably beyond. Traditional, rigorous methodologies mainly look at what management science already knows in order to refine it, but 'problematizing' and 'mystery creating and solving empirical material'-methodologies could challenge that status quo (Alvesson & Sandberg, 2013). To unravel 'what's going on?' in situations where defensiveness emerges, we need novel ways for investigation that combine two dimensions at their crossroads. One is the dimension of differing disciplines, which could more learn from each other, like behavioural, business and organisational studies. The other is the dimension of differing quantitative variable-oriented strategies versus qualitative case or agent-oriented strategies that should cross-fertilise better. Such an interdisciplinary 'comprehensive' research approach is capable of 'handling the quantitative all-the-while maintaining its qualitative objective of understanding of the actors as 'knowledgeable agents' (Dana & Dumez, 2015). A broad view on research could just do that, and contribute to an embedded understanding of sometimes surprising organisational defence mechanisms.

Notes

1 Published as Peter Oeij, Steven Dhondt, Jeff Gaspersz & Tinka van Vuuren (2016), Defensive behaviours in innovation teams – how project teams discuss defensiveness and its relationship with innovation resilience behaviour and project success, *Language, Discourse & Society,* 4(2), 15-36.
This chapter is based on Oeij, P., Dhondt, S., Gaspersz, J., & Van Vuuren, T. (2016). Defensive behaviours in innovation Teams - How project teams discuss it. Paper for *Third ISA Forum of Sociology*. 'The futures we want: Global Sociology and the Struggles for a Better World'. RC25 Language and Society, session Discourse in Practice: Microsociology of Social Exclusion and Control. Vienna (Austria), July 10-14, 2016.

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3 The interviewer is a researcher; there is no other researcher present during these interactions.

Chapter 6

Leadership of innovation projects: An explicit formulation and illustration of the reflective practitioner model and an elaboration of the organisational learning model

Based on: P.R.A. Oeij, J.B.R. Gaspersz, T. van Vuuren & S. Dhondt (2016), Leadership in innovation projects: an illustration of the reflective practitioner and the relation to organisational learning. Submitted to *Journal of Innovation and Entrepreneurship,* 2016.

Leadership of innovation projects: An explicit formulation and illustration of the reflective practitioner model and an elaboration of the organisational learning model

Abstract[1,2]

The purpose of this conceptual article is to demonstrate that Donald Schön's *Reflective Practitioner* actually outlines an explicit model of the steps that project leaders in practice apply largely unaware. This reflective research model furthermore can be meaningfully combined with Argyris and Schön's model of organisational learning. The combined research and learning model can support project team members and leaders to enhance their reflectiveness and improve their project success. Eighteen project leaders of innovation teams were studied by means of in-depth interviews aimed at assessing how project leaders act when dealing with critical incidents during their projects. Based on a selection of three project leaders an empirical illustration of Schön's model is provided: they recognized there was a problem, researched the problem, developed alternative solutions, tested different solutions and alternatives on validity, tried out and experimented with solutions, selected and applied a particular solution, and evaluated the process completed. The authors' suggestion for practitioners is applying the combined model of the reflective practitioner and organisational learning, as this can help innovation leadership in practice at both the individual and the team level. The scientific value of this contribution lies in the conversion of Schön's latent (tacit) model into a manifest (explicit) model; and by relating it to the model of organisational learning, a result emerges that is both applicable to future research and practice.

Keywords: reflective practitioner; organisational learning; project management; innovation leadership

1 Introduction

According to Schön (1983) competent professionals are highly unaware that they have a wide range of knowledge when solving issues, which he calls tacit knowing-in-action. They act on skills and experience in an unreflective manner. Some practitioners are able to not only think about what they are doing, but can think about it whilst they are doing it. This Schön calls reflecting-in-action. Schön asserts that professionals often act unaware of their expertise. In his theorising he states that it is very difficult to make such competencies explicit, which is a pity because when such competent behaviours could be made explicit they can be taught and people can learn about them.

This article reports on behaviour of project leaders of innovation projects when these projects encountered critical incidents, i.e. events that could cause a project to significantly deviate from its planning. In solving issues, such as critical incidents, most project leaders use their expertise in tacit ways, and sometimes they reflect-in-action. Analysing project leaders behaviour we discovered that some project leaders use rigorous and investigative ways in problem solving and they even proved to follow a logical model without explicitly mentioning this model. We further noticed when we applied the thinking of Schön on how these project leaders were behaving, that Schön actually has an implicit model of the reflective practitioner, which could be made explicit. Moreover, this model did fit quite well on some of the project leaders. The purpose of this conceptual article is two-fold. First, the implicit model of Schön is made explicit and connected to the theory of organisational learning (Argyris & Schön). In so doing we present a model of reflective practice and organisational learning that can be used for the professionalization of behaviour of project leaders in innovation projects; and perhaps for other kind of projects as well. Second, we illustrate how some project leaders' behaviours are congruent with the model of Schön. These are meant as empirical illustrations and not as full evidence of the validity of the model. The validation of that model is a future step. In this conceptual article we formulate a suggestion for follow-up study, and how the model can be used for the practice of project leader behaviour in innovation projects.

This article, which is conceptual from a theoretical perspective and meant as illustrative from an empirical perspective, is organised as follows. We start by conceptualising the reflective practitioner model and organisational learning. In the next step we introduce the research and present findings about the behaviour of project leaders. Finally we draw conclusions and discuss limitations of the study and avenues for future research.

2 The reflective practitioner and organizational learning

Reflection as research

To Schön (1983), the reflective practitioner is the opposite of a technical, rational problem-solver. The concept of technical rationality rests on a model in which professional activity consists of instrumental problem-solving that is based on the application of scientific theory and technique (Schön, 1983: 21). However, such a rational model tends to be inadequate when it comes to helping society achieve its objectives and solve its problems; indeed, there is increasing awareness that the actual practice of social problems is complex, uncertain, unstable, and inclined to value-conflict, for which the technical rationality model forms an unsatisfactory standard (Schön, 1983: 39). As a result, professionals can suffer from a legitimacy crisis, being swung back and forth between (positivist) rigor on the one hand and (everyday) practical relevance on the other. Schön proposes to discard the technical rationality model, and "search, instead, for an epistemology of practice that is implicit in the artistic, intuitive processes which some practitioners do bring to situations of uncertainty, instability, uniqueness, and value conflict" (Schön, 1983: 49). In Schön's view, competent professionals have a wide range of knowledge, which they apply - being more or less unaware that they do so - when solving certain issues. With this tacit knowing-in-action, as Schön calls it, professionals are able to achieve desired results, by basing themselves on skills and experience in an unreflective manner, or applying a repertoire of 'automated behaviours.' Tacit knowing-in-action comprises spontaneous actions, of which people are often unaware of ever having learned how to carry these out, and which they often cannot describe in terms of the (internalized) knowing which their actions reveal (Schön, 1983: 54). In other cases, though, professional practitioners think consciously about what they are doing whilst they are doing it, because they have been stimulated to do so after being taken by surprise (Schön, 1983: 50).

Reflecting-in-action means that people not only can think about what they are doing, but that they can think about doing this whilst they are doing it (Schön, 1983: 50). For example, professional baseball pitchers can have 'a special feel for the ball': they can try to get the ball to repeat exactly the same successful curve, or 'find the groove', every time they play, which means they try to repeat previously winning moves. In such a case, someone does not only reflect on action, but also in action. Much reflection-in-action hinges on the experience of surprise, or unexpected effects or events; indeed, surprise often evokes the response of reflection-in-action. Schön mentions the example of an improvising jazz ensemble, where all players know the basic theme, but individual musicians respond to one another in order to create a coherent performance as an ensemble. "They are reflecting-in-action on the music they are collectively making and on their individual contribution to it, think what they are doing and, in the process, evolving their way of doing it" (Schön, 1983: 56). A practitioner's reflection-in-action is bounded by the 'action-present', or the time zone in which action can still make a difference to the situation. The action-present may last for only seconds for a sportsman, for days for a lawyer, or as long as months for a project manager, depending on the pace of the activity in question and the situational boundaries of the practice concerned (Schön, 1983: 62).

Reflective practitioners function in a certain practice, the professional situation in which they work. For project leaders such situations are 'cases', or the projects they execute. A professional practitioner is a specialist who encounters certain types of situation over and over again (Schön, 1983: 60). Practicing the practice, the professional develops a repertoire of expectations, images, and techniques. Eventually, the accumulated knowing-in-practice tends to become increasingly tacit, spontaneous and automatic, which means that the professional can act in a highly effective manner by means of tacit knowing-in-action. However, because of the complexity of practices these days, most professionals tend to experience variations in their work situation and, as a consequence, often have to learn new skills. This means that practitioners will also reflect on their knowing-in-practice.

Schön would perhaps disagree with the view of reflective practitioners following certain steps when performing reflection-in-action, as this seems to imply an instrumental approach that closely resembles the technical rationality which he criticizes. Yet it is clear that there is a certain model underlying his ideas. As has also been noticed by other authors, Schön is perhaps more rational than he claims to be (see in: Hébert, 2015), and although his model should not be seen as a simplified linear view of how professionals deal with surprises, it is helpful to try and understand which steps exactly are involved (Schön, 1983: 68-69; 1987: 26-29). Professionals think on their feet, improvise, and act both intuitively and creatively (Finlay, 2008).

As mentioned, the model to be applied consists of a number of steps.

0. Step 0 is when people act routinely, without being conscious of the fact that they are skilled professionals. In a situation of routine, there is no reflection-in-action because a task or operation runs smoothly.[3]
1. In step 1, the practitioner allows him- or herself to experience surprise, puzzlement, or confusion in a situation which is judged uncertain or unique. This may occur when a situation is 'not normal'.[4]
2. In step 2, the practitioner reflects on the phenomena and on the prior understanding which was implicit in his or her behaviour and experience.[5]
3. The practitioner now proceeds to rephrase the situation.[6]
4. In step 4, the practitioner carries out an experiment which serves to generate both a new understanding of the phenomena and a change in the situation.

When reflecting-in-action, the practitioner becomes a researcher in the practice context. The practitioner acts in a way that is independent of established theories and techniques, and constructs a new theory of the unique case. Inquiries are not limited by predefined means and ends, and whilst ratiocinating (reasoning logically) towards a decision, the practitioner does not separate thinking from doing, but builds implementation into the inquiry and experiment, thus converting the decision to action. Because this reflection-in-action is not bound by the limitations of technical rationality, it can proceed even in situations of uncertainty or uniqueness (Schön, 1983).

As the above shows, the practitioner as researcher implicitly applies a research methodology, which consists of the following steps: 1] acknowledging or recognizing a situation as a problem (or an issue that demands a response); 2] investigating the problem; 3] developing alternative solutions; 4] testing solutions and alternatives on their validity, and experimenting with solutions; 5] selecting and applying a solution; and 6] evaluating the result of the (new) process. At the same time, the research route is a learning process, as reflection and learning are closely related.

Reflection as learning

The reflective practitioner is a professional who learns and acts on it. As will be clear, learning is essential during innovation projects, in order to prevent failure and disinvestment. An insight, as far as we know not explicated elsewhere, is that the model of the reflective practitioner can be linked to the theory of organisational learning, which distinguishes between single, double and triple-loop learning (Argyris, 1999: 68; Argyris & Schön, 1974: 18-19; Tosey et al., 2011). If a professional performs a task based on tacit knowing-in-action, learning is limited to building up experience by executing routine tasks. In such situations, a novice learns more than an expert, seeing that the former has less experience. If carrying out a task has the intended result, no reflection will take place. If, on the contrary, there is a mismatch between the expected and actual result, the professional may try to apply an alternative, available action by way of solution. This will be a single-loop learning activity, which means that it involves learning what is already available as knowledge-in-action, which knowledge can be obtained from, for example, one's colleagues.[7]

If the single-loop action does not render a solution, the mismatch between the actual and expected result remains. In such a case, the professional can try to solve the situation by applying a double-loop learning action. This may lead to varying the norms or even existing governing values. It can involve applying a new solution and therefore undertaking a new action, which broadens the action repertoire.[8]

If the double-loop action (still) does not result in a solution, and the mismatch remains, a professional with enough experience and expertise can try to apply triple-loop learning actions. At this level, a professional 'learns-to-learn' and is capable not only of varying norms and make certain adaptations, but also of composing totally new values. This implies that new governing values may emerge, because the existing ones are rejected. The system as a whole changes, as if a paradigm shift took place, resulting in "a corrective change in the system of sets of alternatives from which choice is made" (Tosey et al., 2011)[9]. From time to time erratic events such as serendipity, charismatic behaviours, reckless risk-taking, and foolishness can occur, which set into motion systemic changes. Such triple-loop learning is rare, though, and is not included in the models of Argyris & Schön or Schön (Visser, 2007; Tosey et al., 2011). However, it goes beyond saying that triple-loop learning has "a dark side, is non-instrumental, exists beyond language and is recursive" (Tosey et al., 2011: 303). Because it is risky as well (its 'dark side'), triple loop learning is no guarantee for improvement; just like innovation itself is no such guarantee (Sveiby, Gripenberg & Segercrants, 2012). Indeed, triple-loop learning "cannot be actively planned and may not necessarily have beneficial outcomes" (Tosey et al., 2011: 304). While triple-loop learning bears conceptual relevance to organisational learning, as yet little empirical data on this is available (Tosey et al., 2011). Schön nor Argyris give examples of such a form of learning[10]. Hypothetically, it is conceivable that professionals set disruptive, systemic change in motion as serendipity-driven agents, charismatic change leaders or as foolish and reckless, sensation-seeking individuals.

Integrating the reflective practitioner and organizational learning models

Figure 1 shows a control cycle model, which integrates the reflective practitioner model with the organisational learning model (single-, double- and triple-loop learning). The control cycle model is based on Schön, (1983, 1987), Argyris and Schön (1974), and Bateson's learning levels model (in: Tosey et al., 2011). The steps distinguished in the reflective practitioner model are indicated in the figure as well: 1] within the boundaries of existing norms and governing values, a tacit 'knowing-in-action' is unconsciously applied to execute a task - [A] after execution of the task, its effect is assessed in terms of match or mismatch, which will only lead to a conscious 'reflection-on-action' in case of a mismatch; 2] simultaneously, the professional will experience surprise because of an unexpected outcome; 3] instantaneously, 'reflection within the action-present' is triggered, resulting in a decision to choose a single-loop action (a known remedy, which is expected to lead to a solution); or resulting in 4] 'reflection-in-action'. Once this process is completed, two options for action remain open. One is the double-loop action, and adapts the norms within the boundaries of governing values, so as to design a new solution and experiment and test this on the spot. The other option is to cross boundaries and, apart from changing the norms, also redesign governing values, which means the entire action process changes. Whichever path is followed, the professional will eventually arrive at [B], or the 'ante-action-reflection'. This is a pre-assessment by the professional aimed to judge whether the solution will work. Greenwood (1993) has criticized Schön for omitting reflection-before-action. Such criticism seems valid when it concerns the process of designing a new action (double- and triple-loop) which does not result from knowing-in-action. However, when it comes to routine actions, Greenwood's point does not seem to apply, as such knowing-in-action is actually automated behaviour (single-loop). It could well be that Schön himself would argue that this reflection-before-action is, in fact, part of reflection-on-action, because generally one can reflect on one's own (and others') experiences before one undertakes an action, and reflection is not necessarily limited to the action at hand.

The final option, which is not included in the models of Argyris nor Schön, is to effectuate a triple-loop action, which is disruptive and constitutes a radical, paradigmatic change from existing norms and governing values. This is not a controllable and plannable process, though, and goes beyond what is fully and consciously a reflective act, as the actor does not know what he or she is doing or causing. Triple-loop actions can be spontaneous, impulsive and untested. Paradoxically enough, conscious reflection can get lost in the action itself, which is why such an action can be described as partly explicit and partly tacit.[11]

In Figure 1, the numbered circles correspond with Schön's 'reflection-in-action' model and its implicit sequence of steps. The circle with A is a separate activity in Schön's approach; the circle with B seems to be absent in his model (Greenwood, 1993).

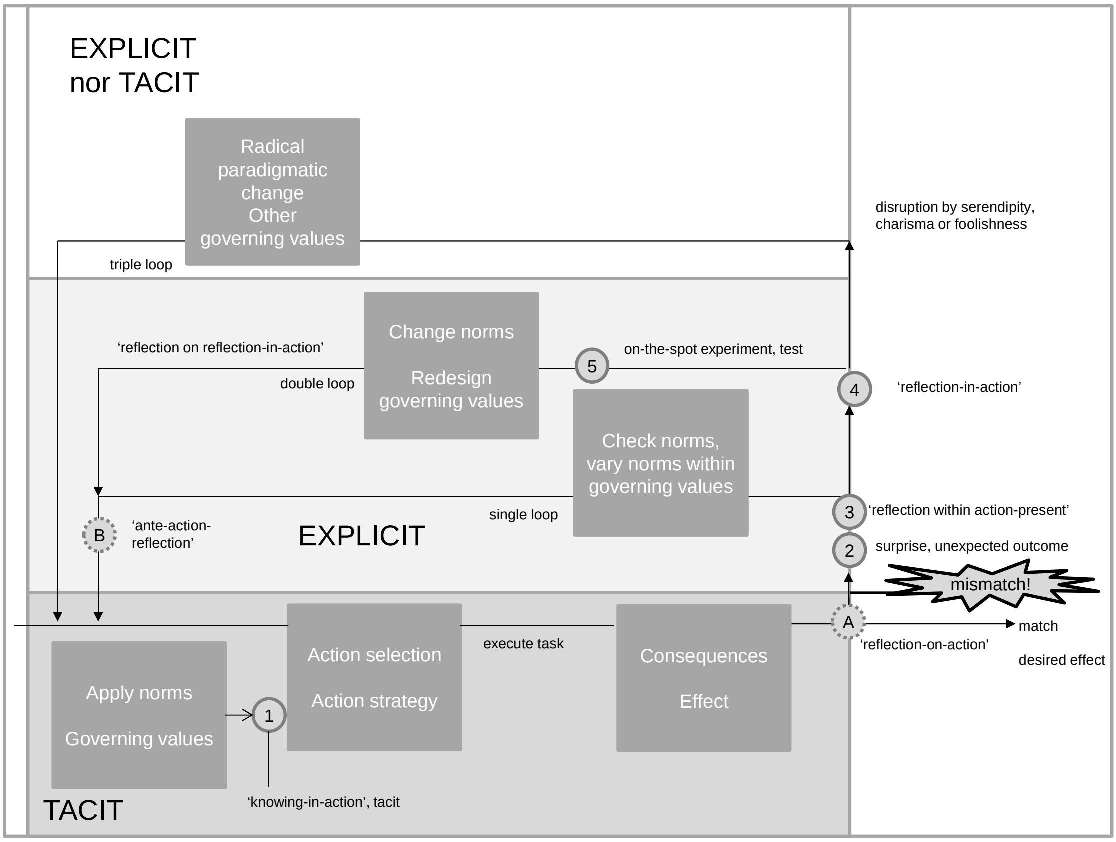

Figure 1 Reflective practitioner model integrated with organizational learning model

Legend:
1 tacit 'knowing in action' to select an action and execute a task
A 'reflection-on-action' to assess match (not necessarily consciously) or mismatch (consciously)
2 (immediately) experience surprise due to unexpected outcome
3 assess next options as 'reflection within the action-present'; select an available single loop action as alternative (norms and governing values remain unchanged) or to design a new action
4 select as a newly to design action a double-loop or triple-loop action by means of 'reflection-in-action'; in case of triple loop action (serendipity, reckless risk taking) a paradigmatic change is caused
5 test the action and gather data to validate; norms and governing values are adapted
B pre-evaluate the effect of the action by 'ante-action-reflection' (does not happen with triple loop untested or spontaneous actions); execute the task and return to A

3 Reflective practice and innovation leadership

The process of innovation projects depends to a great extent on the skills of project leaders and the quality of their leadership (Burke, Stagl, Klein, Goodwin et al., 2006; Müller & Turner, 2010), yet it is often unclear what leadership styles work best in certain circumstances (Clarke, 2012). Innovation projects often suffer from setbacks. What project leaders do during such setbacks is assumed to affect the progress of a project and the innovation that is being developed. Dealing with setbacks is a way of problem-solving, which usually implies making a deviation from rule-based and routinized tasks. Deviations have to be made when setbacks are experienced and reflected upon, a process which leads to learning in terms of modifying beliefs, mental models and knowledge, which eventually results in active problem-solving behaviour (Schley & Van Woerkom, 2014). Schley and Van Woerkom argue that reflection is a basic prerequisite for learning and problem-solving. Learning is closely related to innovation – a precondition even - , and reflective skills are crucial for this (Verdonschot, 2006), being relevant to both project leaders and the teams executing the innovation project. Learning in the workplace occurs when someone senses that his or her own expertise does not meet the needs to fulfil a certain task, and when this problematic task triggers reflection. A problem-solving situation arises if there are certain barriers that prevent the project from moving from its current state to the desired end goal, which means that new behaviours have to be developed by thinking about and reflecting upon the situation. As this implies, reflection is crucial for problem-solving, workplace learning, and professional development[12]. This means that reflection is a conscious, voluntary, and cognitive process (Dewey, 2004: 6), which commences when triggered by errors, mistakes and surprises (unexpected events) of either a positive or negative kind[13]. To authors like Schley and Van Woerkom (2014) and Van Woerkom and Croon (2008), reflection and learning are conscious processes[14].

Innovation leadership, which is a style of leadership aimed at motivating employees to produce creative ideas, products and services (Gliddon, 2006; also Deschamps, 2008), is usually associated with psychological leadership theories, such as the theories of transactional and transformational leadership. Transactional leadership is directed at an exploitative type of innovation, aimed at getting concrete or improved results; transformational leadership, on the contrary, is directed at an explorative type of innovation, aimed at developing new and creative ideas or radical renewal (Jansen, Van den Bosch & Volberda, 2006; Oke, Munshi & Walumbwa, 2009). Transactional leadership seems to be linked to single-loop learning, or developing 'alternative solutions', whereas transformational leadership involves a process of double-loop learning, which involves developing 'improved solutions', or triple-loop learning, in the sense of developing 'innovative solutions' (see Figure 1). While psychological approaches of innovation leadership tend to concentrate on the interaction between leaders and followers on the one hand, and the relation between leadership and organisational aspects (such as culture) on the other (Amabile, Conti, Coon et al., 1996; Basu & Green, 1997; Jassawalla & Sashittal, 2002; Lee, 2008; Sarros, Cooper & Santora, 2008), the present study focusses on the behaviour of the project leaders of innovation projects. However, the idea is not to limit ourselves to a 'trait approach' (Zaccaro, 2007), which is dominant in, for example, Deschamps (2008); rather we acknowledge that behaviour results from the interaction between people and their environment. The interest lies in what project leaders do with regard to the innovation that occupies a central place in the execution of their project. Also, the reflective practice of the project leader is seen as an actionable form of innovation leadership: the project leader leads the project by solving a problem and, more specifically, applies a research-oriented methodology in a tacit, reflective fashion, which stimulates the innovation process of the project. Following Schön, it could be assumed that the project leader performs these actions in a tacit manner, which means that he or she may not be fully aware of applying a stepwise research methodology.

The decision to analyse reflective practices was based on a serendipitous experience we had whilst interviewing project leaders, when we realised that some project leaders apply a research methodology that is analogous to Schön's model of the reflective practitioner. The behaviour of project leaders greatly resembles the implicit or tacit model first proposed by Schön: whilst project leaders consciously solve the problem at hand, they subconsciously or unconsciously apply a variant of Schön's model. In Schön's view, tacit or implicit knowledge is embedded in practice, and actual practice must be reflected upon to make this implicit knowledge explicit, so that improvements can be made (Fook, 2013). This implies that, although practitioners already 'know' about their practice, much of this knowledge tends to be implicit rather than explicit.

In the present study, the main interest lies in the model that is applied by project leaders, and not so much in their intrapsychic introspection and reflection. The model studied is closely related to the notion of organisational learning. The central research question in this study is the following: how do project leaders deal when leading their project and solving or preventing critical incidents; do they perform according to the reflective practice model? Can we make their tacit practices explicit, and translate them into a tangible model that is useful in real life? Based on the above, our primary purpose is to illustrate the process of problem-solving by using the Schönian model. From that practice we induce theoretical notions of organisational learning, with the ultimate aim to support future innovation management processes of innovation project teams. After having integrated the model of the reflective practitioner with the model of organisational learning, and discussed innovation leadership, the methodology and data will be presented, followed by a description of the results. Three examples of reflective practices of project leaders stand out to illustrate the real-life application of the Schönian model.

4 Method of research

Data collection and embeddedness in previous study

The analysis carried out forms part of a broader, earlier study into team dynamics of innovation projects (Oeij, 2013). During this study, the researchers observed that certain project leaders showed particular behaviours that suggested the application of reflective practices. For this reason, it was decided to perform a secondary data analysis of the interview data that were collected earlier. In the broader study, eighteen innovation projects were examined as cases that were carried out by eighteen different project teams. An innovation project can be defined as a temporary task, organised as team work, which is carried out with the goal to develop a new product, service or process to improve an organisation's market share or its internal production process of goods and services. Each case study comprised face-to-face interviews with project leaders, team members, and the managers responsible for the innovation project in question. Also, a survey was carried out, with the same respondents and similar project teams in the same organisations. For the analysis of the present study, mainly the face-to-face interview data of project leaders were used. To provide the broader framework of this conceptual contribution as a background, results of measured leadership behaviour based on the survey data will be used as well.

Method of analysis

During the interviews with project leaders, their project's progress was discussed by identifying critical incidents as milestones: "Through the use of the critical incident technique one may collect specific and significant behavioral facts, providing (…) a sound basis for making inferences as to requirements for measures of typical performance (criteria), measures of proficiency (standard samples), training, selection and classification, job design and purification, operating procedures, equipment design, motivation and leadership (attitudes), and counseling and psychotherapy" (Flanagan, 1954). Critical incidents are events or conditions that interrupt the normal procedure of a project; such incidents can lead to significant deviations from the original plan, and result in setbacks, delays or even termination of a project. Critical recovery takes place when the project gets back on track towards the intended or adjusted goal, which can be achieved by 'speeding up' activity, applying a solution, making a decision, or serendipity. Together with the project team leaders, critical incidents that had caused delay and critical recoveries towards speeding-up situations and getting back on track were assessed. By focussing on the critical incident method, we ensured that in the case studies the problem-solving[15] behaviour of the project leader formed the unit of study[16].

During the interviews, project leaders were asked how they and their teams had dealt with any critical incidents. As it turned out, several of the people interviewed had applied an implicit research methodology that greatly resembled Schön's model; an operationalization and mapping of this model onto the steps of a general research methodology[17] is shown in in Table 1.

This table was used to interpret the interview data. The central topics were the critical incidents and how project leaders dealt with them. Based on the answers to the questions and the storytelling about these incidents, related events and experiences by the interviewee, we used Table 1 as an interpretation grid and recorded whether the steps of the model were absent or present. On the basis of these results we could reconstruct the narrative of this episode on the innovation project. This approach resembles qualitative exploratory data analysis as we perform phenomenon detection, i.e. observing that project leaders apply a systematic model, which normally precedes theory development (Jebb, Parrigon & Woo, 2016). The novelty is that we induce this phenomenon not into a completely new theory, but in the implicit theory of Schön; and as a consequence we are able to make this implicit theory explicit. Jebb et al. (2016) point out that inductive research can also be strongly informed by theory, because the exploration of researchers is guided by their substantive knowledge and their tacit ideas about where meaningful patterns will occur.

Table 1 Schön's reflective practitioner model mapped onto a general research methodology*

Reflective practice	Innovation leadership by applying a research methodology in a stepwise approach
1 Tacit 'knowing in action': performing a task unreflectingly	0 Unconscious task performance (0 because it precedes reflection)
A Assessing if task execution matches or mismatches the desired effect: in case of a match this is an unconscious/subconscious process; in case of a mismatch: 'reflection-on-action'	1 Sensing an unexpected outcome: what is going on? Reflecting on one's understanding of, feelings about and experience with a particular incident
2 Surprise: a mismatch is assessed in the event when the outcome of task execution is unexpected (positive or negative)	2 Experiencing and acknowledging an unexpected outcome: is there a problem? Structuring the incident and bringing it to the surface (explicating what is implicit)
3 'Reflection within the action-present' **	3 Assessing ('scoping') the implication of the outcome (defining boundaries and governing values; critical evaluation of outcomes)
4 Reflection-in-action	4 Assessing outputs and outcomes and developing alternatives (conceptualizing, restructuring)
5 On-the-spot experimenting and testing	5 Experimenting and testing alternatives (general hypothesizing, [re]designing new actions) and striving for validated data (operationalization; putting new actions into a testable framework)
B Ante-action-reflection (not per se in the case of triple-loop learning)	6 Anticipating effects of the newly chosen solution; pre-evaluation (specific hypothesizing)
Performing the task: 'reflection-on-action'	7 Executing the new solution (intervention, implementation of new action)
(return to) A Reflection-on-action	8 Evaluating the outcome of the new action or solution (feedback, a return to 'reflection-in-action' and 'on-action')

* Column 2 are in fact actions undertaken by project leaders of innovation projects as an interpretation of the model of Schön.

** Finding a solution at this level is single-loop in nature; going beyond this stage is double-loop. Single-loop is instrumental means-end reflection on actions (technical rationality), whereas double-loop learning results from of reflection on the norms and values and social relationships (Greenwood, 1998: 1052).

Data and cases

Three cases of leadership behaviour were selected from the total number of eighteen teams. These eighteen teams perform innovation projects. Those projects and teams are selected from profit and non profit organisations in the Netherlands. The purpose of the overall study was to investigate team dynamics during innovation projects in order to determine aspects that can support teams to improve their performance, such as leadership behaviour, resilient team behaviour called innovation resilience behaviour (Team IRB), and achieving project success (Oeij, 2013)[18]. The eighteen team leaders encountered a variety of issues they had to solve, such as technical issues, issues with decision making, or combinations of smaller issues that clustered into bigger ones (Oeij, Dhondt & Gaspersz, 2016). But not all teams were reporting encountering critical incidents (some had none) or project success (some reported lower than average project success). And six of the eighteen teams showed they did not do very well on innovation resilience behaviour; they had a lower than average score on being resilient in dealing with setbacks.

In the end nine project leaders of teams with higher than average innovation resilience behaviour and higher than average project success reports remained. All these project leaders performed parts of the reflective practitioner model, but only three of them applied all parts.

Criteria for inclusion cases of team leaders in this conceptual analysis were the following[19]. First, a critical incident or an anticipated critical incident in the innovation project had been identified as a situation that demanded problem-solving behaviour. The problem-solving behaviour had resulted, or failed to result, in success or critical recovery. As will be clear, the success of problem-solving behaviour does not depend solely on a project leader's behaviour: external factors, such as the behaviour of clients, partners, and higher management, could potentially negatively affect the results of the action undertaken by the project leader. For the purpose of the present study, therefore, the act of problem-solving behaviour of the project leader was more important than the effect it had in terms of success. The second criterion was that it had to be possible to reconstruct all the steps in research methodology that had been implicitly undertaken by the project leader. Apart from the three cases, the other fifteen cases turned out to be less or unsuitable as illustrations of reflective practitioners. Two cases had not encountered any critical incidents, and five other cases no critical recovery, which means that there was no resilient activity or measures that satisfactorily curbed a critical incident. The eight remaining cases had performed critical recoveries, but these were not exclusively related to the behaviour of the project leader. These cases showed, for instance, a combination of measures, the application of project management tools or the intervention of higher management to get the project back on track (Oeij, Dhondt & Gaspersz, 2016). Summarising, three cases had critical incidents or a serious threat of such an incident, did perform resilient activities to prevent or recover from critical incidents, and showed that the project leader played a decisive role in that process. Moreover, these cases could provide easy-to-reconstruct evidence of reflection by the project leader according to the reflective practitioner model, in the sense that the full Schönian model could be reconstructed. Of the eighteen project leaders in the database those three examples stood out: these project leaders had clearly reflected on the situation at hand and on their own behaviour. The three cases selected are presented in Table 2.

Table 2 Cases

Main target of the project leader's reflective practice	Organisation and innovation project
1. Project leader Team01 project: get stakeholders on board	Team01 is an R&D team in the dairy industry; the project is a co-innovation with another company aimed to develop a specific substance as an ingredient for food products.
2. Project leader Team06: continuous impact management	Team06 is an R&D-team of a food and care products producer. The project was set up to use (deploy) a new product much faster than normal. In this project there were no critical incidents, only limited incidents, but there were several high risks of critical incidents.
3. Project leader Team17: redesign the product	Team17 is an R&D team of a company producing automated material handling systems. This team's project was to develop an automatic detection system of human beings by measuring body form and the body heath.

The 18 teams are anonymized for privacy reasons.

5 Results: Reflective practices by project leaders

1. Project leader Team01: get stakeholders on board

William is a highly experienced project manager of innovation projects; he is circa 50 years of age. The innovation project he led was aimed at developing a certain substance as an ingredient for food products; the project was carried out in cooperation with a co-innovation partner (another company). William's role was to bring the right people from the management side of both companies together, and to recruit people from his own R&D team and the R&D team of the partner. Over the years, William had developed his own set of project management tools, which enabled him to steer projects in terms of the '5 Ps': Pace (tempo, timing, meeting), Points (issues), Persons (internal and external stakeholders), Presentation (framing and communication), and Place (where things happen). Based on his experience, he could anticipate certain issues in different project phases. This 'reflection-on-action', or reflection on past experiences, structured his actions. As William explained, it had taken two years before the actual start of the project in question to 'find the right people': approaching the right managers at the right moment to build a business case for the project had been a delicate task. Once the project had been launched, critical incidents arose during the collaboration with the co-innovation partner. The main two incidents were disputes about IP-rights (intellectual property) and the fact that the co-innovation partner had trouble convincing their business side that the innovation objective was good for their own business. The first incident, William said, was only to be expected, because IP-disputes are more or less normal in such situations. Such disputes are often complex and absorb much time. In this case, an external expert had to be brought in to mediate in the matter; however, William had anticipated this and could quickly apply the required scenario. "It was critical, we almost walked out of the project." The second incident was a 'hidden' incident, because their partner failed to inform them that their business had not given the green light to go along with the project and finance the necessary research activities. In fact, their partner kept redefining the objective of the project, which, in retrospect, was done to convince their internal business partner by adjusting specs and scopes. Meanwhile, William had to act on the recurring unexpected delays. Right after the project had been launched, the partner already wanted to redefine the specs. Not only did this threaten progress, but it also endangered the acquisition of internal resources from their own business side, because people grew nervous. To ensure enough progress, William called a meeting during which the project teams of both partners were set the assignment to make a system description. Ten to twelve routes were developed to realise the requirements of these so-called conceptual approaches, after which a limited number of most likely routes were selected. This resulted in five prototypes, with enough cogency to keep the internal business department on board, and let the team continue their research work. A striking feature of this project leader's organisational skills - professional artistry in Schön's words - was his conviction that it was important to hold regular team meetings, even when no new results had been realised. "Projects need rhythm. Regular meetings provide rhythm but also create a sense of urgency and cohesion. I firmly belief in doing things together, making plans together, and listening to what people have to say. Even when you do not have a clear reason for meeting up, it is always valuable." According to William, the results of such regular meetings are new ideas, hunches, and unexpected yields.

2. Project leader Team06: continuous impact management

Marcus is an energetic and experienced project manager in his early forties. The innovation project he led was aimed at bringing a new product on the market, called deployment, which implied preparing the production process, including packaging and transport, and getting the product 'on time in full on the shelf' of targeted retail businesses. The normal time for such a deployment process needed to be cut in half, which was deemed nearly impossible. Although not a critical incident yet, a risky situation arose that could easily become an incident. The purpose was to launch the new product line quicker than competitors in the same market segment. Marcus accepted the challenge, built a project team, and scrutinized and anticipated possible caveats, after which he and his team closely monitored the process of preparing, testing and executing production, whilst keeping an eye on the entire line from factory to consumer. His reflection-in-action was based on his reflection-on-action in former deployment projects. Despite the presence of a high risk of critical incidents, due to extremely tight planning, the project went well. As the preparation, testing, production and transportation of the product were tightly interrelated, one serious mishap could have meant a delay in the product launch of six months. Unplanned issues that emerged were sudden changes in the production lines, a cap of a mismatching colour, a new tube that burst during production, and spare parts that were delivered too late to another production site. The project leader and his team anticipated any possible problems at every stage of the project: they kept 'going up and down the project' in order to assess and monitor possible risks, the possible consequences of these risks, and developed back-up plans. "We had an extremely high number of back-up plans, like I've never seen before." Throughout the project, they communicated intensively with their partners at local test and production sites. For any unplanned issues that occurred, solutions were quickly developed. Meanwhile, the project leader communicated any progress and setbacks in detail to the business side, the actual marketing department that had commissioned the project. As this shows, the project leader kept going through the research methodology, as if it were a cycle. Whilst the organisation used tools for continuous impact management and consequence management, and trained its staff to employ these tools, the project leader's professional artistry lay in how he managed the expectations of stakeholders and suppliers. "You must know how the game is played here." Marcus knew what marketing and business need. He discussed every relevant detail with the different departments, keeping them feel fully informed and getting their immediate feedback on how to proceed. He was familiar with how higher management judges and evaluates progress. For example, information about the mismatching colour cap could have been fateful if it had been given too early in the process, but by timing this news cleverly at the point of no return, accepting it as a fact was traded off against meeting the deadline. "You know, when a deadline approaches fast, details become less important, like the colour of the cap. They decided to leave it as it is, which we had anticipated". Marcus knew how to put the right (contractual) pressure on suppliers, so as to get them to solve the issues they were responsible for in a timely manner, and prevent his own project from getting delayed. One mitigation measure he took was to split up production lines in order to minimize risks; another was to plan production first and the tubes later. In all these activities, the golden rule was to provide the solution before a problem was brought to the table.

3. Project leader Team17: redesign the product

Alexander, an entrepreneurial person in his mid-thirties, has worked as a project manager for a few years. The purpose of his team's innovation project was to develop an automatic detection system of people by measuring body form and body heat (3D and infrared) on a conveyer belt system. He and his team members joined the project at a late stage, inheriting the task from their predecessors. The predecessors had already performed the feasibility study and defined the scope of the project, and the new team continued from the point where the old team had left off. Along the way, several critical incidents occurred, in the form of technical setbacks to do with camera hardware, image processing, and the software from an external supplier. At a certain point, the project reached an impasse. The accountable manager wanted the team to continue according to plan, because so much had already been invested and the business case still seemed valid. However, Alexander sensed that the original plan would not work and wanted to find alternative ways, exploring other avenues that might be more fruitful. He started meetings with other R&D-people, organised a work session with his team, and soon some new ideas emerged, which he wanted to test. "A conversation of one hour with a software developer resulted in a new concept, which we explored further with the team." Yet the accountable manager wanted the team to continue with the original plan, which the team duly did, until a few months later, when they reached a dead end. This opened the way to present the new ideas to the management team, who soon grew convinced of the possibilities. Alexanders' reflection-in-action was to try and change tack when he sensed the old idea would not work and a new idea seemed more promising. He consulted others on the validity of his hunches, and gradually developed new ideas. He let the team prepare presentations supported by the evidence needed for the management team to be convinced of the worth of changing course. The evidence-based presentations were important to persuade both the project manager and the management team.

4. Overall view

Table 3 summarizes the findings in terms of the research methodology (as set out in Table 2). In all three cases, reflection could be perceived, and more occurred than just tacit 'knowing in action' or performing a task without giving it any thought. In all cases, the project leader assessed whether the execution of the task matched or mismatched the desired effect, and they sensed the likely risk of a mismatch: 'reflection-on-action' was triggered by looking at what was actually happening (Alexander; William in the case of B) or what might or might not happen (William in the case of A; Marcus). In William's case B (the partner redefines the scope) and Alexander's case (the design does not work as planned) what Schön would call a surprise occurred, as the mismatch was assessed as an unexpected outcome of task execution. In all three situations the project leader's reflection remained within the 'action-present', and their solutions were partly single-loop actions. This means that the solutions they applied were to a degree instrumental means-end reflection on actions (technical rationality), as they fell mainly within existing values and norms. Yet at the same time, the solutions applied could also be described as double-loop learning actions, resulting from reflection on norms and governing values. Marcus' solutions to keep the deployment project on track remained within the boundaries of deadlines and quality norms, and was therefore single-loop; however, he crossed the boundaries of existing values in the way he dealt with suppliers – note that he showed risk-taking and not reckless behaviour in the entrepreneurial sense of the word. Moreover, when he accepted the assignment he negotiated with his managers to loosen the rules of the stage-gate model which is usually applied in deployment projects. Alexander and his team developed a new design that was partly based on former feasibility studies, but they added new technical insights that lifted the solution to a double-loop form of action. William's solution for the IP-rights issue - calling in the help of an external expert - was a single-loop solution or a foreseeable intervention. His solution to deal with the partner's continuous redefinition of the objectives and scope of the innovation required solutions beyond the standard model of his own project management tools. Although it is true that he was equipped to cope with unexpected situations, William's design of the system description session included elements of improvisation in order to reach consensus with external and internal partners. Stretching the rules to keep partners on board and keep the business case clear for his own commercial department makes this a double-loop solution.

While this reflection-in-action shown by the project leaders took place within the action-present, the experimenting and testing they did were also carried out within the action-present. Broadly speaking, one could call this 'on-the-spot experimenting and testing.' Before implementing their solution, the project leaders reflected on the possible effects of the actions they were about to undertake, which could be seen as ante-action-reflection. The clearest example of this is the presentations given by Alexander and his team, which formed a pre-evaluation of what might be expected from the new design. This return to reflection-on-action by the project leaders closes the circle of the Schönian model.

Table 3 The research methodology applied by project leaders of innovation projects

Innovation leadership by applying a research methodology as a stepwise approach	Team01 project leader [A and B here refer to 2 critical incidents]	Team06 project leader	Team17 project leader
1. Sensing an unexpected outcome: what is going on? Reflect on one's understanding, feelings and experience of an incident	A]Pre-sensing possible risks with IP-rights B]Experiencing delay and redefinition of objectives	Anticipating issues that are expected to emerge	Sensing that present design is not going to work
2. Experiencing and acknowledging an unexpected outcome: is there a problem? Structuring the incident and bringing it to the surface (explicating what is implicit)	A] IP-distribution needs to be settled B] Objective must be made clear in system description	No unexpected outcomes due to anticipation and being alert; risks are explicit	Acknowledging that a new design is needed
3. Assessing ('scoping') the implication of the outcome (defining boundaries and governing values; critical evaluation of outcomes)	A] Action is a single-loop solution: intervention by expert B] Action is a double loop solution: arranging a special session	Action is single-loop: keeping risks within manageable boundaries; and double-loop: creating workarounds when needed	Action is single-loop: finding new ideas partly based on former feasibility studies; and double-loop: developing additional solutions based on new technical insights
4. Assessing the outputs and outcomes and developing alternatives (conceptualizing, restructuring)	A] Agreement on IP-rights will continue the project with the partner B] Developing routes will continue cooperation and team work	Back-up plans are made for likely deviations	Developing a new design by consultation of others and team
5. Experimenting and testing alternatives (general hypothesizing, [re]designing new actions) and striving for validated data (operationalization; incorporating new actions into a testable framework)	A] Consensus is drive for sharing business with partner B] Trust is a drive for collaboration with the partner team but not always achieved	Solutions for emerging issues are designed on the spot	Gathering evidence-based information, preparing and giving presentations
6. Anticipating effects of the newly chosen solution; pre-evaluation (specific hypothesizing)	A] IP-right distribution is a condition for sharing B] A good business case will convince business side of partner	Solutions for issues are provided to stakeholders in advance to gauge their responses	Building a business case for the new design
7. Executing the new solution (intervention, implementation of new action)	A] Effectuated B] Effectuated	Effectuated	Effectuating new plan
8. Evaluating the outcome of the new action or solution (feedback, a return to 'reflection-in-action' and 'on-action')	A] Cooperation continued B] Five prototypes were developed in the end	Project debriefed to gather lessons learned	Execution is underway; expectations are favourable

6 Conclusion

In all three cases studied, the project leaders of innovation projects acted as problem-solvers and applied a Schönian model of reflective practice that closely resembles a research methodology. This research methodology goes beyond rational-technical instrumentalism, as it combines with the project leaders' professional artistry or skill, which efficiently and effectively supported them whilst sensing, designing, testing and implementing solutions. Professional artistry is a personalized capability to design solutions according to one's reflective appraisal of events, situations and relations, which cannot always be expressed in words, according to Schön. Mostly unaware of the Schönian model, the project leaders studied each had their own problem-solving methods and ways of dealing with critical incidents. However, despite the fact that their problem-solving was not merely instrumental, they all took more or less the same steps. They all sensed or foresaw an undesired outcome, which triggered the need to find out what was going on, and led to a search for alternative solutions. These alternatives were tested on their likely consequences, and subsequently implemented and monitored. When project leaders reflect-in-action, they are likely to reflect on both past actions and future outcomes; when they design solutions consciously and deliberately, they seem to apply ante-action-reflection. As the cases of William and Marcus show, if project leaders anticipate critical incidents, they can undertake single-loop actions; however, at the same time, they can flexibly add double-loop actions when needed, as could be seen when William and Marcus created workarounds to stretch their 'action present'.

Our findings have certain implications for innovation projects, both from the perspective of organisational learning and that of innovation leadership. First, the organisational learning model makes a distinction between single-, double- and triple-loop learning. In our small sample, the three project leaders applied single-loop learning actions for solutions which were already part and parcel of their repertoire of available actions. Double-loop learning actions were designed to implement solutions that went beyond the present norms (standards) but fell predominantly within governing values (corporate rules of the game). The double-loop learning actions showed more of the project leaders' professional artistry or skill. Triple-loop learning did not take place in any of the cases studied.

Second, innovation leadership means that one influences others in order to achieve innovation success. Reflective practice is not always or easily observable; however, just as professional skill, it can be observed in its effects. Such effects can form a subject for reflection and imitation by team members, and thus offer an opportunity for learning and obtaining new knowledge-on-action. Making this tacit research methodology of project leaders explicit (see the organisational learning model in Figure 1) would be beneficial to other project leaders and for project teams doing innovation projects.

7 Discussion

From a research point of view, there are some limitations to this study. First of all, our selection of examples is very small, which does not allow for generalization to a higher level, but only serves to confirm our theoretical conceptualizations. Second, the original sample of 18 projects was not targeted at analysing the reflective practice of project leaders, but aimed to arrive at a broader understanding of team dynamics in innovation projects. The present study followed an unexpected serendipitous hunch the researchers had after having completed the basic field-work. Third, deducing reflective behaviour of professionals from face-to-face interviews suggests that the researcher can retrospectively objectify what a practitioner has been doing whilst being unaware of doing it. This 'thinking for others' can be invalid if not tested properly. The validity could have been approved if the findings had been discussed with the respondents.

In order to meet these limitations a follow-up research is needed that at least takes two steps into account to support the validity of results. The first step is to use an instrument that enables the valid measurement of each of the steps of Schön's model and the second step is a way to analyse the data resulting in highly reliable interpretations. In this study we did not have such instruments. In fact, we followed a hunch to understand what we experienced as it emerged. Future studies could for example develop a validated instrument before data are being gathered and apply inter-rater reliability by having the data analysed by more researchers. Other than our exploratory analysis which performs phenomenon detection that precedes theory development, hypotheses could be formulated to be tested on new data sets. In order to validate the conceptual theoretical notions of the reflective practitioner and the application of a rigorous research methodology as a behavioural tool in leading innovation projects, future research is needed to test the hypothesis that effective problem-solving project leaders apply such models when critical incidents occur. Taking into account the risk of social desirability in answering questions, a combination of observation of project leader behaviour and measuring the presence of the steps of reflective practitioner model (see Table 1) via interviews or surveys could be a fruitful avenue.

A final note of self-criticism is that we may have given the impression that making Schön's tacit model explicit is to give it a rational-technical turn. To a certain extent this is no doubt true, yet doing so seems unavoidable if one wishes to gain an understanding of what goes on in organisations. Such tensions between wanting to know and realising that rationality has its limits, which are hard to avoid. Our integration of reflective practice and organisational learning could be described as a 'too neat' exercise, reminiscent of the 'paradox of coerced freedom' (Dalton, 1959: 243) identified long ago, which describes how leaders and managers have a certain amount of freedom to act on their own (informal organisation) as long as it does not harm superiors (formal organisation). Double- and triple-loop actions may require the freedom necessary for innovation, yet they constitute a conflict with the organisational standard model, which, in its turns, touches upon the question of which values promote the best way to move forward.

From a theoretical point of view, we have limited reflective practice to situations of problem-solving by project leaders of innovation projects. We could easily be criticized for ignoring team contexts and the interaction with others, and making a quick connection between an individual's intrapsychic and extra-psychic behaviours. We do acknowledge that these are important issues, which can perhaps be explored by others (for criticism on Schön, see also Finlay, 2008). However, we would like to stress the relevance of individual reflection for innovations brought about by teams. Reflection is essentially an individual's intrapsychic activity. "What presents a large challenge for individuals is all the more so for teams and especially teams that are working together in projects as they are faced with problems that can seldom rely on routines as project work is highly problem based"(Schley & Van Woerkom, 2014: 116). This means that reflection in teams or team reflexivity (the extent to which teams collectively reflect upon and adapt their working methods and functioning) is crucial for team learning and innovation (Schippers, den Hartog & Koopman, 2007; Schippers, Den Hartog, Koopman & Van Knippenberg, 2008; Schippers, West & Dawson, 2015), and arrive at effective and efficient team work (Schley & Van Woerkom, 2014). Other researchers have found that, for teams working on innovative projects, team reflexivity shows a positive association with team effectiveness, but not with team efficiency (Hoegl & Parboteeah, 2006). Research on favourable conditions for team reflexivity points to transformative leadership (Ollila, 2000), the team leader as initiator, and the importance of psychological safety (Schley & Van Woerkom, 2014). In order to promote innovativeness at the project level, project leaders need to consider how their leadership influences the behaviour of the different project members (Ollila, 2000; Clarke, 2012)[20].

For practitioners, the take-home message rests on the notion that critical reflection can form a weapon against organisational inertia and the cover-up of undesired situations that require a change, as can sometimes happen during innovation projects. Technical rationality closely resembles the dominant theories-in-use in organisations. Theories-in-use often represent the single-loop norms and governing values on which everybody unconsciously agrees. Even if theories-in-use do not work, people will hesitate to refute them, for fear of appearing incompetent or disloyal (Argyris & Schön, 1974, 1996; Schön, 1983). However, as our discussion of reflective practices and professional artistry shows, a new theory-in-use can emerge that specifies double-loop norms and governing values on which most people agree when they are made explicit; examples are valid information, free and informed choice, and internal commitment to the choices made (Argyris & Schön, 1974: 87)[21].

An important prerequisite to benefit from reflective practice for innovation seems that professional artistry or skill and its value are made explicit. Ultimately, it should be accepted that there will always remain a paradoxical tension between technical rationality and the 'arts' of professionals; however, organisational members have to become aware of the choice they make about their espoused and applied theory-in-use. A practical means to align one's espoused values with the theory-in-use is to apply the steps of the reflective practitioner and organisational learning model (see Table 1 and Figure 1) when mismatches are experienced. To make innovation leadership a team attribute, it is recommended that this model be applied at the level of the (project) teams when critical incidents are met [22].

Notes

[1] Submitted, without the endnotes in this chapter, as P.R.A. Oeij, J.B.R. Gaspersz, T. van Vuuren & S. Dhondt (2016), Leadership in innovation projects: an illustration of the reflective practitioner and the relation to organisational learning. *Journal of Innovation and Entrepreneurship*.

[2] This chapter is based on: Oeij, P., Gaspersz, J., Dhondt, S., & Van Vuuren, T. (2016). Innovation leadership in innovation projects: The application of the reflective practitioner model. Paper for *Third ISA Forum of Sociology*, 'The futures we want: Global Sociology and the Struggles for a Better World'. RC52 Sociology of Professional Groups, session Uncertainties, Reflexivity and Rigidities in Professional Work. Vienna (Austria), July 10-14, 2016.
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[3] "There is, to begin with, a situation of action to which we bring spontaneous, routinized responses. These reveal knowing-in-action that may be described in terms of strategies, understandings of phenomena, and ways of framing a task or problem appropriate to the situation. The knowing-in-action is tacit, spontaneously delivered without conscious deliberation; and it works, yielding intended outcomes so long as the situation falls within the boundaries of what we have learned to treat as normal" (Schön, 1987: 28).

[4] "Routine responses produce a surprise – an unexpected outcome, pleasant or unpleasant, that does not fit the categories of our knowing-in-action. Inherent in a surprise is the fact that it gets our attention" (Schön, 1987: 28).
"Surprise leads to a reflection within an action-present. Reflection is at least in some measure conscious, although it need not occur in the medium of words. We consider both the unexpected event and the knowing-in-action that led up to it, asking ourselves, as it were, "'What is this?' And, at the same time, 'How have I been thinking about it?' Our thought turns back on the surprising phenomenon and, at the same time, back on itself" (Schön, 1987: 28).

[5] "Reflection-in-action has a critical function, questioning the assumptional structure of knowing-in-action. We think critically about the thinking that got us into this fix or this opportunity; and we may, in the process, restructure strategies of action, understanding of phenomena, or ways of framing problems" (Schön, 1987: 28).

[6] "Reflection gives rise to on-the-spot experiment. We think up and try out new actions intended to explore the newly observed phenomena, test our tentative understandings of them, or affirm the moves we have invented to change things for the better (…). On-the-spot experiment may work, again in the sense of yielding intended results, or it may produce surprises that call for further reflection and experiment" (Schön, 1987: 28).

[7] "Single-loop learning occurs whenever an error is detected and corrected without questioning or altering the underlying values of the system (…) when matches are created, or when mismatches are corrected by changing actions" (Argyris, 1999: 68).

[8] "Double-loop learning occurs when mismatches are corrected by first examining and altering the governing variables and then the actions" (Argyris, 1999: 68).

[9] Tosey et al. (2011) refer to Bateson's III-rd level of learning, which they regard as exemplary for triple-loop learning.

[10] Argyris and Schön (1974) do mention deutero learning, which is not equivalent to triple-loop learning, but points at reflexivity in processes of learning at either single-loop or double-loop learning levels (Visser, 2007; Tosey et al., 2011), which Visser (2007) dubs meta-learning.

[11] As in Bateson's level III of learning (Tosey et al., 2011).

[12] Reflection often involves a deviation from routine and rule-based behaviour; however, it is "only triggered if there is an instruction or the appearance of any failure within routines, for example, through errors, obviously and surprisingly changed conditions, questions and dissatisfaction, and these circumstances offer the possibility of solving the problem or breaking up routines and inducing workplace learning" (Schley & Van Woerkom, 2014: 115). Schley and Van Woerkom define reflection as "the deliberate realisation and critical analysis of a memory content (object of reflection as a thought) using the mechanisms of recapitulation and reconstruction." As they state, "the reflectitioner looks at various perspectives and varying viewpoints (extent of reflection), in regard to different qualitative outcomes of the learning potentials (levels of reflection) and its possibilities to learn and solve problems as a kind of Munchhausen trick, to lift oneself up by one's own bootstraps" (Schley & Van Woerkom, 2014: 118).

[13] Yet positive or negative emotion-based evaluations, such as "(1) surprise, interest and fright; (2) palatableness, approximation / prevention and passion / disinclination; (3) fright and anger vs. pleasure and satisfaction", are not sufficient to act as triggers. As Schley and Van Woerkom claim, reflection processes will only begin if appraisal comes from the fourth level of intellectual regulation, that of "(4) confidence vs. fear, awkwardness and depression"; if it is not, people will try to perform routines and show automated, rule-based autonomous reactions,

(Schley & Van Woerkom, 2014: 120), all of which share the characteristic of being carried out at the unconscious or subconscious level.

[14] However, other authors claim that people also learn from routine and rule-based processes, even though such processes arise from tacit knowledge and are carried out unconsciously or even subconsciously (Argyris & Schön; 1974, 1996; and Schön, 1983, 1987, 1991).

[15] Schön's model revolves around forms of problem-solving rather than trouble-shooting. Problem-solving strategies revolve around the steps someone undertakes to find the problem(s) that prevent the attainment of a certain goal; taken together, these steps form, as it were, a 'problem-solving cycle'. Such a cycle consists of: recognizing the problem; defining the problem; developing a strategy to fix the problem; organising one's knowledge of the problem cycle; acquiring the resources that are at one's disposal; monitoring progress; and evaluating the solution in terms of accuracy (Bransford & Stein, 1993). Troubleshooting constitutes a subset of problem-solving, which is often applied to repair failed products or processes. In general, troubleshooting is the identification or diagnosis of "trouble" in the management flow of a corporation or a system, caused by some sort of failure. The problem is initially described as symptoms of malfunction; troubleshooting is the process of determining and remedying the causes of these symptoms (https://en.wikipedia.org/wiki/Troubleshooting; accessed January 3, 2016).

[16] Other researchers have also examined reflective practices by applying the method of critical incidents (see, for example, Kressel, 1997; Verdonschot, 2006; Fook, 2002, 2013; Schley & Van Woerkom, 2014). As Fook states: "One of my favourite tools for accessing practice is the description of critical incidents by practitioners (…), because, if I am aiming to theorize from practice as it is experienced by others, I find it best to elicit their own descriptions of their practice, rather than to study accounts which have been constructed in some other way or for some other purpose" (Fook, 2002: 89-90, italics in original).

[17] The steps (circles with figures and letters) of Figure 1 are shown in the left-hand column of Table 1.

[18] The study included 'behavioural complexity in leadership' which measures the capacity to exhibit a broad array of contrasting or competing behaviours (Lawrence, Lenk and Quinn (2009). The behaviours are to collaborate, create, control and compete and form four subscales (comprising 36 items) representing leadership roles or styles that are more or less competing with each other. Different situations demand different styles. Complexity leadership was measured by asking project leaders and team members how skilled they assess their project leader in these aspects on a 5 point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (5). Here project and team leader are synonymous. In the mentioned overall study it was researched whether complexity leadership contributed to team behaviour that is characterised by being able to solve critical events and setbacks during the project. This team behaviour is called 'innovation resilience behaviour'(Team IRB), defined as a set of team competencies that can make a team anticipate on unexpected events, manage these events, and bounce back on the right track once a project takes or already has taken an ineffective course (a mishap) with regard to its innovation goal. Team IRB was measured with an instrument based on the work of Weick and Sutcliffe (2007: 94-102), who developed this instrument based on five principles that make teams operate reliably under difficult circumstances (namely preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience, and deference to expertise). IRB (consisting of 48 items) was measured by asking respondents to what extent it was present in their project team on a 7 point scale ranging from 'not at all' (1) to 'to a very great extent (7) (Oeij, Dhondt & Gaspersz, 2015). Respondents were project leaders and team members of the 18 teams and an additional group of comparable project leaders and members. A total number of 222 respondents completed the survey. Based on all respondents to enable statistical robustness the relation between the four leadership styles and IRB was analysed by Mann-Whitney tests, which all resulted in positive, significant effects of a medium effect size. Teams with a low level IRB-score significantly report lower levels on each leadership style compared to teams with a high level IRB-score. Mann-Whitney U Tests revealed a significant difference in IRB levels as reported by the team leader and team members and the report of their team's: 1] collaborate-leadership style: low-level IRB teams (Md = 2.56, n =91) and high-level IRB teams (Md =3.89, n =106), U= 3115 , z=-4.29 , p= .00, r= .31; 2] create-leadership style: low-level IRB teams (Md = 3.67 , n =102) and high-level IRB teams (Md = 3.89 , n =115), U=3899, z= -4.27, p= .00, r= .29; 3] control-leadership style: low-level IRB teams (Md = 3.44 , n =103) and high-level IRB teams (Md = 3.89, n =119), U=3538.5 , z= -5.43, p= .00, r= .36; and 4] compete-leadership style: low-level IRB teams (Md = 3.33 , n =101) and high-level IRB teams (Md = 3.67, n =112), U= 3931, z= -3.85, p= .00, r= .26. This implies that high level IRB teams have a richer spectrum of leadership behaviours present. One can reason that in such teams leadership is better able to adapt to changing needs and circumstances. For selecting team leaders for this article, the eighteen teams

were checked on their score on IRB. Based on this score and information from the case-study in-depth interviews 12 cases were qualified as high-level and six as low-level IRB. The high-level IRB teams report on average that 2.58 leadership styles out of four were present in their team (those styles were rated by the team as above the average of the total score of that style); the low-level IRB teams reported 1.2 styles to be present.

19 Apart from the two criterion mentioned below, a the third criterion, that is related to the survey-data on leadership, was that the selected project leader is from one of the teams with a more than average score on both innovation resilience behaviour and project success, because Team IRB is positively associated with project success (Oeij, Dhondt & Gaspersz, 2016).

20 Innovation at team level can also benefit from facilitating certain organisational features, an example of which is the development of mindful infrastructures (Weick & Sutcliffe, 2007) which stimulate team mindfulness, team psychological safety, and team learning (Oeij, Dhondt, Gaspersz & De Vroome, 2016). Facilitating such organisational features could provide a better ground for a team's reflective practice during the implementation of debriefings and briefings (Schley & Van Woerkom, 2014). Debriefings – reviews afterwards – and briefings – preparations in advance – are consonant with, respectively, team reflection-on-action and team ante-action-reflection. Such briefings and debriefings are indeed common in High-Reliability Organisations (Weick & Sutcliffe, 2007) but, perhaps wrongly, as seen as less urgent in market and public sector organisations, where the emphasis lies on the need to be or remain innovative for the sake of competition, the cost effectiveness and the quality of products and services, and the staff's quality and their innovative capabilities.

21 This new theory-in-use, based on espoused norms and values, demands critical opinion-sharing and critical reflection. If it enables conversation with and feedback from others, such reflection may help to critically evaluate what has thus far been taken for granted (Brooks, 1999; Van Woerkom & Croon, 2008). This is exactly why Schön stressed the importance to create space for professionals, specifying it as a condition for making a discussion about defensive mechanisms feasible; thus 'discussing the undiscussable'. Enough space also means enough time (Raelin, 2002), and since time is money, creating space implies giving 'slack', because learning requires time (Schein, 2002). The valid Return On Investment on a medium or longer term of these investments will be a successful innovation process for businesses, whereas the valid ROI for HROs will be safety (Weick & Sutcliffe, 2007).

22 Leadership today requires being able to apply the needed style to differing situations (Burke et al., 2006). Teams with high levels of IRB have a richer repertoire of collaborative, creative, controlling and competing leadership styles. Future research could investigate the relations between those styles and acting as a reflective practitioner. It seems plausible that effective innovation leadership can not fully benefit from a rigorous research-oriented style if leaders cannot flexibly handle situational diversity and change.

Chapter 7

Innovation resilience behaviour and critical incidents: Relevance to the management of R&D and innovation projects

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Innovation resilience behaviour and critical incidents: Relevance to the management of R&D and innovation projects

Abstract[1,2]

Eighteen project teams carrying out innovation projects are investigated, and twelve of them are observed to be able to bounce back from critical incidents in their projects. These teams have the benefit of supportive organisational facilities - called a mindful infrastructure - which enables them to keep on track successfully with their project goals after setbacks, and their behaviour is called innovation resilience behaviour (Team IRB). Such teams display certain resilient behaviours, or display certain leadership styles, or apply certain project management tools, or use a combination of these. The main conclusion is that teams that score highly for IRB are more active in recovering from critical incidents, by managing and dealing with them once they have emerged, than they are in preventing or minimising critical incidents before they emerge. These findings give support to the idea that the concepts of mindful infrastructure and Team IRB, derived from the field of safety and crisis management, are applicable to innovation management and project management.

Key words: project management, innovation, team, innovation resilience behaviour

1 Introduction: Purpose, theorising and questions

What do teams that have mindful infrastructure (one that enables team innovation resilience behaviour), do in the case of critical incidents to allow critical recoveries? Team innovation resilience behaviour (Team IRB or IRB) is the capacity of a team to withstand and overcome critical incidents (i.e., stressors that threaten the innovation project, team cohesiveness and performance) in a manner that enables sustained activity towards the goals of the innovation project by critical recoveries (i.e., handling and bouncing back from challenges) that safeguard team cohesiveness and performance (Oeij, Dhondt, Gaspersz & De Vroome, 2016). Oeij, Dhondt and Gaspersz (2015) and Oeij et al (2016) derived Team IRB from Weick and Sutcliffe (2007) who defined a set of team behaviours that enabled teams in High Reliability Organisations (HROs) to anticipate 'unexpected' problems and to contain them and to recover quickly. The unexpected problems that such teams face are small events that can have large consequences if they remained unnoticed. HROs are operating:

> "under very trying conditions all the time and yet manage to have fewer than their fair share of accidents. HROs include power grid dispatching centres, air traffic control systems, nuclear aircraft carriers, nuclear power generating plants, hospital emergency departments, wildland firefighting crews, aircraft operations, and accident investigation teams. (…) They face an "excess" of unexpected events because their technologies are complex, their constituencies are varied, and the people who run these systems, have an incomplete understanding of the systems and what they face. (…). HROs (…) act *mindfully* (…) organize themselves

(…) to notice the unexpected (…) halt its development (…) focus on containing it (…) focus on resilience and swift restoration of system functioning." (Weick& Sutcliffe, 2007: pp. 17-18, italics in original).

The five team behaviours are:
1. Preoccupation with failure (a focus on weak signals of lapses),
2. Reluctance to simplify (seeking validated information),
3. Sensitivity to operations (connecting operations and the relationships between events to the big picture),
4. Commitment to resilience (keeping errors small and improvising to keep the system working), and
5. Deference to expertise (if need be, migrating the authority to decide to experts, regardless of rank) (Weick & Sutcliffe, 2007: 9-16).

The antecedents of these team behaviours lie in an organisation's mindful infrastructure, which Oeij et al. (2015) see as a combination of team psychological safety, team learning behaviour, complexity leadership and team voice, all of which enable Team IRB. A positive relation between mindful infrastructure and Team IRB was shown in a study of the same teams that are the subjects in this article (Oeij et al., 2015). The underlying assumption is that mindful infrastructure and the concepts of team behaviour that are developed in the domain of crisis and safety management are applicable in the domain of innovation management, which presupposes that there is a sense of urgency to make people alert for weak signals that may negatively affect innovation processes. The big difference between HROs and other organisations is the capability of HROs to see the significance of weak signals and to respond vigorously (Weick & Sutcliffe, 2007). The conceptualisation of Team IRB can be made applicable to teams in innovation management with the help of the many studies that have been carried out into team resilience.

When it comes to team resilience, Alliger, Cerasoli, Tannenbaum and Vessey (2015) have observed in a review study that resilient teams demonstrate three behavioural strategies for dealing with pressures, stressors and difficult circumstances: minimising, managing and mending actions.

In the first place they perform minimising actions before the arrival of a problem, which involves four types of behaviour. Resilient teams:
1. Anticipate challenges and plan for contingencies;
2. Assess and understand the team's current readiness by monitoring,
3. Vigilantly identify early warning signs of potential problems,
4. And prepare to handle difficult situations by documenting what-if situations and standard operating procedures.

In the second place such teams perform managing actions when difficult situations are occurring. Five behaviours of resilient teams are:
1. Assessing challenges quickly, honestly and accurately;
2. Addressing chronic stressors (like a noisy work environment, ambiguous team roles, lingering personality conflicts), even though it is tempting to ignore them, because they realise that these stressors can affect team cohesiveness and effectiveness;

3. Providing backup and assistance to one another and recognising one another's needs,
4. Consciously maintaining basic processes under stress and being able to face emergencies;
5. And seeking guidance and support when needed.

In the third place resilient teams perform mending activities after a stressful event, which involves recovering from stress, learning from experience and adapting as necessary. Four behaviours are associated with mending activities. Resilient teams:

1. Regain situation awareness as quickly as possible to know what needs to be done;
2. Debrief by reviewing their actions and reflecting on what went wrong and what went right,
3. Ensure they address concerns and risk points that became evident during the encounter with the challenge; and
4. Express appreciation to build bonds and team norms (Alliger et al., 2015).

The minimising, managing and mending behaviours of resilient teams set out by Alliger et al. largely overlap with the five team behaviours of Weick and Sutcliffe (2007), mentioned above that we used as the basis for innovation resilience behaviour. In addition to these five team behaviours we added:

a. Monitoring vigilantly what the team does,
b. Debriefing and carrying out after action reviews/peer reviews,
c. And learning from feedback loops (Oeij et al., 2016).

In Table 1 the two approaches are compared.

Table 1 Overlap of team resilience and innovation resilience behaviour

Team Resilience (Alliger et al., 2015)	**Innovation Resilience Behaviour** (based on the mindful team behaviour dimensions of Weick& Sutcliffe, 2007)
Minimising (Before a critical incident**)** Anticipating challenges and planning contingencies Understanding current readiness Identifying early warning signs Preparing to handle stressors	Being preoccupied with failure/tracking small failures/being alert of weak signals Being reluctant to simplify/resisting oversimplification Being Sensitive to operations/ making continuous adjustments
Managing (During a critical incident**)** Assessing challenges quickly and accurately Addressing chronic stressors/providing backup and assistance Maintaining processes under stress Seeking guidance	Being sensitive to operations/ making continuous adjustments Vigilantly monitoring what the team does Being committed to resilience/maintaining a stable state Deferring to expertise
Mending (After a critical incident**)** Regaining situation awareness Conducting team debrief Addressing concerns and risk points Expressing appreciation	Being committed to resilience/regaining a stable state Debriefing/carrying out after action review/peer review Learning from feedback loops

By further detailing the minimizing, managing and mending behaviours Alliger et al. can describe as many as forty types of behaviour in which resilient teams engage (2015: 181). Their overview is helpful for analysing what the teams in our sample do when they have to deal with critical incidents. We will analyse the team behaviours using Alliger et al.'s grid with two added factors that appear to be relevant elements in our study, namely leadership and the presence of specific project management approaches and tools. These two factors are regarded as antecedents of Team IRB, as their presence is a feature of the mindful infrastructure and organisational facilities that enable IRB at team level.

Leadership is conceptualised as complexity leadership, which is seen when the leadership style changes according to the situation. Complexity leadership is the ability to perform with leadership styles that fit particular situations but may seem incompatible when applied simultaneously. One situation may require transformational leadership, to motivate people into visionary perspectives and encourage them to contribute to grand visions, whereas in other situations transactional leadership is required because results must be achieved. In yet other situations, a synergy of the two leadership styles is needed – for example, the situations may be ambiguous, as in the case of the need to 'be creative but keep an eye on the costs'. In such instances seemingly opposing leadership styles might need to be used in synergy. Lawrence, Lenk and Quinn (2009) distinguish four opposing leadership styles, namely leadership creativity, control, collaboration and competition. Complexity leadership is the ability to switch between required styles. When defining team resilience, Alliger et al. underscore team behaviour, not individual behaviour. One could say that resilient, self-managing teams include a kind of leadership that is incorporated in what the team does 'as a whole', but even in such teams there may be individuals whose behaviour is the driver for team decisions and actions. Empirical evidence includes team leadership as one of the five components of teamwork (Salas, Sims & Burke, 2005). Moreover, other research reports that leadership, namely 'shared transformational leadership', is positively associated with team resilience (Van der Beek & Schraagen, 2015).

Apart from leadership we will additionally investigate the role of project management tools. Some organisations have specific tools in place for innovation management processes. The absence or presence of such tools seems to influence the behavioural options of teams. Specific project management tools refer here to tools, procedures and approaches that are applied to manage innovation projects that are different from predictable, routine projects, and having specific project management tools means here that the organisation has special ways in place to deal with critical incidents in the management of innovation projects. The presence of such tools relates to team resilience if a team is able to apply these tools when needed .On the basis of what is set out above, this paper will describe exploratory research into whether teams showing innovation resilience behaviour are more successful in dealing effectively with critical incidents, and whether such teams perceive themselves as successful. This study is explorative because the number of cases is limited and the field of research is rather novel: concepts from one domain are being applied in another.

The research questions that will be addressed are partly descriptive and partly explanatory:

- Which teams in our sample show innovation resilience behaviour?
- How do the teams deal with critical incidents in terms of innovation resilience behaviour? More specifically, do the teams apply a degree of team resilience, a certain style of leadership, and specific project management tools?
- Do teams showing more Team IRB also more often report project success?

2 Study background, methodology and data

The research is part of a study of team dynamics in innovation projects of eighteen project teams (Oeij, 2013). The purpose of the overall study is to investigate the presence of characteristics that enable these teams to keep on track towards their project goal. The characteristics being studied are the organisational facilitating structure of the teams and the teams' innovation resilience behaviour. The facilitating structure is called mindful infrastructure. The presence of an infrastructure is assumed to enable teams to demonstrate innovation resilience behaviour, which can keep a team on track by, for example, dealing constructively with critical incidents and setbacks. The study adopts these concepts from the fields of safety and crisis management and the aim was to research how they can be applied in the field of innovation management, and particularly to project teams carrying out innovation projects. The underlying reasoning is that between 40 and 70% innovations projects fail (Castellion & Markham, 2012; Mulder, 2012), and that innovation teams may be able to learn from crisis and safety teams how to minimise the risk of failure. The analyses presented in this contribution focus on what teams do after experiencing a critical incident in their innovation project, whether they show innovation resilience behaviour, and what this then actually looks like. The analyses are based on face-to-face interview data with team leaders (project leaders) and team members, and on a survey among 283 team leaders and team members. Of these 283 respondents, 101 belong to one of the 18 teams (on average there are 5.9 members per team, with a minimum of 3 and a maximum of 16 team members), and the remaining 182 respondents belong to teams other than the 18 teams in the research.

'Team innovation resilience behaviour' was measured by a short version (containing 18 items) of the test for the five Audits of Resilient Performance of Weick and Sutcliffe, 2007: 94-102) which consists of 48 items. The scale was made context-specific for the level of teams, and respondents were asked about the what extent the five types of team behaviour (preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience, and deference to expertise) were present in their project team; they answered on a 7-point scale ranging from 'not at all' (1) to 'to a very great extent' (7). Project success was measured with ten items, such as satisfaction of end-users, suppliers and stakeholders, meeting the project goals of functionality, budget and timing, and the project team's self-defined success factor, as developed by Müller and Turner (2010). A 5-point scale ranging from 'strongly disagree' (1) to 'strongly agree' (5) was used.

Based on the scores for team innovation resilience behaviour, twelve of the eighteen teams[3] can be classified as teams that showed innovation resilience behaviour, and six cannot, as can be seen from Table 2.

Table 2 Team innovation resilience behaviour (subscales and overall score) for the 18 team and 'other teams' (team members in other teams than the 18 cases)

	N	M	SD	Team 01	Team02	Team 03	Team 04	Team 05	Team 06	Team 07	Team 08	Team 09	Team 10	Team 11	Team 12	Team 13	Team 14	Team 15	Team 16	Team 17	Team 18	Other' teams
N	368			6	6	4	6	4	5	3	5	4	5	8	3	8	7	6	16	4	7	261
Variable (range 1-7)																						
Preoccupation with failure	232	4.80	0.92	4.87	4.00	4.33	4.73	4.25	5.33	5.56	4.50	5.00	4.20	5.06	5.33	4.19	4.76	5.61	5.02	5.08	4.90	4.79
Reluctance to simplify	232	4.75	0.87	5.33	4.78	4.11	4.93	4.25	4.50	4.89	4.75	5.33	4.40	4.83	5.00	3.95	4.86	5.72	4.67	5.00	4.76	4.74
Sensitivity to operations	232	4.97	0.89	5.13	4.67	4.56	4.93	4.83	4.92	5.56	5.25	5.00	4.87	4.72	5.33	4.05	5.10	5.78	5.11	5.42	4.95	4.96
Commitment to resilience	232	4.74	0.78	4.93	4.36	4.50	4.70	4.58	4.75	5.33	5.13	4.88	4.77	4.53	4.94	3.93	5.07	5.44	4.99	4.75	4.93	4.70
Deference to expertise	232	4.88	0.96	5.60	3.78	3.89	5.00	4.83	4.58	5.67	5.33	5.83	5.07	4.83	4.44	3.71	5.14	5.67	4.89	5.42	5.00	4.87
Total average score: Team innova-tion resilience behaviour	232	4.82	0.75	5.13	4.32	4.31	4.83	4.56	4.81	5.39	5.01	5.15	4.68	4.75	5.00	3.96	5.00	5.61	4.94	5.07	4.91	4.79

Table 3 Teams ranked according to Team Innovation Resilience Behaviour (Team IRB); mean values for Team IRB and Mindful Infrastructure variables

Team	Team IRB	tpsysaf	tlearn	leadcol	leadcre	leadcont	leadcom	tvoice
Team15	5.61	4.29	3.55	3.95	3.87	4.26	3.69	4.42
Team07	5.39	4.33	3.71	4.61	4.51	4.61	3.85	4.00
Team09	5.15	3.68	3.54	3.92	3.69	3.31	3.04	3.95
Team01	5.13	3.86	3.71	3.91	4.16	3.86	3.66	4.07
Team17	5.07	4.14	3.00	3.92	3.64	3.97	3.36	4.10
Team08	5.01	4.14	3.39	3.65	3.78	3.23	3.66	3.96
Team14	5.00	3.92	3.29	3.74	3.69	3.74	3.56	4.05
Team12	5.00	4.52	4.10	3.63	4.28	2.72	2.61	4.11
Team16	4.94	3.90	3.16	3.19	3.40	3.89	3.87	3.81
Team18	4.91	4.16	3.37	3.64	4.06	4.14	4.29	3.81
Team04	4.83	3.80	3.46	3.73	4.09	3.51	3.89	3.90
Team06	4.81	3.89	3.25	3.74	3.69	3.56	3.56	3.67
Team11	4.75	3.98	3.57	3.95	4.27	3.22	3.57	3.62
Team10	4.68	3.71	3.49	4.16	4.04	3.54	3.29	3.85
Team05	4.56	3.86	2.86	3.77	3.33	3.89	3.19	3.69
Team02	4.32	3.74	3.07	3.67	3.32	3.58	3.00	3.74
Team03	4.31	3.81	3.00	3.65	3.49	3.53	3.14	3.67
Team13	3.96	4.08	2.92	3.12	3.17	3.13	2.98	3.44

The mean value for overall Team IRB (all five factors added up) is 4.82 (SD= .75), but on the basis of the qualitative interviews the threshold for considering that a team showed Team IRB was set at 4.8 in order to include a team with a score 4.81 (for the exact procedure see Oeij, Dhondt & Gaspersz, 2015)[4]. The teams for which Team IRB was observed to be present can be identified from Table 3, where teams are ranked according to their Team IRB score: the first twelve teams with scores from M=5.61 (Team15) to M=4.81 (Team06), are within the range. From a quick glance these twelve teams are also more likely to have a score above the mean for the mindful infrastructure variables[5] than the six teams who have a lower than average value for Team IRB.

For the twelve teams showing IRB we will investigate how they dealt with critical incidents in terms of innovation resilience behaviour.

3 Results: distinguishing the innovation resilience behaviour of teams

3.1 Overview of critical incidents and critical recoveries

The inventory of critical incidents and recoveries is based on a first interview with the team leader, a subsequent interview with the team members, and a third interview with the team leader and the team members together. The end result that is presented represents a consensus of the whole team (those who took part in the interviews). Critical incidents are occurrences or conditions that interrupt the normal procedure of an innovation project (Flanagan, 1954). Critical incidents can stop or delay a project, or can speed up the innovation process. In the cases, we studied delays as critical incidents, and we understood critical recoveries – if these happened – to be occurrences and conditions that allowed the project team to get the innovation project back on track. We tried to assess whether innovation resilience behaviour took place. A critical recovery should be regarded as lying in a subset of innovation resilience behaviour. The main difference is that Team IRB is an action of the team, while a critical recovery *can* also be caused by a condition external to the team , such as a decision by higher management, customer behaviour or a market development

It is instructive to mention that incidents, in the sense of critical incidents and recoveries, are perceived differently by the different respondents in the teams. More experienced teams differ from less experienced teams in how they assess events such as setbacks. In the interviews, the question was whether the team had experienced a critical incident, namely an occurrence or event that threatened the continuation of the innovation project and made it necessary to deviate from the original plan. Experienced teams who dealt with some setbacks perhaps saw such events as insignificant 'bumps on the road' that one encounters when driving, whereas less experienced teams saw them as significant issues that hindered the innovation project. Some experienced teams were confident that the bumps ahead might be difficult but could still be handled effectively, and were hesitant even to call those incidents 'critical'. These teams were confident about developments, where inexperienced teams were unsure about the possible effects.

Table 4 IRB cases and the presence of critical incidents, critical recoveries, and project success (source: Oeij, Dhondt & Gaspersz, 2016)

Teams	Critical incident(s) present T=technical issues D=decision making issues C=clustered events		Critical recovery(ies) present A=active; TI=team initiative MI= management initiative PM= project management tools/approaches P= passive		Project success (self-report by team) (1=low; 5=high) Mean= 3.9
High score IRB-cases					
Team15	several technical setbacks	T	adjust plan and outcome	A,TI,PM	4.0
Team07	clustered small incidents adding up to a critical situation	C	close monitoring of the actual facts and good working relationship	A,TI,PM	4.4
Team09	several technical setbacks	T	install new steering group and team building	A,TI/MI	3.6
Team01	several conflicts of interest	D	close monitoring on the process to be alert for weak signals; strong focus on targeted outcome	A,TI,PM	4.1
Team17	technical setbacks	T	adjust plan and convince management to make a shift	A,TI	4.0
Team08	none	-	none (not needed)	-	4.5
Team14	clustered small incidents adding up to a critical situation	C	clustered measures to recover	A,TI	3.7
Team12	clustered small incidents adding up to a critical situation	C	management support to go along with project	A,MI	4.0
Team16	several technical setbacks	T	8D teams is a method to deal with issues that enable the process to continue	A,PM	4.4
Team18	technical setbacks	T	new project leader, formation of Kanban team to settle issues	A,MI	4.0
Team04	no progress of the innovation	D	new leadership brought focus on results	A,MI	3.6
Team06	no serious CI's because risky situations did not escalate	-	close monitoring of risky situations to steer when needed	A,TI,PM	4.5
Low score IRB-cases					
Team11	resistance of top management	D	hardly due to doubt by management, delayed decision making	P	3.7
Team10	feasibility setbacks	D	new project leader	P	4.1
Team05	none	-	none (not needed)	-	4.1
Team02	dissenting opinions about directions within team	D	limited because an impasse remained	P	3.3
Team03	decision vacuum at team level due to wavering man-agement	D	limited because an impasse remained	P	2.9
Team13	clustered small incidents adding up to a critical situation	C	market demand forced team to be productive	P	3.1

Therefore, caution is needed when comparing critical incidents across the teams, and information about the experience of teams needs to be mentioned for every case. Table 4 presents the eighteen teams and the presence of critical incidents and critical recoveries in key terms as described by the team. The teams in Table 4 are ranked according to their score for team innovation resilience behaviour (high to low)6. Self-reported project success is also added.

Table 4 suggests that the critical incidents seem to be grouped in three clusters:
1. technical issues;
2. decision making issues (including dissent, conflict, vacuum); and
3. clustered incidents (a combination of events adding up to an incident).

The critical recoveries cluster in another way:
1. there is an active side where we see
   a. team initiative (adjustment of plan and outcome, monitoring, team building, clustered measures - 7 times),
   b. management initiative (new project leader, new steering group, Kanban team [here problem solving by the best employees], management support - 4 times), and
   c. project management tools (8D team [an approach that deals with issues by deploying a dedicated problem solving team] , risk management methods - 4 times);
2. and there is a passive side where we see limited resilience and limited management commitment, or reactive responsiveness to market demands.

The passive actions seem to dominate the low-IRB cases (5 out of 6), while the active actions reside with the high-IRB cases (11 out of 12).

Project teams that have emerged as high IRB cases differ from low IRB cases in being active and not passive. One might think that teams with high IRB are more successful or make more progress. High IRB teams indeed report project success more often than low IRB teams (75%, respectively 40%, of the teams have a higher score than the mean score of 3.9). Although the correlation between Team IRB and project success showed a substantial effect size (that is, a phi coefficient value between medium and large), the chi-square test for independence indicated no significant association, $x^2(1, n=18)= 1.43$, $p= .23$, $phi= .40$. Presumably, the association is insignificant because the number of observations is low. The picture is not entirely clear, because teams that did not show IRB did not discontinue their projects, and there were also successful results for such teams, as in the case of Team05. The teams that showed no IRB, however, seem to have encountered issues such as critical incidents during certain periods of the project that were not dealt with in a way that was effective for keeping on track towards the intended innovation goal. Team10 and Team13, for example, were well under way with their projects at the time the research was done, but had had previous periods in their projects with very limited or no progress, and demonstrated a team process that lacked mindful infrastructure and team resilience. The project undertaken by Team06 was a project without any critical incidents, and thus it needed no critical recoveries. It went smoothly because of anticipatory risk monitoring, and was a routinely run project. As such it was a deviant case in the sample, illustrating that Team IRB is irrelevant for routine processes in innovation projects. A comparable inference can be made for the case of Team08, which was a high IRB team. Although this project did not encounter critical incidents and recoveries either, the team nonetheless acted with resilience by anticipating possible critical situations and holding intensive communication with its stakeholders. We do not know if the presence of the mindful infrastructure and the team innovation resilience behaviour prevented critical incidents from emerging here, but it could be observed that the team largely consisted of very experienced team members and the team leader was also very experienced.

Table 4 therefore does not reflect a black and white situation; the cases are nuanced. To understand the team dynamics better, we need to illustrate what the teams do. For this purpose we will describe the critical incident and recovery and the team innovation resilience behaviour of the teams showing IRB. We use the division of critical incidents, namely technical issues, decision-making issues and clustered events.

3.2 Practice: Innovation resilience behaviour in dealing with critical incidents.

A. Technical issues as critical incidents

The first case, with the highest score of Team IRB, is Team15, a team forming part of the R&D Department of a manufacturer of components for electronic devices.

Team15

Critical incidents

The project encountered several technical drawbacks, which were assessed by the experienced project leader as 'small spikes on the road', such as one normally encounters. Nonetheless, the technical problems were not easy to tackle. Initially the team wanted to start with the toughest issues, based on the notion of 'structural similarity', assuming that the smaller problems would then be solved more easily. One issue was that a supplier could not fix a technical problem for which they had IP rights. This caused months of delay. At a later stage there were several technical issues in the production, and problems with finding solutions.

Critical recoveries

The project leader, who is highly experienced, mentioned matter-of-factly that in cases of trouble one needs to stay calm, look ahead what needs to be done, and be reassured or confident that resources (such as 8D-teams, an example of a project management tool) will be made available if they are really needed. The project encountered several technical drawbacks, which were assessed by the experienced project leader as 'small spikes on the road', such as one normally encounters. Nonetheless, the technical problems were not easy to tackle. Initially the team wanted to start with the toughest issues, based on the notion of 'structural similarity', assuming that the smaller problems would then be solved more easily. One issue was that a supplier could not fix a technical problem for which they had IP rights. This caused months of delay. At a later stage there were several technical issues in the production, and problems with finding solutions.

This team showed a number of innovation resilience behaviours. The team members were research-driven, which implies that they built decisions on validated knowledge. Technical issues were researched with rigour. Team members communicated and discussed findings in a critical but constructive way, meaning that they listened to each other and respected one another's expertise. The team leader acted calmly, without panicking; he structured the tasks and steps to be taken; he gave clear information to other departments (e.g. managing the expectations of the production department); he asked higher management for help when the need was urgent; he applied project management tools that support the analysis and management of risks; and he managed the team by walking around, meaning that he communicated intensively, built bridges between stakeholders, and kept the team together (team cohesion).

The organisation applied project management tools in innovation projects. One example is the 8D-team method, which means that a team is quickly brought together to solve any issue that arises. The main purpose of this tool is that the innovation process continues in order to meet the initial planning, while the 8D-team works on its special task.

Team09 was an IT team from a higher education institute and was part of the support department in IT & Facilities management.

Team09

Critical incidents

There were several incidents, some more critical than others. Some were personal, others technical.
1] Personal: the project leader was not supported during a steering group meeting and felt personally attacked, overwhelmed by feelings of incompetence. 2] Technical: a technical release deadline was missed when a final test failed. This felt like losing face, the team explained. The events coincided with personal, stressful issues in the team, caused by the death of a family member of one team member and the stress-related illness of another.

Critical recoveries

The recovery measures followed the critical incidents. After the missed deadline several measures were put in place: the steering group was made leaner and more effective, with more focused responsibilities and targets (a redefinition of deliveries and scope); Prince2 was introduced as a project management method; the team adopted SCRUM [specific team based method of problem solving] as a 'innovating learning' method; the project team was enlarged with more manpower (an operational project leader); and technical issues were resolved by calling in an external firm. The project leader, who is qualified to apply certain team building methods, introduced team building activities. The consequence was that the project became well managed and feasible and that the social relations, cooperation, motivation and self-confidence of the team was given a boost. Team cohesion became significantly stronger as a result of the team building activities.

The innovation resilience behaviour of the team was largely latent at the beginning, and became apparent after the team's work was severely criticised by stakeholders. The project leader took a vulnerable position and asked for help. The project steering group responded and helped, by re-scoping the project, adding human resources, making the steering group leaner, and introducing Prince2. Further, the project leader implemented team building activities and SCRUM techniques, which encouraged team cohesion, and this ignited the team to become assertive instead of passive. With regard to the stakeholders, namely the twenty faculties who had to deliver crucial information, the team started to set boundaries, whereas before the team had been walked over by the faculties.

Team17 was an R&D team of a company producing automated material handling systems. This team's project was to develop an automatic detection system for human beings by measuring body form and body heat.

Team17

Critical incidents

Critical incidents were mainly technical setbacks. First there was a problem with the camera hardware and then there was one with the image processing. Third, software problems with the camera, which was provided by a supplier, remained outstanding, because the supplier could not solve them.

Critical recoveries

An important role was played by the market, as prospects continued to ask for the product. The promising business case propelled the project to start again after several setbacks. However, this was not the only reason. The team felt that the endeavour was technically feasible. A combination of steps was important. First, the project leader convinced the project manager to try another plan; second, the management team was convinced by several presentations by the team that they were working on a feasible solution. This involved explaining the facts behind why the old way did not work and why an alternative was feasible. In combination with these two steps, there was a fertile interaction between a risk-taking project leader (i.e., an enterprising personality) and his risk-avoiding team members (i.e., people oriented towards evidence-based research). As it turned out, one of the team members found a solution that the project leader and this team member could 'sell' to the management team. The team was thorough in its research but it also proved to be resourceful. A third element was that the team decided to change the chosen hardware, terminate the relationship with the supplier, and work out the problem themselves (for, after all, they had learnt so much in the past years that they no longer needed the external supplier as a partner). A special point to mention was that the project leader was explorative and communicative in finding solutions. He talked to many people to check and improve his ideas until the project manager approved the change of course. His persistence, power to convince, and communication made him a driving force. He also convinced one talented but timid and inexperienced team member to be more confident in presenting good new ideas. Finally, the PSDM (Problem Solving and Decision Making) method, which is an approach used by the company to improve root cause solutions, was applied, and this was a supportive tool.

The innovation resilience behaviour of the team resided largely with the project leader, who was an enterprising person. He made a great effort to develop a new plan and to try to sell it to the project manager and his management. Other members of the team also proved to be resourceful. They did the research and developed new insights to support the new plan. Project management tools allowing decisions to be based on empirical evidence also played a role, so that solutions were grounded on valid information.

Team16 was an R&D team of the manufacturer of components for electronic devices discussed earlier. The project is a new generation innovation of an electronic device that had to be implemented into the market as quick as possible.

Team16

Critical incidents

The project had to solve several technical requirements that caused setbacks. One setback was of a strategic nature. The business line wanted to speed up delivery, and forced the implementation phase to begin before the feasibility study was fully completed. This meant that research was still needed in the implementation phase to meet specifications, which eventually delayed the process. The technical setbacks were, in a way, foreseen, since in the generation of every innovation (this was an improvement of an existing component) it is known that there will be technical issues that emerge and must be dealt with. This is associated with the strategic issue mentioned above of speeding up the delivery. This caused conflicts of interest between the Business Line (BL) and R&D, which were supposed to be tackled by the project review board (on which both were represented at a higher level).

Critical recoveries

The critical recoveries were, on the one hand, embedded in the project management approach of the 8D-teams, the problem solving teams, and on the quality of the team on the other hand. The 8D-teams were deployed to ensure progress. In relation to these 8D-teams, it should be noted that the project team was capable of developing solutions to technical issues, indicating that the team members were resourceful researchers. The recoveries reflect the actual combination of the organisational facilitation of the relevant project management methods (here, 8D-teams) and the quality and experience of the team. The team was research-minded and searched for validated solutions.

The innovation resilience behaviour of this team can be seen in its members' self-managing actions, such as doing research without being asked, and sorting things out on one's own initiative. Another IRB example is distributed leadership. The project leader was leading his first project, but experienced colleagues assisted in an open way. The team developed solutions for issues in a resourceful and confident manner. Apart from team behaviour, the organisation applied project management tools like 8D-teams. As discussed earlier, these are tools that prevent the innovation process from being interrupted, because special teams work on specific issues at the same time as the innovation process continues.

Team18 is a team in the company producing automated material handling that was discussed before. This project was to improve the functioning of products that had already been delivered to customers.

Team18

Critical incidents

The critical incidents were technical setbacks. First, the products that had been sold functioned unreliably, causing a high workload and overwork. Second, specific products, such as smooth boxes and (shapeless) bags filled with items, could not be handled well by the systems. Incidents were caused by market pressure, which resulted in insufficient testing of products, especially regarding software-related issues.

Critical recoveries

The first recovery action was the appointment of a new project leader, who was very experienced, to get the products working reliably; the second was the assignment of a 'Kanban team', which was a team of the people who were best qualified to solve the issues on-site and was very resourceful; the third, and related, action was that management gave full priority to this operation in terms of resources. The Kanban team worked full time and more (overtime) on the project for about six to nine months. Apart from that the team applied 'agile' and SCRUM methods [both are team based methods for problem solving] to solve issues in an evidence-based and systematic way.

The innovation resilience behaviour of this team was its resourcefulness to develop solutions for the many issues. The team consisted of the best people. The project leader had the ability to understand both the technological issues and the business issues, which enabled a well-balanced cooperation between the local customers (who were dissatisfied with the underperforming products) and the Kanban team. The project leader set a good example (he was very committed and a hard worker) and was a great communicator between the stakeholders. The team applied SCRUM techniques. An important factor was that top management decided to give full support to the Kanban team.

B. Decision-making issues as critical incidents

Team01 is an R&D team in the dairy industry and the project was a co-innovation with another company.

Team01

Critical incidents

The project had two main phases, research and development, and application to business. The critical incidents in the first phase were a number of events: it took a great deal of time to mobilise the right stakeholders; there was a great struggle to agree on the IP rights with the partner; and the partner redefined the scope several times, which required more work and caused delays. In the second phase it emerged that the business side of the partner had not approved the innovation, which was critical for the application of the innovation (an ingredient) in end products for customers. There was no convincing business case (perhaps there was too much of a technology push). The project team and project manager could not do much about this incident except to wait, as this was an internal matter on the partner's side. This matter was not solved during the period of the study.

Critical recoveries

The role of a project leader is to monitor the process of an innovation project very closely. The way he does this is highly relational and personal. Bringing people together and keeping them in contact with each other (brokerage) is one of his central activities. When there was a conflict about IP rights the project leader decided to have an external expert mediate in the matter, as a process intervention. In the start-up phase he organised a session to develop possible routes to the end-product, so-called 'conceptual approaches'. Despite the fact that the partner redefined the scope a number of times, the progress to develop the ingredient went quite well. The project leader monitored the project very closely by stakeholder management, interventions, good timing, and, when necessary, 'threatening to quit' to put functional pressure on others. His own project management approach was his guide.

The innovation resilience behaviour of this team was centred on the project leader. The team members worked at different locations, and the team of the partner organisation worked in their own premises. The project leader closely monitored the innovation process, the interests of the stakeholders, and the opportunities for interventions and actions. He was keen on relations and managed the project by walking around, and carefully planning his actions at the appropriate times. He decided on crucial actions, such as having a conflict mediated by an external expert, or organising sessions with the team, to realise breakthroughs. To assist his work, the project leader developed a personal project management approach as a tool, and stated that rhythm was important, meaning that meetings should be planned even if nothing is happening, to gauge what is going on. In addition to all this, the team members were resilient in the way they strove as researchers to find valid data on which to base their decisions.

Team04 was a project team of an IT-consulting company. The project was to develop services for customers based on Big Data and to develop tools to analyse Big Data.

Team04

Critical incidents

According to the project leader there were no critical incidents. “When things go awry you just have to intervene”, is what he said, maybe downplaying issues. However, talking to others gives a richer picture. Before the project leader was appointed, the project was in a phase of idea development that needed more structure: from divergence to convergence, from exploration to exploitation. The arrival of the team leader also meant the replacement of some staff, with hands-on people instead of people who were ‘too creative’. A change was needed. After the arrival of the project leader, the project, according to him, improved, but the project managers said there were also disagreements with others (internal colleagues who were very experienced) who then turned their backs on the project. The picture presented may therefore have been rosier than the reality. For example, the project tool to guide clients through an analysis of whether or not it was good for them to apply big data services encountered a fundamental difficulty in quantifying the costs of such services for the client.

Critical recoveries

The project leader was a decisive person who seemed to know very well what he wanted and how to achieve it. He communicated very intensively with team members and stakeholders, trying to be sure that he understood their needs. He also had a clear focus on getting results (exploitation). One observation is of interest here. The team was not really a team, in the sense that the members had clear interdependent tasks and a common focus. Instead, the team members conducted clear-cut sub-tasks, with a clear division of labour. Each team member only interacted bilaterally with the project leader, and did not interact as team. It is too early to draw any conclusion about the effectiveness of the recovery. That depends ultimately on the sales results, and it remains crucial for the senior consultants and other internal partners to offer these services (for their clients).

The innovation resilience behaviour in this project team was concentrated on the team leader’s role. He closely monitored what the stakeholders wanted, and moved the project decisively from exploration towards exploitation. The project leader was a driving force behind the realisation of the economic targets. The team members, however, hardly functioned as a team, because they all had separate, individual tasks that did not seem to be interdependent (they worked on sub-projects). This is called a working *group* - not an interdependent *team* - or a pseudo team: members may believe they are part of a team but are not acting like one (Katzenbach & Smith, 1993).

C. Combinations of clustered events as critical incidents

Team07 was a team within the R&D department of a food and care products producer, and was responsible for deploying products. This deployment involved preparing the product in order to get it on the shelf on time for consumers for a specific market segment in a specific region or country.

Team07

Critical incidents

There was a cluster of incidents that, taken together, were not very critical because they were managed quite well. In the collaboration between stakeholders there were some critical events: the local management of the brand (in another country) was very worried about the new product and demanded a large number of tests in order to be convinced and assured that it would be evaluated positively by consumers; the business development team resided in a different country but was to relocate to yet another country, and the composition of this team was changed to include quite inexperienced people (which led to a delay in artwork). Then there was a test location in another country again that had limited capacity, also causing delays. All these issues demanded that the project team closely monitored relations and managed expectations across different countries (four to five countries were involved).

Critical recoveries

The project team worked very hard. One example was that the testing was done extremely thoroughly, and took twice as much time as usual. Another example was that the communication with all the partners was meticulously prepared by the project leader and executed with a great deal of attention to detail and with validated information, especially for test results. The team worked very carefully and precisely and was well prepared. Much was done regarding risk management. The project was well scoped and managed by the project leader. There was some delay (caused by others) but the deadlines were not very rigid (customers do not notice a relaunch, so a delay is less sensitive in that regard).

The innovation resilience behaviours of this team were shown in how they anticipated possible discussions and disagreements by performing thorough research and acquiring valid information. The team worked in a highly transparent and intensive way, and discussed strategies and actions towards stakeholders. The work was carefully scoped, documented and planned. The team documented what they did, why they did it, what the results were, and so on, to make it explicit who was doing exactly what during the process. The team leader organised the process in a detailed way and was open to the opinions of team members. If she was in doubt, she consulted higher management promptly. After the project was finished she celebrated the results with the team. The organisation applied project management tools to guide this process, especially for risk management and to create alternatives for what-if situations.

Team14 was a project team making laboratory equipment and laboratory systems in the medical technology sector. The organisation had recently been taken over by a multinational. New support systems and procedures had been introduced and the functional organisation of project work (with people from different departments collaborating on projects) was replaced by team-based working (with team members for a project being physically placed together).

Team14

Critical incidents

The project encountered a number of issues in a short time frame that together constituted a critical incident. These issues all led to a higher workload and delays: the new ways of working (the quality management system) that were the result of the takeover enhanced the workload; there was a change of project leader; there were changes in the scope of the project (the product had to be adapted to meet other market demands); there were more requirements regarding quality assurance and the verification and validation of the product; there were increases in the production volume (in series) to meet market demands; a prototype had to be made for external (international) certification; and following the certification test a great deal of rework had to be done (because the certification was first rejected).

Critical recoveries

The recovery came in two waves. First there was a phase using a pilot of a larger lab system in which the equipment (an incubator) was integrated, for which ten copies had to be built, and there was a customer to whom products had to be delivered. This gave the team a boost. The second upswing was caused by a number of feel good successes, namely the external certification being acquired, the internal certification being obtained and the product (improved mechanically and with better software) being launched. Moreover, at around the time of the second wave, the team started to work with Agile and SCRUM team methods. This improved team cooperation and team output.

The innovation resilience behaviour of the team consisted of introducing Agile and SCRUM methods when they needed to process the rework effectively and efficiently. The team's cooperation and decision-making became even more participative. Team members respected each other's expertise, listened to each other, and carefully identified the causes of problems. The organisational changes were also important. The introduction of team-based working made the process more effective and enhanced team cohesion. The new procedures, as part of the project management tools of the new owner, although piling up the workload, led to more methodical ways of working and greater efficiency.

Team12 was a project team of a public organisation that was responsible for implementing Lean Six Sigma (LSS) in the organisation's departments.

Team12

Critical incidents

After a good start and the execution of two lean trajectories, there was a reorganisation of the organisation in order to cut costs. The department by which the project was managed was disbanded. The project team was placed in another department whose head questioned the use of the LSS project. Apart from that, the majority of middle management and team leaders/heads did not see the benefit of LSS and thought they were efficient enough compared to other municipalities. Some LSS trajectories flagged.

Critical recoveries

The project leader played an important role. He believed firmly in LSS, and convinced the management of the benefits: on the one hand, greater efficiency, and, on the other hand, better collaboration and a better alignment of departments. The management decided to 'roll out' LSS across the organisation. One event that was a tipping point was a visit to a manufacturer where LSS was implemented successfully: this convinced a manager in a crucial position to go along with LSS. The project leader was good at managing the powerful stakeholders. Once LSS became a leading principle, the project became more successful. The team made SWOT analyses to detect 'low-hanging fruit' among department heads and to see how LSS could spread unchecked, like an oil stain. At one time the team leader even threatened to resign because a controller who was against LSS as a philosophy and was only interested in cost reduction was to become a member of the steering team. The team leader succeeded in keeping the controller out of this core team.

The innovation resilience behaviour in this team came mainly from the team leader, who was a firm believer in the LSS method. He was able to convince relevant stakeholders to incorporate and embrace LSS as a way to combine efficiency with new ways of cooperation and leadership. Together with the team members he was able to convince the middle managers who had to implement LSS that it would improve their processes, and he used validated data to do this. The team focused first on the most willing middle managers, the 'low-hanging fruit', and tried to identify allies by SWOT and network analyses. The team, especially the project leader, was highly skilled in (politically) managing the stakeholders.

D. An absence of critical incidents

Team08 was a project team of an education centre in the field of management, consultancy and change, and its innovation was a massive open online course (mooc). This was the only case of a team with IRB where there was no critical incident.

Team08

Critical incidents

The project had no critical incidents. There were some setbacks, such as the fact that the work of the facilitators (these were former students who played an active role in the mooc) proved harder than foreseen, causing some of them to terminate their participation; another point was that the interaction inside the mooc was less than had been hoped (the intention had been to create a great deal of online interaction and many learning situations). Setting up a mooc was framed as a learning experience for the organisation: even if it failed, it could not fail because the learning would still win. It therefore was not easy to identify any critical incidents.

Critical recoveries

Apart from the absence of critical recoveries (as they were not needed) the team solved issues based on experience, intensive consultation (with facilitators), and some IT solutions (with the IT supplier) to simplify the mooc structure and stimulate interaction. The limited interaction within groups was partly solved by enlarging/clustering the groups participating in the mooc and by reducing the number of groups.

Despite the absence of critical incidents and recoveries the team was mindful and alert about things that could go wrong, and had prepared for what to do in such instances. It had thought out well and in advance how to develop this mooc, and communicated intensively with the stakeholders involved and with the mooc participants (students).

Team06 was an R&D team of the food and care products producer described earlier. The project was to deploy a new product significantly faster than had been done before. In this project were no critical incidents, only limited incidents, but there was a high risk that critical incidents would occur.

Team06

Critical incidents

The project met many new issues that had to be solved instantaneously because of the time-to-market pressure. The main issues were: a sudden change of production line at one of the (international) production sites; a cap of the packaging tube with the wrong colour; a new tube that burst during production; and another (international) production line that received spare parts too late. All these issues were critical given the tight planning. Missing a deadline would have meant that the product launch would be delayed by at least six months. In short, there were no critical incidents, but there were several possible risks.

Critical recoveries

The project team and the project leader performed impact management, which means that they continuously examined the project to monitor possible risks and the possible consequences of risks. There was very intensive communication with the partners/suppliers on the local test and production sites, and with the (internal) supply chain management and (internal) business development teams to manage expectations. There was high trust amongst the project team about each other's expertise and about the role of the project leader. The team also took care to have a backup for every issue. This caused a great pressure of work, but also much enthusiasm within the team. The issues mentioned proved to be manageable, but they were on the edge. They could have caused incidents that were so critical that the project would have missed the deadline. In short, critical incidents were suppressed and near misses quickly identified.

The innovation resilience behaviour of this team was shown in the way it was alert and proactive on every possible issue that could go wrong. The team foresaw risks and their impacts, and planned alternatives for every step. The project leader communicated intensively with all the stakeholders. Impact and consequence management, part and parcel of the project management approach of the organisation, implied that the team was always a step ahead of what stakeholders might think or do. This can be seen as the company's risk management approach. Nothing went wrong, thanks to the team resilience.

Summarising

From these cases we can learn that decision-making issues are related to the issue of having sufficient power and influence to be able to steer the project. In the cases with technical issues, a great deal of weight was put on having validated data and knowledge about whether to move on or not. In the cases with clustered incidents and those without critical incidents, coordination and leadership played a significant role in keeping the project on track. The next exercise is to cluster the innovation resilience behaviour of the twelve high IRB cases according to the grid of Alliger et al. (Table 1).

3.3 Evaluation of innovation resilience behaviour

A subjective expert judgment was made on the basis of the oral interview data and the survey data by ascribing innovation resilience behaviour to the twelve teams that scored above the mean value (Table 4). As discussed, we applied the overview of team resilience behaviour of Alliger et al. (2015) as an analysis grid, and added to that overview complexity leadership and specific project management. The team resilience behaviours of Alliger et al. make distinctions between what a team does before, during and after a challenge or critical incident, which allows for a dynamic view of the course of a project.

Table 5   Innovation resilience behaviour by the twelve teams with a higher Team IRB-score

	Team15	Team07	Team09	Team01	Team17	Team08	Team14	Team12	Team16	Team18	Team04	Team06
Minimise (Before)*												
Anticipating challenges and planning contingencies	X	X		X		X		X	X			X
Understanding current readiness	X	X		X					X			X
Identifying early warning signs	X	X		X		X		X	X			X
Preparing to handle stressors	X	X				X		X	X			X
Manage (During)*												
Assessing challenges quickly and accurately	X	X		X	X	X	X	X	X	X		X
Addressing chronic stressors/providing backup and assistance	X	X				X			X			X
Maintaining processes under stress	X			X	X	X	X			X		X
Seeking guidance	X	X	X	X	X	X		X	X	X	X	X
Mend (After)*												
Regaining situation awareness		X	X	X	X		X	X			X	X
Conducting team debrief	X	X	X		X	X	X	X	X	X		X
Addressing concerns and risk points	X	X	X	X	X	X	X	X	X	X	X	X
Expressing appreciation		X	X		X							X
Other												
Complexity Leadership	X	X		X	X		X	X	X	X	X	X
Specific project management	X	X	X	X	X		X		X	X		X

x = present; empty = absent.

* Source: Alliger et al., 2015, Table 3, p. 181.

An ‘X’ implies an interpretation that the behaviour was manifest or present or very likely to be present; an empty cell means that the resilience behaviour was not assessable, or was absent or latent. The exercise results in one central conclusion and six additional findings. The central finding is that teams with high IRB, who are presumably already more resilient than teams with low IRB, are especially competent in the managing and mending resilience behaviours, and less good at the minimising resilience behaviours (respectively 33, 34 and 25 boxes with an ‘X’). This is a finding that corroborates Weick and Sutcliffe’s (2007) statement about the big difference between HROs and other organisations: HROs are more alert to weak signals.

From Table 5 the following remaining observations can be made. First, looking at the number of boxes with an ‘X’, most teams with IRB apply more than half of the team resilience behaviours identified by Alliger et al. Team15, Team07 and Team16 and Team06 scored particularly well. Their organisations have specific project management tools in place that support the teams’ project work. In the case of Team15 and Team16 the 8D-teams can be mentioned, and for Team06 and Team07 the almost innate habit of applying impact and consequence management are relevant. Both are tools to prevent critical incidents from emerging or escalating. Team01 is somewhat comparable with these cases, as it also has specific project management tools, although the project leader gave them a personal twist and perfected them to his liking. In contrast, it can be observed that Team04 has fewer than half of its boxes with an ‘X’. This perhaps is mainly due to the fact that this project was not carried out by a team in the sense of a group of people working on the same goal with interdependent tasks. The team members worked more or less separately on their tasks, and were only in direct contact with the project leader.

Second, it can be seen that two teams that did not have special project management tools and were not based in an R&D organisation performed in a highly resilient way, namely Team08 and Team12. In both cases the teams were very prepared and alert for possible setbacks, and the project leaders of both teams had clear ideas about the project’s direction and the goals to be achieved.

Third, most teams displayed a kind of personal or distributed leadership that could handle complex situations or could enable them to switch leadership styles when a situation required it. The individual leadership of the project leader was a leverage factor in teams like Team01, Team15, Team12 and Team06, while distributed leadership among team members played a role in Team07, Team16 and Team14.

Fourth, in five cases we found no distinct team resilience behaviour in the minimising phase of preventing critical incidents from occurring. The case of Team18 is clear, as this was a project to recover delivered products that did not function reliably. The Team04 case signifies a transition from exploration to exploitation with a new team leader and the replacement of team members to make this transition work. In the same vein, Team17 consisted of a team that had completely replaced the original team that had started the project, and it gradually gained grip and direction after critical incidents emerged. Team14 was an ongoing generation-innovation where the team was confronted with a takeover by another company that introduced new tools and procedures and team-based working. The product had to be adjusted for international markets, which did not allow for proactive minimising actions. Team09 did not show minimising behaviour because the first phase of the project was characterised by failures and a very limited grip on the project by the team and its leader.

Fifth, most teams performed mending behaviours, which means that these teams learned from what had happened during critical incidents and adapted to the changed situation when necessary. If we look again at the teams for which minimising behaviour was absent (Team09, Team17, Team14, Team18, Team04), it is interesting to observe that they all perform mending behaviours at a later stage.

Sixth and final, team resilience as operationalised by Alliger et al. (2015) shows considerable overlap with innovation resilience behaviour (IRB) (see Table 1). It comes as no surprise that these twelve teams performed well on a number of dimensions of mindful team behaviour that therefore support the central conclusion. As indicators of 'managing and mending actions', that is, actions for dealing with critical incidents, all twelve high-IRB scoring teams (Table 2) scored rather highly on sensitivity to operations (M=4.97, SD= .89, range 1-7), scoring 4.9 or above, on commitment to resilience (being able to change course if needed) (M=4.74, SD= .78, range 1-7), scoring 4.7 or above, and on deference to expertise (expertise is valued higher than rank) (M=4.88, SD= .96, range 1-7), scoring 4.6 or above. On their ability to anticipate possible critical incidents, these twelve teams had favourable scores on 'minimising actions' as well. They scored 4.7 or higher on preoccupation with failure (being alert for weak signals) (M= 4.80, SD= .92, range 1-7), and 4.5 or higher on reluctance to simplify (preferring validated data) (M=4.75, SD= .87, range 1-7). The average score for team innovation resilience behaviour was M=4.82 (SD= .75, range 1-7) and all twelve teams had a value of 4.81 or above. High IRB teams again scored better on managing and mending behaviour than on minimising behaviour.

4 Conclusion

This contribution addressed the question of how innovation teams deal with critical incidents and what innovation resilience behaviour looks like, by analysing what the teams in the study did in practice and by applying the grid of team resilience of Alliger et al. (2015). The twelve teams (out of the total of eighteen) that had a relatively high score for team innovation resilience behaviour varied somewhat in their actions. This comes as no surprise since earlier analyses have already pointed to different combinations of the elements of the mindful infrastructure that enable innovation resilience behaviour (Oeij et al., 2015). The variation in Team IRB relates particularly to the degree to which teams showed more 'managing and mending' team resilience behaviour than 'minimising' behaviour that would prevent or curb the escalation of critical incidents. Teams embedded in R&D environments seem to be more IRB-minded in this regard. The numbers are small, but all five R&D cases (Team15 and 16, Team06 and Team07, Team01) showed minimising behaviour in combination with the presence of specific project management tools.

Apart from variations in Team IRB there are also commonalities. All twelve teams showed IRB in relation to 'managing actions'. They were sensitive to what went on in their operations and were able to change course if needed. Some of the teams that did not show IRB were not resilient in this regard. They either lacked the power, if, for example, there were external powers that could not be influenced (Team11), or they lacked a consensus to set out on a new course (Team02, Team03)(see Table 4). In most cases the role of leadership, either that of the project leader or as distributed among team members, was important. Effective leaders proved to be able to switch styles or apply particular styles when required. Leadership must be dynamic to a certain extent in order to meet these situational requirements. Most teams also performed 'mending actions'. They learned from critical incidents and adapted to the new situation. Some teams were self-reliant, with autonomous team members who performed tasks without being asked. Resilience can therefore be regarded as a form of professionalism, in which team members understand what needs to be done and have an intrinsic drive to carry out their tasks.

The last research question, whether teams with high IRB scores also more often report project success, cannot be answered decisively, probably because of the low number of cases. There is a positive association between the two variables, with a large effect size, but it is not statistically significant.

5 Discussion

One critical reflective remark is that the grid of Alliger et al. (2015) was applied after the data had been collected. An expert judgment was made on how this grid of team resilience behaviours made a fit with the data, which is a subjective activity and possibly leads to errors of judgment. Another critical observation is that the cases include factors that vary across teams and could not be held constant. For example, some projects were not fully innovation projects in the sense that something new or something improved was being developed. Despite the fact that some kind of renewal took place in all cases, Team12 and Team16 were largely carrying out implementation projects, and Team18's project was, to a considerable degree, a recovery project. As the study does not focus on innovative or creative behaviour as such, it could be argued that the findings do not solely apply to innovation teams, but perhaps are applicable to a broader range of project teams, including organisational change and implementation teams.

Innovation resilience behaviour does not come out of the blue, as it is based on a support system that we dubbed mindful infrastructure. Earlier analyses (Oeij et al., 2015) indicated that mindful infrastructure enables innovation resilience behaviour. The elements of a mindful infrastructure are a combination of team psychological safety, team learning behaviour, team voice and complexity leadership styles, namely creativity, control, collaboration and competition. How the twelve teams handled their critical incidents also gives us insight into the relevance of these elements. We have already discussed leadership. Team psychological safety and team voice, for example, form the basis for team members to utter deviating ideas, mention problems, and be allowed to make mistakes. Teams that nurture critical discussions were, for example, Team14, Team15 and Team16, Team17 and Team18, and Team06 and Team07. Team learning is an important asset for reflection and trying out ideas, and was present, for example, in Team17 and Team08.

This study gives solid indications that concepts used in safety management and crisis management studies are applicable to innovation management contexts. The concepts of innovation resilience behaviour and mindful infrastructure, embedded in these contexts, are largely based on the work of Weick and Sutcliffe (2007), who operate in the field of High Reliability Organisations. The insights of Alliger et al. (2015) into team resilience stem from 25 years of research with all types of teams, but mainly with firefighting and oil exploration teams, surgical and other medical teams, emergency response teams, and law enforcement and military teams. The applicability of these concepts might even be broader, because in our study, as we said earlier, there were teams that may not have had all the characteristics of innovation teams. It may be that other types of teams encountering critical incidents or high uncertainty and risks can benefit from these findings. Further research into the applicability of mindful infrastructure and team innovation resilience behaviour could incorporate teams performing several types of projects, ranging from manufacturing and building 'things' to change management and implementation 'processes'. Finally, further research is needed to find statistical evidence for the positive relation between Team IRB and the success of innovation projects. The trigger should be the intriguing finding that teams with high IRB are good at minimising, particularly when they have specific project management tools in place, suggesting that teams that omit such behaviour may run greater risks of troubling innovation projects.

Notes

1 Presented as Peter Oeij, Steven Dhondt, Jeff Gaspersz & Tinka van Vuuren (2016). Innovation resilience behaviour and critical incidents: The relevance for the management of R&D and innovation projects, Paper for *EURAM 2016 'Manageable Cooperation?'*, 1-4 June 2016, European Academy of Management and Université Paris-Est Créteil (UPEC), France. Awarded the 'IPMA – PMI Best Student Paper Prize, EURAM 2016', Project Organising Strategic Interest Group, IPMA (International Project Management Association), PMI (Project Management Institute).
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2 The authors would like to thank Sarah Frith (Proof-reading-service.com) and Samuel Quain (Koforidua Polytechnic, Ghana, former colleague-Phd-student at Open University of the Netherlands) for proofreading the English text.

3 For reasons of privacy the cases are anonymised. In Appendix 3 of this these a short description of each team is provided.

4 In the mean time this paper has been accepted for publication by Team Performance Management (Chapter 4 in this thesis).

5 Team IRB is Team innovation resilience behaviour; Mindful infrastructure includes the following variables: tpsysaf, Team psychological safety; tlearn, Team learning behaviour; leadcol, Leadership collaboration style, leadcrea; Leadership creativity style; leadcont, Leadership control style; leadcom, Leadership competition style; tvoice, Team voice. The four leadership styles together constitute Complexity leadership behaviour.

6 Observe that we interchangingly speak of either presence and absence of Team IRB and high and low IRB-scores. In both cases this must be read as above or below the average score of 4.81.

Chapter 8

Conclusions

Conclusions

Abstract

This chapter discusses the findings, answers the research questions, and addresses the scientific and societal contribution of the study. It closes by describing the limitations of the research and makes suggestions for future research. The main finding is that project teams in innovation management can benefit from HRO principles of crisis management and safety, because there is a valid chain of reasoning that begins with the presence of mindful infrastructure (MI) at the team level, enabling innovation resilience behaviour in teams (Team IRB), and ends in understanding the project outcomes which are influenced by MI and Team IRB in a positive way.

Keywords: findings, research questions, scientific and societal contribution, limitations, future research

1 Introduction

The general objective of this study was to contribute to knowledge of the process of innovation management in teams that are responsible for an innovation and who are working in projects. The background of the study objective is the assumption of a high failure rate of projects and innovation (Castellion & Markham, 2012). There are several reasons why projects on innovation fail. The study was limited to the team dynamics of the project teams. The premises on which innovations fail, from the perspective of human behaviour, are that innovation projects are complex in terms of both content and context which, in the first place, triggers a tendency in the team to control this complexity through rational-logical thinking; and in the second place by processing ambiguities and unexpected events by risk-avoiding defensive behaviours in order to prevent feelings of discomfort, threat and failure (Argyris, 1990; 2010). Whilst team members are selected to deal with complex content, this is not self-evidently the case for complex context caused by the interaction of every stakeholder involved in the innovation process (Stacey, 2010). Defensive behaviour such as risk-avoiding is often not a conscious process, let alone a choice, but takes place for self-protection, hence unintentionally constituting a culture of limited controlled risk-taking, only further increasing the chance of failure (Argyris, 2010; Kahneman, 2011). By studying the teams of High Reliability Organisations (HROs) it can be seen that there are ways to suppress risk-averse behaviour by developing mindful infrastructures that enable mindful team behaviour. Such team behaviour is characterised by alertness for weak signals, a preoccupation with failure, a sensitivity to connecting the big picture with what is going on at shop floor level, being trained and competent to act resiliently when needed, and letting go of the hierarchy when expert decisions have priority. These five principles ensure that teams can proactively anticipate unexpected events, and that they can contain events, such as critical incidents, to improve and maintain the general functioning of the system. Another assumption of this study therefore was, whether such HRO-principles could be helpful to make innovation teams less risk-averse and more effective in dealing with critical incidents, so as to eventually lower the failure rate of innovations. In other words, it was thought that experiences from the field of crisis management and safety could be beneficial for the field of innovation management. We therefore examined how innovation teams handle critical incidents, and whether the HRO-principles helped us to better understand and tackle those incidents.

The research objective was to investigate the team dynamics in innovation projects, how teams deal with setbacks in their project - critical incidents - and whether teams show innovation resilience behaviour when successfully dealing with such setbacks. In other words: to find out how project teams can improve in their innovation process. The main question of the study is: *How do project teams deal with critical incidents during their innovation projects by developing mindful infrastructure and innovation resilience behaviour?*

The research questions were:

Table 1 Research questions

Research questions	Chapter
1. What is mindful infrastructure and what is innovation resilience behaviour (Team IRB)?	2, 3, 4
2. Does innovation resilience behaviour affect perceived project results and perceived project progress?	3
3. Do teams have different configurations of mindful infrastructure?	4
4. Is innovation resilience behaviour associated with less defensive behaviours?	5
5. How do project leaders manage innovation projects?	6
6. How do teams respond to critical incidents during innovation projects?	7
7. What can innovation management teams learn from HRO teams?	2, 3, 4, 5, 6, 7

2 Findings

A research framework was developed based on the literature and a pilot study, as depicted in Figure 1.

The research was carried out in two steps. A pre-study or pilot study was performed on a single case to test the measuring instruments and theoretical assumptions. On the basis of the results of the pilot study the measuring instruments and the research framework were adapted, and subsequently applied to a multi-case study of eighteen innovation projects involving the same eighteen teams.

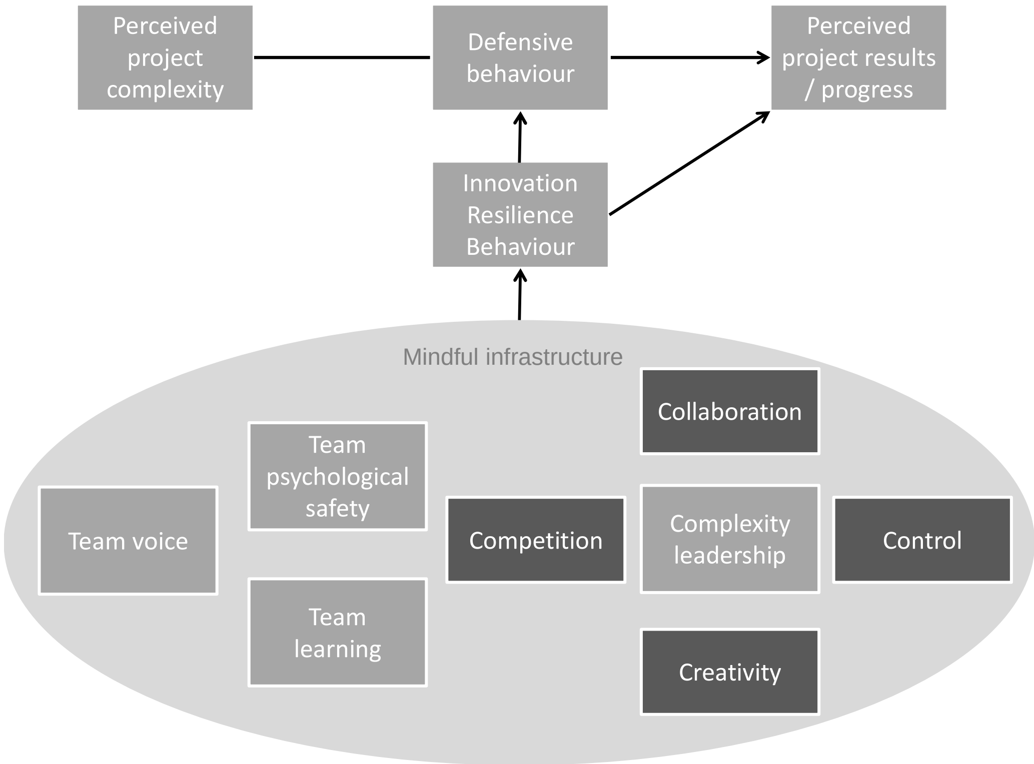

Figure 1 Framework of the research

Pilot study

In the pilot study (Chapter 2) a single case study of a research and technology organisation (RTO) was investigated. In-depth interviews, a team observation, and a survey were combined, to explore how the perceived complexity of innovation projects might be conducive to defensive behaviour. Whether team mindfulness, team psychological safety and team learning behaviour could combine to constitute a mindful infrastructure, and whether or not this mindful infrastructure had a positive correlation with how team members perceived the project results, was also explored. The explorative study returned three main results.

1. The project managers of innovation projects experienced complexity when they had to account for time and budgets, but also for innovative results.
2. Defensive behaviours were observed that seem to be associated with risk avoidance during a team meeting.
3. A positive correlation emerged between the presence of mindful infrastructure and the perceived project results found among the surveyed team members.

The results led to the assumption that mindful infrastructure was relevant for the outcomes of a team and that such an infrastructure could enable innovation resilient behaviour.

Multi-case study

Based on the literature of HROs, teams and leadership, the concept of mindful infrastructure was adapted as consisting of team psychological safety, team learning, team voice and complexity leadership. Mindful infrastructure is studied as the antecedent of Team IRB. Team IRB, in its turn, is based on five principles. The five HRO-principles that form the foundation of Team IRB were developed by Weick et al. (1999; 2007) to represent the organisational level, and were made context-specific for teams by us. The main relationships of the model were then tested (Chapter 3). Based on survey data involving 260 team members and team leaders it was determined that mindful infrastructure enables the emergence of innovation resilience behaviour. The mindful infrastructure-variables of leadership control, team voice, team learning and team psychological safety contributed to this association. Team IRB proved to be connected to both perceived project success and perceived project results. Teams with more IRB reported more often that they achieved the project goals. Team IRB is also a mediator between the relationship of the mindful infrastructure-variables: team psychological safety, team learning, team voice and leadership control on the one hand, and the project outcomes (perceived project success and perceived project results) on the other. In other words, the presence of Team IRB has a significant effect on how the mindful infrastructure-variables are associated with project outcomes. The effect of perceived project complexity on either Team IRB or on perceived project progress or perceived project success proved to be negligible. The main model relationships, namely between mindful infrastructure and Team IRB, and between Team IRB and project progress and project success, are validated on the level of the whole dataset, but could not be replicated on the aggregated level of teams. We noted that the number of respondents restricted the possibility of drawing conclusions about aggregated data at the team level. Perhaps the eighteen teams in our sample differ too much from each other, or are too low in number to produce coherent associations.

A subsequent study of the same eighteen case studies of innovation teams (Chapter 4) took the team level as a central focus, and analysed the composition of the mindful infrastructure of twelve out of the eighteen teams that demonstrated innovation resilience behaviour. The goal was to examine whether teams could differ in their constitution of mindful infrastructure and still be able to perform innovation resilience behaviour. In this investigation, based on qualitative comparative analysis (QCA), team innovation resilience behaviour was studied as a function of the following four elements of mindful infrastructure: team psychological safety, team learning, team voice and complexity leadership, which consisted of four subsets of styles, to: compete, control, create and collaborate. The results showed that the twelve teams fit with one or two of the eight 'configurations' of 'paths' that are associated with a team innovation resilience climate. In other words, there were eight paths or combinations of the variables of mindful infrastructure that led to innovation resilience behaviour. Each configuration is a different combination of the mentioned variables, yet each of these eight combinations leads to team innovation resilient behaviour. The most interesting configuration was the path with the most cases, and the highest unique coverage, which means its contribution to the model solution within this dataset is the largest. In this configuration team innovation resilience behaviour is most likely enabled when team voice, team learning and all four leadership styles (compete, create, control, collaborate) are present within the mindful infrastructure of a team. As said, the other seven solutions or configurations will all also enable Team IRB, but follow another path; they have another combination of elements that constitute their mindful infrastructure. There was no variable that was a 'necessary condition' for team innovation resilience behaviour, nor were any of the mindful infrastructure-variables a 'sufficient condition'. In other words it was not the case that one of the variables was required to be present in all configurations or solutions, and it was also not true that only one variable was sufficient for team innovation resilience behaviour to emerge. This implies that there is no 'one best way' to design mindful infrastructure that enables team innovation resilience behaviour (equifinality: more roads can lead to the same result). In other words, teams can follow different strategies for the same purpose; they have room for organisational choice. At the same time, the research suggests that some configurations are more likely than others, which limits this room for choice.

Organisational defence mechanisms can best be studied through observation. Organisational defence mechanisms (or defensive behaviour or organisational defensive routines) are any action, policy, or practice that prevents organisational participants from experiencing embarrassment or threat and, at the same time, prevents them from discovering the causes of the embarrassment or threat (Argyris, 2004a: 392). They are triggered subconsciously by feelings of discomfort and made undiscussable by denying their existence in order to protect the self. When interviewing team members it emerged that some responded defensively when discussing the possible presence of defensive behaviours in their projects. That was an inducement to study defensiveness more deeply from three viewpoints, self-reports, interpretations by the researchers whether defensiveness was manifest or not, and observations from the discourse between interviewees and the interviewer (Chapter 5). From the self-reports of fourteen examples of defensive behaviour it was learnt that defensiveness does occur. The teams reported the presence of several defensive strategies that they have observed in or around their project team. The three strategies most commonly mentioned were: (1) compliance strategy; if your superior persuades you to commit, say that you comply regardless of whether you really do; (2) undergo strategy; if your superior initiates a change process, just undergo the interventions passively and do not question whether this is going to work; and (3) plan strategy; agree to make a plan and act as if you comply with the plan; this way you contribute to change and stay in your comfort zone. We noted that teams suggested that if it was possible to make defensiveness discussable, it would improve team cooperation. Indications in the interpretations of defensive behaviours suggest that those teams with defensive behaviour which is manifest, are associated with lower scores for their level of Team IRB and for perceived project success. The assumption that teams with defensive behaviour are more inclined to be in control, tend not to lose but to win, and to try to save face, is partly confirmed. Teams with lower scores for innovation resilience behaviour (low-IRB teams) undertook more (evaluated or interpreted as manifest) defensive behaviour and had relatively more observed defensive behaviours. Low-IRB teams might have lower thresholds for defensive behaviour. Statistical tests confirmed that the degree of Team IRB seemed to relate positively to the degree of perceived project success. More defensiveness is thus associated with less innovation resilience behaviour and lower perceived project success. The main lesson is that defensiveness could negatively affect mindful and resilient team behaviour; this is more relevant given that most people are unaware of their defensive behaviours. To be critically and constructively reflective during an innovation project therefore requires a great deal: one first needs to see one's own defensive behaviours, then acknowledge that this may be harmful for the innovation process and team dynamics, and finally be competent and motivated not only to do something about it as it happens, but also be willing to accept training in order to proactively be able to prevent it from happening in the future[1].

Reflection can help to suppress defensive behaviours, as it can trigger organisational learning, and organisational learning can improve people's innovative ability and the innovative capability of a team or organisation. Reflection is associated with learning from mistakes which is most likely when mistakes can be made discussable. During the interviews with project leaders it was noted in hindsight that some of them seem to apply a methodological research rigour that resembled the model of the reflective practitioner of Schön (1983), and it was decided to reconstruct the project leader's implicit behaviours and make them explicit (Chapter 6). In addition to making the reflective practitioner model tangible, a connection was established with the organisational learning model of Argyris, Schön and Bateson (see Tosey et al., 2011) that links single, double and triple loop learning. The practical side is that the combined model of reflective behaviour and organisational learning can be used to monitor and evaluate how decision making in teams connects what teams do, ought to do, and need to do. Teams responsible for innovation projects can benefit from 'debriefing' their own practice to stimulate their individual and collective innovation leadership. They do this by what can be called team reflexivity, namely collectively reflecting upon and adapting their working methods and functioning (Schippers et al., 2007), whilst using the combined model as a grid or compass. Apt moments to apply the model are, of course, in the emergence of critical incidents. Without question, however, it would be preferred that reflective practice and organisational learning are espoused and embedded in the daily routine of innovation work.

Nonetheless, it is of interest how teams actually deal with critical incidents, which are events that interrupt the normal procedure of an innovation project. In contrast, critical recoveries are activities to get the innovation project back on track. Such activities can come from the team, management or external factors, but when they are the team's, they are seen as examples of innovation resilient behaviour. Twelve of the eighteen investigated project teams with a relatively high score on innovation resilience behaviour (Team IRB) were noted as being able to bounce back from critical incidents in their projects (Chapter 7). These teams are embedded in a mindful infrastructure which enables them to display certain resilient behaviours, or certain leadership styles, or apply certain project management tools, or a combination of those. The twelve out of eighteen teams that have a relatively high score for team innovation resilience behaviour vary partly in their actions. The main conclusion is that teams with high IRB are more active in recovering from critical incidents by managing and mending them once these have emerged, than in preventing or minimising critical incidents before these emerge. It was noted (in Chapter 7) among the high-IRB teams that:

1. Most high IRB-cases apply many different team resilience behaviours, including minimising, managing and mending resilience (Alliger et al., 2015). Teams embedded in R&D environments seem to perform more minimising in combination with specific project management tools;

2. Some teams, often being based in an R&D organisation, thus combine resilient behaviours with special project management tools[2];
3. Most teams display a kind of personal or distributed leadership that could handle complex situations, or enabled them to switch leadership styles when situations required to do so;
4. Teams that had no distinct team resilience behaviour in the minimising phase of preventing critical incidents were often teams that underwent personnel changes. They had, for example, replaced former team members, the team leader or the former team;
5. Most teams enact mending behaviours, which means that these teams learn from what has happened during critical incidents and adapt to the changed situation when necessary;
6. The twelve teams that showed team resilience as operationalised by Alliger et al. (2015) perform well on HRO-principles sensitivity to operations, on commitment to resilience, and on deference to expertise as indicators of 'managing and mending actions'; on preoccupation with failure and reluctance to simplify as indicators of 'minimising actions';
7. Teams with high IRB-scores more often report project success, but the low number of cases prevented us from conducting any statistical tests.

A general finding is that mindful infrastructure and innovation resilience behaviour stemming from the crisis management and safety domain are applicable to the innovation management domain. It is important to develop and apply mindful infrastructures and team innovation resilience behaviour for innovation projects to be more successful.

3 Answering the research questions

1. *What is mindful infrastructure and what is innovation resilience behaviour; and what is their relationship?*

We start with Team IRB. Innovation resilience behaviour consists of preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience and deference to expertise. All five factors are relevant to team behaviour because all five were given high total scores (between 4.7 and 5.0 on a 7 point scale; the overall average score is 4.8). It was noted from the case studies that teams with high-IRB scores were better at 'managing and mending resilient behaviours' after a critical incident, than 'minimising resilient behaviours' to prevent critical incidents from occurring (Chapter 7). In this regard innovation teams differ from HRO-teams who excel at minimising behaviours. Team IRB as a concept was similar to findings in a review study of team resilience by Alliger et al. (2015), as discussed in Chapter 7. This improves the validity of the concept.

Mindful infrastructure is regarded as the elements that form the antecedents of innovation resilience behaviour. Such a group of elements facilitate specific behaviour, in the sense of how a semi-structure (Brown & Eisenhardt, 1997) enables or disables certain behaviour. Semi-structures reflect rules, prescriptions and customs in an organisation. Mindful infrastructure is conceptualised as a combination of team psychological safety, team learning, complexity leadership and team voice. Complexity leadership consists of four leadership styles, to collaborate, create, control and compete[3].

The relationship between mindful infrastructure and Team IRB was studied in Chapters 3 and 4. Linear regression analyses pointed out that in our dataset of 260 team members and team leader team psychological safety, team learning, leadership control and team voice mostly explained the presence of Team IRB (Chapter 3). There proved to be more variety in the nonlinear qualitative comparative analyses (QCA) of the eighteen teams: eight combinations of team psychological safety, team learning, team voice, and the four leadership styles, collaborate, create, control and compete, emerged as 'configurations' or paths that resulted in the presence Team IRB (Chapter 4). The exact constitution of a team's mindful infrastructure, in other words. may vary according to specific needs and circumstances. The most consistent configuration, as chosen by the teams, was the combination of team learning, team voice, and all four leadership styles[4].

2. *Does innovation resilience behaviour affect perceived project results and perceived project progress?*

The correlation and multiple regression analyses indicated strong and significant associations between innovation resilience behaviour (Team IRB) and perceived project progress and perceived project success (Chapter 3). It was also noted that Team IRB served as a mediator between mindful infrastructure (team psychological safety, team learning, team voice and leadership control) and project outcomes (perceived project success and perceived project progress). Qualitative (Chapter 5) and non-parametric analyses (Chapter 7) pointed in the same direction but did not provide enough statistical evidence: effect sizes were substantial, but not significant[5]. It seems plausible to suggest that the presence of mindful infrastructure enables Team IRB, and that Team IRB performance positively affects project outcomes.

3. *Do teams have different configurations of mindful infrastructure?*

We noted earlier that teams do indeed differ in the path they take towards innovation resilience behaviour. Eight different combinations of mindful infrastructure were observed in the study of eighteen teams (Chapter 4), and are summarised in Table 2.

Table 2 Configurations of mindful infrastructure elements leading to innovation resilience behaviour

Solutions (configurations or paths) that lead to innovation resilience behaviour is teams	Elements of mindful infrastructure Present	 Must be absent
1. Team dependent goal-orientedness: focus on achieving goals through the project leader, and for which the separate contributions of team members are crucial for the project's progress.	Team voice Team learning Leadership compete Leadership create	Leadership control Leadership collaborate
2. Trusted and focussed team work: coherent team work and a type of (joint) leadership that involves team members in order to gain results step by step.	Team voice Team psychological safety Leadership control Leadership collaborate	Team learning Leadership create
3. Team driven resourcefulness: a psychologically safe and learning-friendly environment with a mature team role and creative leadership to solve practical, process-related problems.	Team voice Team psychological safety Team learning Leadership create	Leadership control Leadership collaborate
4. Team minded and balanced leadership: reflects the presence of four leadership behaviours, with team work offering ample opportunities for learning and voice.	Team voice Team learning Leadership compete Leadership control Leadership create Leadership collaborate	
5. Goal and task-driven leadership: a type of transactional leadership that is pushed by market-driven priorities.	Leadership compete Leadership control	Team voice Team psychological safety Team learning Leadership create Leadership collaborate
6. Goal and process driven leadership: charismatic leadership that is pushed by market-driven priorities and can be successful through closely monitoring the antecedents and consequences of every step in the process.	Leadership compete Leadership collaborate	Team voice Team psychological safety Team learning Leadership control Leadership create
7. Team minded collaboration: an environment where team building and team cooperation can be conducive to restoring the progress of a project.	Team voice Team learning Leadership collaborate	Team psychological safety Leadership compete Leadership control Leadership create
8. Goal-driven problem solving: a rigorous goal-oriented leadership approach focusing on results for the client with a psychologically safe environment for core team members only.	Team psychological safety Leadership compete Leadership control Leadership create	Team voice Team learning Leadership collaborate

The variable names 'Leadership compete, control, create and collaborate' should be read as the leadership styles 'stimulating competition', 'emphasising control', 'stimulate creativity' and 'stimulate collaboration'.

The understanding that mindful infrastructure is made up of different combinations of elements is more meaningful than knowing the specific combinations that emerge from our data. It is in line with our everyday experience that teams differ, that there is no 'one best way of organising' and that different roads lead to Rome. This finding stresses the importance of teams and organisations having room to choose their unique mindful infrastructure. Finally, since there is no single variable that is sufficient to establish such an infrastructure, there can be alternative configurations that enable team innovation resilience. Unspecified 'bundles' of factors in conjunction are successful, which is in line with a specific view of economic organising. The Resource Based View of the firm claims that the basis for the competitive advantage of a firm lies primarily in the application of a valuable bundle of tangible or intangible resources that are at the firm's disposal, because their combination is unique and hard to copy (Wernerfelt, 1995; Barney, Ketchen & Wright, 2011)[6]. This supports the idea of unique bundles in which the exact combination of enablers – in our case the mindful infrastructure variable – differ, as is the case in our study where we distinguished eight solutions or paths to Team IRB. The findings also suggest that not 'anything goes', because the eight configurations within the data represented a higher empirical likeliness, than those with no reliable and inconsistent solutions (Chapter 4). Although it is not possible to predict the combination of leverage factors for each team, some factors are more plausible than others. It is no easy task to choose the elements of mindful infrastructure that are thus most likely to work for a specific team or company: there is no simple answer to a complex practice.

4. Is innovation resilience behaviour associated with defensive behaviours?

The study did not find conclusive statistical evidence to answer this question positively, but the findings do indeed point to an association between innovation resilience behaviour (Team IRB) and defensiveness. It was suggested in the pilot study that defensive behaviours were associated with risk avoidance when observing a team meeting (Chapter 2). In the multi-case study it was noticed that respondents reacted in defensive ways when discussing defensiveness in their team (Chapter 5). The teams first reported the presence of several defensive strategies that they have observed in or around their project team: compliance strategy (comply uncritically), undergo strategy (undergoing, not speaking up) and plan strategy (planning to delay action) as the most common defensive behaviours[7]. We analysed the relationship between defensiveness and the level of IRB-scores, and found that more defensiveness is associated with less innovation resilience behaviour and lower project success. Both the pilot and multi-case study thus suggested that defensiveness affects Team IRB and vice versa; the presence of Team IRB might help to suppress defensiveness. Mindful infrastructures that, for instance, encourage openness, speaking up, and learning from mistakes, are easily understood to effectively countervail organisational defensiveness. It was furthermore shown from the discourse analysis that teams generally apply defensive behaviours subconsciously, such as by pausing, applying humour, external attribution and devaluation regarding sensitive topics (Chapter 5). We assume, but could not test, that teams who generally perform defensive behaviours subconsciously may become unaware of risk avoidance and thus become unaware of being non-reflective, so that they risk reproducing this non-aware behaviour again and again. Unlearning results in more unlearning (Argyris, 2002), with possible negative effects on the process of innovation in projects undertaken by these teams.

5. How do project leaders manage innovation projects?

Complexity leadership involves behavioural complexity, which is the capacity for a broad array of contrasting behaviours, particularly the collaboration, creativity, control and competition leadership styles. Three out of four teams with the highest IRB-scores had a project leader whose four leadership styles were evaluated as higher than average, whereas the three teams with the lowest Team IRB-score had a project leader whose four leadership styles were evaluated as lower than average. The face-to-face interviews suggested that certain project leaders apply a rigorous research approach (Chapter 6). Through in-depth analysis it was possible to study how these project leaders handled critical incidents. They followed steps in a systematic way: they recognised there was a problem, researched the problem, developed alternative solutions, tested different solutions and alternatives on validity, tested and experimented with solutions, selected and applied a particular solution, and evaluated the process completed. The steps they applied more or less subconsciously were consistent with the reflective practitioner model of Schön, and fit rather well with the organisational learning model by Argyris and Schön and by Bateson. The project leaders adjusted their style in accordance with the requirements of the critical incident.

Project leaders differ in leadership style and their ability to adapt their style, and the role of project leadership can also be distributed among the team members. The study (Chapter 7) showed that some team leaders take a leading role during critical incidents, and in other projects leadership was shared by team members, or senior team members supporting a less experienced team leader. Effective team leadership can combine differing interests, such as technical and market requirements, where the first demands quality and the second, also requires speed to market. Ineffective leadership was observed in cases where there was an impasse in decision making or where there were conflicts of interest.

6. How do teams manage critical incidents during innovation projects?

We noted above that teams with high-IRB scores were better at demonstrating 'managing and mending resilient behaviours' after a critical incident had, than at 'minimising resilient behaviours' to prevent critical incidents from occurring. High score-IRB teams show that they are active teams by taking the initiative to settle critical incidents; for instance, through intensive monitoring or adjusting their project plan. The teams in a R&D context, in particular, have certain project management tools in place that are an organisational facilitation enabling Team IRB, as is the case, for example, in the presence of risk management, consequence management, and rapid deployment teams (8D teams). In certain instances higher management intervened to handle critical incidents, replacing team leaders and team members, for instance. Teams with low-IRB were passive, and there was a lack of consensus in some about how to move forward, or they had limited influence to change lock-in situations.

7. What can innovation teams learn from HRO teams?

This study focuses on specific parts of team dynamics, such as psychological safety, learning, leadership, and voice, because not all elements that are related to the multitude of variables in the input-process-outcome model (Mathieu et al., 2008) could be included in the study Our aim here is thus limited to the HRO-principles of alertness, oversimplification, operational sensitivity, resilience and hierarchical flexibility. Innovation teams can learn the psychology of mindful acting and organisational discipline from HROs teams, in order to embed systematic organisational routines such as dedicated briefings and debriefings.

The underlying argument throughout this study was that complex projects may lead to risk-avoidance, and ultimately project failure, if defensive behaviour is not countervailed or prevented by Team IRB[8]. HROs succeed in remaining safe and effective, even during critical incidents. This is partly because they have mindful infrastructure; partly it is because they master the competencies that belong to the behaviours related to the five HRO-principles. Strangely, and differing in fundamental ways from non-HRO organisations, their quality of performance is not directly related to the quality of jobs created by the consequences of organisational design. Non-HROs, for example, with excellent performance, are considered to have the kind of teamwork that is based on 'active jobs', or jobs with tasks that provide task executers with job autonomy and learning opportunities, in such a way that they can work productively and healthily at the same time (Karasek & Theorell, 1990). This is often not the case in HROs, as work can involve the tedious repetition of rules and procedures, and be stressful, with high workloads when critical incidents occur or tend to occur (Rousseau, 1989). Rule-based work might not be in balance with the needs of innovative work and creativity. On the contrary, deviating from rules and experimenting with ideas proved to be very helpful for innovation teams, but might be detrimental for HRO-teams, and yet, HRO-teams must also be resourceful and creative in order to avoid the pitfall of self-evident behaviours and routines. Contrasting innovation teams, HRO-teams are highly disciplined in briefing and debriefing, and performing checks and balances on the fly, because they have learned that it improves their reliable performance; they are encouraged to search for flaws and report them. The work stress element, however, is perhaps a misnomer. Much HRO-work is already related to danger and psychological strain and being done under a pressure that is innate in that work. Maybe HRO-workers take it for granted that some tasks are tedious and repetitive and that others are stressful and very demanding. The balance of job demands and job control might be characterised as more extreme than the work of non-HROs, but results in a balance just as well.

The HRO-literature is relevant to innovation management in its attention to the psychology of avoiding mistakes and the need to put much effort in unnatural human behaviour. The psychological concepts of reliability and mindfulness are central in HRO thinking. The five HRO-principles have a psychological basis, namely in the motivation to pursue cognitive effort in order to detect errors and act upon adapting the situation to effectively deal with (possible) errors. In this sense reliability refers to the stability of cognitive processes. The motivation for continually being aware of potential unexpected situations leads to stable cognitive processes with which to detect possible errors, and to a variable pattern of activities to adapt to events which require revision. This stability of cognitive processes ensures continuous learning from events that unfold in slightly different ways each time, and that eventually result in reliability. Reliability is thus grounded in adaptive human cognition and action (Weick et al., 1999: 86-88).

Weick and colleagues (1999; 2007) relate stable cognitive processes to effective error detection in five areas of concern, the five HRO-principles. These five concerns are tied together by their joint ability to induce a rich awareness of discriminatory detail and a capacity for action, which the authors call 'mindfulness' (Weick et al., 1999: 88-90). Mindfulness in HROs is the willingness to both see and act, and this continually expands the ability to discover and manage unexpected events; the build up of shared cognitive awareness and the varying ability to act. Variation in action patterns thus becomes a 'collective mindfulness' throughout the organisation. In contrast to this kind of organisational learning, if people are blocked from acting on hazards and from detecting weak signals of hazards, these hazards will be ignored and denied, and errors will accumulate unnoticed. Mindlessness, risk-avoidance and defensiveness will reign, characterised by reliance on past categories, acting on 'automatic pilot', complacency, and fixation on a single perspective without awareness that things could be otherwise. HROs actively strive to suppress this inertia or mindlessness.

Table 3 Learnings from HROs for innovation teams

HRO-principles, infrastructure and espoused theory	Competencies of HRO-teams	Lessons for innovation teams performing in projects
Management philosophy and main driver	Act safely; be able to prevent accidents or to contain them	Act to learn; be able to anticipate critical incidents and to operate with several outcome scenarios
Preoccupation with failure	Able to act mindfully	Inventory of thinkable errors related to inputs, throughputs and outputs; risk and consequence management
Resistance of oversimplification	Able to resist confirmation bias	Check important team/project decisions against central project goals; seek alternative solutions before deciding
Sensitivity to operations	Arrange that the top (senior management) understands shop floor events; situational awareness at every level about other levels	The project goals are related to the overarching organisation goals or programme goals; there is awareness of how the two levels interact and there is sensitivity about the outcomes
Commitment to resilience	Trains to be resilient; organises 'slack'	Back and forth thinking about wanted and unwanted outcomes and assessing how to act, including external effects on the project
Deference to expertise	Hierarchy is flexible to judgment from experts and to knowledge flows	Peer review and intervision; absorption of external expertise; feedback from end-users
Mindful infrastructure	• Fosters learning, just cultures and 'mindful' leadership • Briefings, debriefings, monitoring, research, incident reports	• Psychological safety, learning, leadership, voice • (Self-developed) project management tools that are simple but not simplistic and easily applied; application automates behaviour
Organisational non-defensiveness	• Seeks valid and testable information • Creates informed choice • Monitors for errors vigilantly	• Create 'slack' • Make ambiguity and mixed messaging discussable • Celebrate constructive reporting of critical incidents

Table 3 summarises what innovation teams can learn from HROs. HROs excel in that they have the HRO-principles, mindful infrastructure and non-defensiveness by acting according to espoused values (mainly safety and preventing accidents), at their disposal. HROs understand better than markets and other non-profit organisations the importance of cognitive and social psychological qualities and competencies. They have no 'invisible hand' or 'market forces' that implicitly guide their actions. Setting goals may perhaps be easier for them because their sense of urgency is fuelled by a strong and clear-cut public interest. Defining the required competencies is therefore also easier for them (Column 2 in Table 3). Translating these competencies into learning for innovation teams who are working in projects, results in a list of topics that could be applied within the innovation management domain (Column 3 in Table 3). This last column goes beyond the research conclusion and is partly based on insights from the literature studied.

Innovation teams differ from HRO-teams who excel at 'minimising' behaviours to prevent failure and accidents. Comparing this with the apparently legitimate urban legend told in the circle of innovators, that many innovations 'normally fail' before one invention becomes successful, is as depressing as Perrow's notion that complex organisations face disasters as 'normal accidents', the question being not if they happen, but when they will happen.

What is needed to make the lessons in Table 3 applicable, is that issues are actionable, and in doing so prevent being trapped. "For example, rather than being open and honest, we say one thing in public and another in private – and pretend that this is the rational thing to do. We then deny we are doing this and cover up our denial. And in doing so we trap ourselves", explains Argyris in plain words (2010: 2), when describing the infamous theory-in-use that blinds us all. Making solutions cognitively understandable and available does not suffice; making the learnings actionable means that they must be made concrete, relevant and testable, with a causal logic that is valid. In the terminology of Argyris (1996) actionable knowledge involves propositions that are actionable if actors can use them to implement effectively their intentions. Actionable knowledge requires an explicit causal process between an intention, an action and a consequence. Causality is the key to implementation, but a trap emerges when the relationship is only expressed in an abstract cognitive way. The risk in such an instance is that the proposed solution is being paid insufficient attention for the implementable validity of the propositions. This, in turn, leads to propositions that are abstract and disconnected from implementable action; or, there is too much expression of the theory-in-use instead of an actionable solution based on the espoused theory. Kurt Lewin can be paraphrased as saying that there is nothing as practical as a sound theory, which implies that solutions must not only be right theoretically, they simply must work in practice. There is nothing as practical as a theory that works.

4 Scientific contribution

Theory

From a theoretical perspective this study enriched the HRO literature by conceptualising mindful infrastructure as the set of variables that constitutes the antecedents of innovation resilience behaviour. Fostering learning, a just culture and mindful leadership were distinguished in the HRO literature as relevant antecedents of Team IRB. Four indicators were recognised from the team and leadership literatures that operationalise these factors: team psychological safety, team learning, complexity leadership and team voice. The five HRO-principles of alertness, over-simplification, operational sensitivity, resilience and hierarchical flexibility were modified to fit the context of innovation teams. The study thus enriched the innovation and project management literatures by transferring these HRO theories of crisis management and safety to its domains.

The assumption in this study is that the mindful infrastructure variables are antecedents and enablers of Team IRB. These antecedents fall somewhere between structure and culture, and incorporate both structural organisational design elements and organisational behavioural norms. They are the type of characteristics for which Brown and Eisenhardt suggested the term 'semistructure'. Semistructures are a combination of order, prescriptions, and rules (structure), and the decision latitude to move freely and make autonomous choices and decisions. Semistructures "exhibit partial order, such that some aspects are prescribed and others are not" (Brown & Eisenhardt, 1997: 28). The term applied to that semistructure here is 'mindful infrastructure', which is defined as the organisational capacity to anticipate unexpected problems and the capacity to gain such problems, by enabling organisation members to act accordingly. Mindful infrastructure is therefore an *organisational attribute*, while innovation resilience behaviour is an *attribute of humans*.

Note that Weick himself does not make such explicit causal distinctions, but suggests that the infrastructure and the five principles influence each other. The mindful infrastructure is a necessary but not sufficient condition for reliability, according to Weick and colleagues. "That infrastructure must be organised and enacted through conduct that enables organisational members to recognise emerging problems earlier and to manage them more decisively" (Sutcliffe & Weick, 2013: 151). To Weick 'organising' is part and parcel of organisational processes which are interactions between persons that constitute both structure and culture, which have multi-causal relationships, and thus, conversely, constitute mindsets, behaviours, sense and meaning making, and organisational structures and cultures (Weick, 1979; 1995). According to Weick the five principles can eventually end up as a collective capacity, wherein all individuals will learn to behave mindfully (or not if they do not learn and thus fail). In his terminology there is logically no very strict distinction between structure and process, or between terms such as 'organisational mindfulness', 'mindful infrastructure' and 'collective mindfulness' on the one hand (as an observable state or capacity), and 'mindful organising' and 'organising mindfulness' on the other (as acts that are part of a process). As Weick puts it, with Sutcliffe: "Mindful organizing is *enabled* when leaders and organizational members pay close attention to shaping the social and relational infrastructure of the organization (…). And it is *enacted* through five interrelated processes and associated practices" (Sutcliffe & Weick, 2013: 149; italics in original). Vogus and Sutcliffe (2012), however, seem to prefer a clearer distinction between structure and behaviour, when they say that organisational mindfulness (mindful infrastructure in our terms): (1) results from top-down decisions, (2) creates the context for thinking and action on the front line, and (3) is a relatively enduring property of an organisation (such as culture) (Vogus & Sutcliffe, 2012: 724). In contrast, mindful organising (innovation resilience behaviour in our study) is a dynamic and social process, comprising specific ongoing actions, that relies on extensive and continuous real-time communication and interactions that occur in briefings, meetings, updates, and in teams' ongoing work; and results (1) from bottom-up processes; (2) enacts or forms the context for thinking and action on the front line, and (3) is relatively fragile and needs to be continuously re-established. As such, it is a function of the behaviours carried out by organisational members, especially those on the front line (of a disaster or high risk situation) (Vogus & Sutcliffe, 2012: 725).

From a critical-realist perspective Weick is correct in saying that through organising (i.e., assembling ongoing interdependent actions into sensible sequences that generate sensible outcomes – Weick, 1979: 3) structure and process influence each other[9]. For the sake of understanding these social phenomena in our research, we made this conceptual distinction between structure and behaviour, mindful infrastructure and Team IRB respectively, which are also sequential in terms of time.

The theoretical newness of innovation resilience behaviour has limitations, as it is firmly rooted in the HRO-principles. The concept and its measuring instrument, are 'not new to the world, but new to the firm' (Johannessen, Olsen & Lumpkin, 2001) in the business of innovation. The mindful infrastructure and Team IRB of project innovation teams can be measured and the results can be connected to other data, such as that about the input or output of projects and team processes.

Research methodology

1. Mixed methods

Our contribution in terms of research methodology is in providing an example of a coherent approach that combines elements which at first sight may seem barely compatible. The study applies a critical-realist approach in trying to reconcile positivist and interpretivist positions (Bashkar, 2014)[10]. Case studies are used to investigate qualitative issues and topics that differ in nature, such as intangible defensiveness and tangible critical incidents; and survey data is collected to perform both conventional linear statistic analyses and less conventional non-linear statistic analyses. Mixed methods were needed to gather the different types of data, in the course of which integration was aimed for by homogenising the topics across the varying measuring instruments applied to the different respondents. The reason for following a mixed method design is that the newness of the topic[11] required both gathering in-depth data about working mechanisms, and using testable concepts so as to make generalisable statements to a certain extent. We can now say that the likelihood of Team IRB is greater when mindful infrastructures are present, even though the specific constitution of such infrastructures may vary across organisations.

2. Case study design

Case studies are an appropriate research strategy for 'how' and 'why' questions (instead of who, what, where, how much/many) (Yin, 2009). The basic question is 'why' innovation teams that perform innovation resilience behaviour have a specific combination of variables that constitute their mindful infrastructure, and 'how' can this be explained, when studying the innovation project and the way teams deal with critical incidents. Several data collection methods were applied within this case study research, which comprised multiple cases.

An MSDO-design was used for the case selection: Most Similar cases with a Different Outcome design (Marx & Dusa, 2011). The selection of cases was guided by two principles: 1] maximising the variation in the outcome and explanatory conditions under investigation, and 2] homogenising (holding constant) other explanatory conditions which are not under investigation. Eighteen cases of 'innovation projects' carried out by 'project-based teams' were selected, for which the dynamics within the teams - mindful infrastructure, innovation resilience behaviour and critical incidents - could vary across those projects. The cases were selected on the basis of purposive or theoretical sampling, namely to investigate theoretical relationships, and to allow for comparison across cases, for which the main constant factor was that all teams were project-based teams working on an innovation or renewal. The limited absolute number of cases (from the perspective of conventional statistics) did result in the generalisability of results, although limited, as a result of applying a specific technique, qualitative comparative analysis (QCA).

3. Qualitative Comparative Analysis (QCA)

Contrary to conventional statistics, QCA can lead to results that better fit with the way people experience the complexity of life. As in real life, different combinations (high scores on elements of mindful infrastructure) can lead to certain outcomes (Team IRB), but high scores on such conditional variables can also be associated with the absence of such outcomes. For this reason researchers must operate 'back and forth' between the results of the analysis and the original data of the cases. Referring to Ragin, Cambré stresses the importance of substantive knowledge in case-based research. "The selection of relevant conditions to include in the analysis, the calibration of set-membership scores and the resolution of contradictions (cases with the same causal profile but different outcomes) are all based on case-knowledge and/or substantive knowledge. For this reason, Ragin labelled QCA as 'the interplay between case-based knowledge and cross-case analysis'" (Cambré, 2015: 16). As in conventional statistics, where the researcher makes decisions about the design of questions, operationalisations and research techniques, a researcher using QCA is applying their expertise to the case-data in order to interpret the results of the analyses.

The QCA method can be used to address social phenomena that is 'causally complex' in a coherent, sense-making and meaningful way, and as such is in accordance with how people experience reality. This "reality is that no one, including powerful (...) figures, can control or plan the responsive interplay of intentions which is why the (...) patterns that emerge are unpredictable, why we are continuously surprised and find ourselves having to deal with unexpected events" (Stacey, 2010: 5) and situations. This study is also among the first wave of research that has applied QCA in the domain of innovation management (Ganter & Hecker, 2014).

Needless to say, QCA does not replace linear techniques. When investigating specific research questions, each technique has its own value. Linear techniques remain important to investigate phenomena among large populations, to generalise findings to such populations, apart from contributing to scientific theory with such techniques. QCA and other set theoretic approaches are valuable when the number of cases under study is small or when these cases are rich in variety. QCA allows limited generalisability with a small number of cases and is a highly appropriate method by which to develop and test theoretical issues. Most valuable in this study, perhaps, was its suitability for research equifinality, wherein different combinations of variables can all explain the same kind of outcome (Ragin, 2008).

4. Triangulation as integrative mixed method

Triangulation is the use of several methods and data sources to cross check results. "Stripped to its basics, triangulation is supposed to support a finding by showing that at least three independent measures of it agree with it or, at least, do not contradict it" (Miles, Huberman & Saldaña, 2014: 299). The validity of findings is improved when they are confirmed by more than one data collection instrument measuring the same phenomenon, but this is not self-evident. "If you are a pure empiricist, uninterested in the theoretical bases of research design, mixed methods may look like a good idea", warns Silverman, but one should not adopt a naively optimistic view that the aggregation of data will automatically reveal 'the whole picture' (Silverman, 2013: 136-138). This study applied quantitative (survey) and qualitative methods (in-depth face-to-face interviews, team observation) and combined those data sources in the analyses. It strived for homogeneity in the data collection phase by ensuring that the topics of the questionnaires and interview checklists were the same and followed a comparable sequence; and, in addition, by ensuring that the same topics were discussed with team members, team leaders and their team managers. The study can thus be evaluated as triangulation, as an integrative mixed methods approach. In some phases it was not possible to fully integrate the data, as, for example, the case in Chapter 5 where defensive behaviours were studied from different angles (self-reports, interpretations/evaluations by the researcher, discourse analyses of recorded interview fragments). In such instances it is more accurate to speak of a quasi-mixed design (Tavecchio, 2015; Tashakkori & Teddlie, 2008).

5 Societal contribution

The study's findings could add value at the level of organisations and at the level of society. The practitioner's problem, and the reason for undertaking this journey, is the relatively substantial failure rate of innovations. While there are different angles from which to approach failure of innovation, we limit ourselves to projects and innovations, more specifically, to 'projects that do not (completely) succeed' and 'launched product innovations that fail to meet commercial objectives'. Fifty to 90% of projects, such as innovation projects, IT projects, and building and construction projects, are reported as not completing their goals or as facing major overspending (Mulder, 2012); however, research-based findings report that on average 40% of product innovations fail (Castellion & Markham, 2013). These failure rates are not exclusively caused by team dynamics, but project managers are said to focus too much on 'hard' project skills (time, budget, requirements) and to follow standard project management procedures (Shenhar & Dvir, 2007). Projects become more complex, which seems to be more often caused by people than by product or process (Azim et al., 2010). More attention to 'soft skills', such as communication skills, creativity, and the ability to cooperate. is therefore needed.

This study can help to lower failure rates at the level of project teams. The potential benefit for organisations and their stakeholders is a higher return on investments, and, depending on whether the innovation is directed at new products or services, or at new working, production or marketing methods, greater competitive advantage or organisational performance, efficiency and effectiveness (Bessant & Tidd, 2007). For organisational members this will hypothetically affect their job security, job satisfaction, remuneration, and health. Both the organisation and its members might benefit from more organisational learning, meaningful social relations and interactions, and a longer term perspective in terms of sustainability. Generally speaking, more successful innovation at societal level can enhance economic welfare and psychosocial well-being, although there is no single view of the relationships between innovation and economic growth, competitiveness and employment (Cantwell, 2005; Pianta, 2005; Verspagen, 2005). Lessons from the study could also be disseminated across economic sectors where project-based innovation is a phenomenon. since project-based work is becoming so widespread these days (Shenhar & Dvir, 2007). The Project Management Institute commissioned a forecast study.[*] Some findings of interest are that: 1] between 2010 and 2020 15.7 million new project management roles will be created globally across seven project-intensive industries, and the GDP of project-intensive industries will grow substantially; project management jobs will grow by 700,000 in the U.S., by 8.2 million in China and by almost 4 million in India. With poor project performance and high failure rates against a formidable growth of project management and jobs involved, there is much to gain from improved team work in projects.

Although this study does not focus on the structural organisational improvements that lay a basis for innovation resilience behaviour - such as the division of labour, technological applications and management philosophies that, for instance, affect job satisfaction, employee well-being, autonomy, participation, democratic dialogue and organisational learning in structural, sustainable modes (see e.g. Christis, 2010; De Sitter, Den Hertog, & Dankbaar, 1997; Dhondt, Pot & Kraan, 2014; Eurofound, 2015; Karasek & Theorell, 1990), our viewpoint is that these struc-

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[*] 'PMI's industry growth forecast' entitled 'Project Management Between 2010 + 2020'. The information and data in the report came from The Anderson Economic Group, 'Project-Oriented Employment Trends and Costs of a Skills Gap: 2010-2020 report' (not available). Visit: http://www.pmi.org/~/media/PDF/Business-Solutions/PMI_Industry_Growth_Forecase_2010-2010.ashx (Accessed April 5, 2016).

tural design choices are at least as important as choices about semi-structure and (team) behaviour for the innovation process.

6 Limitations and future research

Reliability, validity, generalisability and consistency are four criteria that help determine what passes as rigorous case study. (These criteria were introduced in the appendix research methodology). Gibbert and Ruigrok (2010; see also Gibbert, Ruigrok & Wicki, 2008) made an empirical analysis of case study rigour and suggest that three strategies used in practice may account for rigour. Comparing authors who use rigour extensively versus authors who use rigour less extensively, Gibbert and Ruigrok identified a threefold strategy as used by authors who pay close attention to rigour when reporting their case study research. First, they prioritise internal validity and construct validity over external validity (generalisability). Generalisation is relevant, but when it comes to a limited number of cases, it is more important to ensure the internal and construct validity, due to scientific aims such as theory development and exploring new phenomena. Without rigour, no relevance, is what Gibbert et al. (2008) say. Authors addressing rigour extensively report concrete actions taken to ensure methodological rigour. Instead of pointing to abstract criteria, they are highly transparent, allowing the reader to appreciate the logic and purpose of these actions. Third, papers that address rigour extensively described the challenges and problems that were encountered, instead of devising a 'neat' methodology. Discussing problems and carefully explaining how they were solved enhances the credibility of the research effort and the results (Gibbert & Ruigrok, 2010). We take their suggestions about case study research into account when discussing the four criteria mentioned above. The same criteria are reviewed concerning the survey (Chapter 3) and the observations (Chapter 2 and 5).

1. Internal validity

Internal validity involves the causal relationships between variables and results and the conclusions about these relationships based on the whole research design. The research framework developed provides a basis for the logical reasoning underlying the study. That framework was derived from studies of HROs, teams and leadership, and specifically rooted in the domains of crisis management and safety. The framework argument is that complex projects could negatively affect project outcomes if defensive behaviour triggers risk avoidance. Such risk avoidance is possibly associated with the occurrence of critical incidents, however, when teams possess of mindful infrastructure then innovation resilience behaviour can be enabled. Defensive behaviours can be prevented or suppressed where there is Team IRB, so that critical incidents can be effectively dealt with, initiating critical recoveries, which has positive effects on project outcomes[12]. It is implicitly argued that a lower failure rate of innovation projects is a consequence. The empirical results were largely consonant with the theoretical expectations and validated the model's main relationships. Pattern matching (Gibbert et al., 2008) took place in the study that applied QCA, which assessed 128 possible combinations. The theoretically predicted pattern was empirically found: the pattern of mindful infrastructure in conjunction with Team IRB was associated with positive project outcomes. These findings corroborate the results of other HRO studies (Weick & Sutcliffe, 2007). Although the configuration of mindful infrastructure elements (team psychological safety, team learning, leadership styles and team voice) varied, the overall pattern was consistent. This finding is in line with a seminal study of innovation journeys from almost two decades ago.[13]

Gibbert et al. (2008) further suggest theory triangulation to verify findings from multiple perspectives, which was undertaken by transferring perspectives from crisis management and safety to innovation management, and thus 'confronting' and 'cross-fertilising' both fields.

The internal validity of the survey involves a similar line of reasoning with regard to the (same) model being applied. The conclusions about the causal relationships seem valid, although it was not possible to control for several factors that co-determine project outcomes. The internal validity of the team observation and interview talk to investigate defensive behaviour could have been biased by the preconceived theoretical expectations of the researcher. The overall internal or logical validity of the study is explained from the pragmatic, critical-realist perspective, which, for example explains the seemingly contradictory combination of both linear and non-linear methods.

2. *Construct validity*

Construct validity in case studies involves the extent to which a research procedure leads to an accurate observation of reality, and thus the quality of the conceptualisation or operationalisation of the main concepts. Gibbert et al. (2008) encourage establishing a clear chain of evidence to allow readers to reconstruct the research from the initial research questions to the final conclusions. The research process was planned in a specified fashion according to the research proposal, but, and not unusually in case studies, the process took different turns. The 'main road' of the research was focused on investigating the central relationships of the research framework. Serendipitous inducements – when the researcher followed his curiosity when interviewees behaved differently than expected – opened 'side ways' to allow discourse analysis on defensive behaviours and to reconstruct leadership behaviour using the reflective practitioner model (Chapter 5 and 6). These deviations were described in the respective chapters. Triangulation, another suggestion by Gibbert et al. (2008), was applied to look at the same phenomenon from different angles by using different data collection strategies and data sources. It is noted that the oral interview data, although being recorded, was analysed and considered by one person only. No inter-rater reliability tests could be carried out to test for homogeneity.

The construct validity of the concepts used in the survey addresses whether they measure what the theory says they do and if the internal structure of the concepts is consistent. The high proportion of explained variance in the regression analyses (Chapter 3) might suggest that the items of the various constructs show a degree of similarity (in the eyes of the respondents); some constructs also correlate strongly. Due to the cross-sectional character of the study, correlations might be increased because respondents intend to answer questions in a consistent style; using socially desirable answering patterns to (implicitly) comply with what is approved of by society at large may further increase these correlations. Finally, the survey measured all those constructs in one questionnaire, which might also inflate the correlations due to common method bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). This risk of inflated correlations was reduced because we used different sources to measure project results in one study. We limited the issue of the potentially corrupted objectivity of self-reporting by calculating the inter-reliability between teams and their project managers on important variables such as the project outcomes. This resulted in the assessment of commonalities in their views (Chapter 3). A further critical remark should be made about the reliability of the constructs. The Cronbach's alpha values for team psychological safety and team learning behaviour were rather low, and therefore the research needs to be repeated with larger samples in order to draw conclusions that are more robust, and to investigate whether the theoretical concepts can be replicated. The construct validity of the developed measuring instrument of defensive behaviour was not thoroughly inspected. Based on our own judgement, as a variant of face validity, the instrument seems to measure what was intended, but it must be noted that evaluation bias cannot be excluded: no inter-rater reliability was applied. As an additional check on the validity of the findings, however, we discussed the findings with the teams in feedback sessions and wrote reports per case that were handed to the teams and their responsible managers. This lead to some adjustments, but there were no significant objections to the results.

Finally, the survey data has some limitations[14]. In the first place the survey was completed by a cross-sectional sample of respondents, strictly not allowing causal inferences. Second, the findings from the survey were based on the self-reports of respondents, which can be biased towards socially-desirable answers.

3. External validity or generalisability

External validity means that the findings in the researched setting are applicable to other settings. The multiple-case study of eighteen teams does not allow for statistical generalisation (to populations) but that was not the intention. The purpose is analytical generalisation (to theory). It was concluded that the HRO-concepts are applicable and transferable to the innovation management domain. Limited generalisability was possible due to the use of qualitative comparative analysis (QCA), which allows conclusions to be drawn based on non-linear (non-parametric) statistics, which resulted in the conclusion that there are eight different paths that lead to innovation resilience behaviour. Apart from QCA, which enables a mode of cross-case analysis - one of the suggestions of Gibbert et al. (2008), derived from Eisenhardt (1989) - in-depth case comparisons were performed (for example in Chapter 5, 6 and 7) that corroborated and enabled theory development about defensive behaviour, reflection and organisational learning, and mindful infrastructure and innovation resilience behaviour. As a variant of the extreme-case comparison technique (Edmondson & McManus, 2007), contrasting high-IRB and low-IRB teams were compared to understand how they differed in defensiveness and dealing with critical incidents, and how these differences were related to project outcomes.

Gibbert et al. (2008) further suggest providing a clear rationale for the case study selection and the case study context to allow readers to appreciate the sampling choices being made. The selected cases all had to be project-based teams working on innovation projects dealing with innovation or renewal; the time specifications were that the projects had to be underway long enough (six months as a minimum) so as to speak of a history of events with researchable team dynamics and possible critical incidents or recoveries; and no project to have ended longer that six months ago, in order to minimise bias from retention effects. The main team members had to be available for the research. It proved, however, almost impossible to execute a selection procedure that ensured a minimum of variables had to be controlled for, as would have been the case if we had succeeded in using a nested approach to select different case studies within one organisation (Yin, 2009). As a consequence of not being able to fully control the selection process, some cases proved to have no critical incidents or were working on projects that were characterised more by organisational change or renewal, than by working on an innovation or renewal. Conversely, it can be reasoned that this resulted in the inclusion of 'deviant' cases with features that helped to confirm theory development. One case without critical incidents, for example, was a routinised project that had good project results without any Team IRB observable, implying that Team IRB is not needed when there are no critical incidents[15].another case of an organisational change project experienced critical incidents for which Team IRB was useful in the same way as for cases with innovation projects. Finally in one case where there were no critical incidents, it could be argued that the team was so well-qualified and experienced that their mindful infrastructure prevented such incidents from happening, let alone escalating.

The external validity of the survey is limited because the sample of respondents is not representative of a general population. The findings should be regarded as exploratory and only suitable for analytical generalisation.

A general remark about generalisability is related to the innate complexity and multi-causality of the research topic. On the one hand, the process of innovation projects varies greatly across teams and organisations, not only in our study (Van de Ven et al., 1999), which mean that making simple recommendations for practice is very complicated. External validity is therefore limited by the complex nature of the research topic. On the other hand, and from a positive perspective, a large amount of variety implies that there are many solutions to the same kind of critical incidents: 'no best way of organising' works in two directions.

4. Reliability

Reliability is the consistent assignment of instances to the same category by different observers, or by the same observer on different occasions. It deals with the degree to which findings are independent of the accidental circumstances of their production; and are replicable, that is, whether future researchers can repeat the study and if they would come to similar conclusions (Silverman, 2011). For this purpose we made the study's strategy as transparent as possible, as well as our methodological choices (Gibbert et al., 2008). All interviews were recorded, allowing the possibility for inter-rater reliability and for transcripts to be made. It must be noted that no verbatim transcripts were made of the interviews, as there were 99 hours of audio recorded face-to-face and group interviews. The lack of inter-rater reliability checks was somewhat compensated for by designing the interview checklists and survey questionnaires concurrently, which resulted in fixed-choice answers as a grid to analyse the data collected against the checklist during oral interview. Discussing the results with the teams enabled us to cross-check our findings. This improved valid cross-case comparison. The study procedure is reported in Chapter 1 (and Appendices 1 and 2) and in detailed checklists for the interviews that serve as a case study protocol. A case study database is available to enable replication of the study.

5. Future research

The progress of research can be understood by how well we understand social phenomena, in our case field research in organisations, and more specifically, in the team dynamics of project-based innovation. Edmondson and McManus (2007) propose a continuum of research-based theory that goes from nascent, to intermediate, to mature theory. Mature theory presents well developed constructs and models, and a broad agreement. Mature theory research stresses further refinement and spawns precise, quantitative research designs. Nascent theory, in contrast, proposes tentative answers to novel questions, suggesting new connections among newly discovered phenomena. It involves exploration through qualitative data. Intermediate theory, positioned between, presents provisional explanations of phenomena, often introducing new constructs and proposing relationships between established constructs. It benefits most from a mix of quantitative data and qualitative data to accomplish its dual aims. The presented study can best be characterised as intermediate[16].

Future research, therefore, should have the ambition of encouraging studies developing towards a mature theory. The following avenues for future research are suggested:

- Innovation resilience behaviour is conceptualised as a set of team behaviours rooted in the five HRO-principles to manage critical incidents and to enact critical recoveries. The concept could be tested further among representative samples of the populations of project teams in innovation. Team IRB functions as a mediator between mindful infrastructure variables and project outcomes. The exact nature of the relationships between mindful infrastructure variables, the five Team IRB behaviours and the project outcomes are still unclear and require further scrutiny. Finally some elements that were not predicted in the model but proved to influence Team IRB, are project management tools, notably risk management, consequence management and rapid deployment teams. Indications were found that such project management tools, often present in teams within R&D departments, are positively associated with containing critical incidents. Other contextual elements that seem to negatively affect the innovation process are when innovation projects are given a lower priority than market projects. In these kinds of situations teams tend to focus more on market assignments, especially in commercial organisations, even when such priorities are implicit or denied. Research into whether this is caused by ambiguity or the absence of organisational slack, could offer greater insight into why this occurs; and whether or not there is a relationship with risk-averse behaviour as a result of experiencing mixed messaging.

- Mindful infrastructure is conceptualised as team psychological safety, team learning, complexity leadership and team voice, but how these factors relate to each other and the exact mechanism by which it enables Team IRB, involves several unanswered questions. The research established the presence of eight combinations associated with Team IRB, but this is just the start of investigating its working mechanisms. Larger samples of cases will undoubtedly reveal the presence of other paths as well, and this would help to see whether certain paths are significantly more commonly chosen than others. This would make the question of whether teams and organisation have specific strategies that underlie mindful infrastructure a topic of research in its own right.
- Defensive behaviour has been studied through observation, oral interviews and discourse analysis. In different ways, and to different extent, there were indications that defensive behaviours might be associated with risk-averse behaviours. An instrument was developed to analyse defensive behaviour through the use of audio recordings (Chapter 5). Research is encouraged to more firmly establish the relationships of defensive behaviours and risk-averse behaviours with project outcomes. This would demonstrate the importance of mindful infrastructure and Team IRB so as to suppress defensive behaviours and to reduce negative effects on project outcomes and innovation.
- Leadership is regarded as a behaviour style that synergises multiple interests so that progress is encouraged and deadlocks avoided. Leadership can be executed by the team leader and by other team members as well. Complexity leadership and transformational leadership are often shown to motivate and inspire followers. In relation to innovation leadership, a style to influence employees to produce creative ideas, products, and services (Gliddon, 2006), complexity leadership and transformational leadership both are aimed at motivating others to produce such creative ideas, products and services. Deference to expertise is a clear leadership quality in relation to HROs, but perhaps a less studied phenomenon is leadership that confronts theory-in-use Model I behaviour in project teams by making its negative effects discussable (Argyris, 2010). Model I behaviour is our inclination to strive after control in such ways that we become defensive, whereas Model II behaviour is driven by striving after valid information and not being solely driven by control: we become less defensive and more effective in what we do. The outcome of such investigations involves both knowledge development and a practical purpose, insight into defence mechanisms, into reasons why double-loop learning is inhibited, and into the 'implementable validity' of solutions in critical incidents. By implementable validity Argyris (1996) stresses that knowledge should be made actionable for practitioners: how can such knowledge be made more applicable from the perspective of Model II? (see Chapter 9). Model I behaviours – striving after control leading to defensive behaviour – are reasons that are inhibiting mindfulness (Argyris, 2004b: 218-22). According to Argyris, leadership should confront the dilemma of Model I theory-in-use and Model II espoused theory values, by reducing the defensive reasoning mind-set. In essence this requires being able to switch from Model I to Model II by double-loop learning, which is changing the values and the norms if needed (see the organisational learning model in Chapter 6). Such a change requires not only cognitively understanding what should be done, but requires actionable solutions, says Argyris (2010: 140). On that basis, this requires leaders to face the fact that, although they might espouse Model II values and productive reasoning, they are inclined to retreat to the safety of Model I val-

ues and a defensive mind-set in action: "when we most need to learn, we paradoxically work hardest at *shutting down* conversations, shutting down other people, and shutting down ourselves" (Argyris, 2010: 187-188). Our study only found indications of defensive behaviour among the people we talked to (Chapter 5), and we cannot draw firm conclusions on leadership behaviour in that basis.

- In terms of external validity ('implementable validity' - Argyris, 1996) this scientific research has resulted in limited results regarding the everyday practice of teams, projects, and innovation management, which is partly due to the nature of this knowledge-driven investigation. Team IRB could be supported by making Team IRB competencies tangible and trainable. Tools could be developed that support learning Team IRB by doing. During team meetings, when significant decisions are taken, it is possible to evaluate each decision against criteria that are associated with the five HRO-principles. If the most important stakeholder is considered, for example, then each decision could be weighted against criteria such as: 'being alert that the decision supports the interest of the stakeholders' (alertness about misjudgement); 'having considered alternative decisions based on valid facts' (reduce oversimplification); 'ensuring that the decision is in line with both organisational, teams and project goals' (sensitivity to detail and general goals); 'being able to alter decisions when needed execute another tack' (commitment to resilience); and 'ensuring that expertise can outweigh hierarchy in the interest of the stakeholder' (deference to expertise). Such 'project management tools' are simple but not simplistic (Pacanowsky, 1995), can be learned on the job so that those tools become automated behaviour, and can be developed by teams so that ownership guarantees the motivation to apply them. Experimental research, comparing teams that do and do not develop such tools, could evaluate the effect of these tools as interventions with a pre-test and post-test design. Variables that must be considered for integration into the design are mindful infrastructure, Team IRB and project outcomes.

Notes

1 "In the interest of more mindfulness, you're asking people to pay more attention to their failures than to their success, forgo recipes and rules of thumb in favour of what amounts to reinventing the wheel every time they act, pay attention to tactics and nuts and bolts rather than strategies and grand visions, get better at being reactive than proactive, and acknowledge that someone else may know more than they do. That's a big order. People would prefer to pay more attention to success, recipes, strategies, initiatives, and status" (Weick & Sutcliffe, 2007: 148).

2 The role of project management tools was not central in the design of the study. In hindsight we assumed that such tools can play a major role in 'minimising' and preventing escalating critical incidents. Future research is recommended into the relationship of such tools with IRB.

3 The observation that the constitution of mindful infrastructure may vary across organisations (Chapter 4) indicates it is not a definitive concept, but a sensitising concept in the sense Blumer proposed it. Blumer contrasts sensitising concepts with definitive concepts. "A definitive concept refers precisely to what is common to a class of objects, by the aid of a clear definition in terms of attributes or fixed bench marks. This definition, or the bench marks, serve as a means of clearly identifying the individual instance of the class and the make-up of that instance that is covered by the concept. A sensitizing concept lacks such specification of attributes or bench marks and consequently it does not enable the user to move directly to the instance and its relevant content. Instead, it gives the user a general sense of reference and guidance in approaching empirical instances. Whereas definitive concepts provide prescriptions of what to see, sensitizing concepts merely suggest directions along which to look" (Blumer, 1954).

4 The concepts are not related in a problematic manner. Despite the fact that the concepts are significantly positively correlated, there remains variation in how specific patterns of mindful infrastructure relate to the absence or presence of Team IRB.

5 The fact that effect sizes were substantial legitimises more future research into these relationships. We expect that those future results will be significant when larger populations are being investigated.

6 There are several variants of this view. A first one, Dynamic Capabilities (Eisenhardt & Martin, 2000) relates economic organisational performance to 'bundles' of HR-instruments (the role of High Performance Work Systems related to HR - Appelbaum, Bailey, Berg & Kalleberg, 2000; Arthur, 1994); a second connects interventions in organisational design and job design in pursuing innovation, better organisational performance and better quality of work (e.g. workplace innovation as an example of organisational innovation (Eurofound, 2015); and a third relates HRO-theory to HR (i.e. the observation that the five HRO-principles are also a 'bundle' of HR-related characteristics - Vogus & Iacobucci, 2016).

7 Observe that defensive behaviours are in fact tacit strategies because they are subconscious.

8 Project complexity did not seem to play a determining role in relation to mindful infrastructure and Team IRB (Chapter 3). Perhaps most teams were comfortable with working in complex projects. The measure we used included many elements of complexity. Maybe this construct was too broad and lacked specific focus, allowing too much variation.

9 Perhaps, because crisis management and safety experts highlight the prevention of accidents, they put more weight on behaviour in the knowledge that structures (alone) are not sufficient for accidents to happen. Innovation management can learn from HROs that behaviour is no less important than structure, rules, regulations and (reward) stimuli. HROs also stress that people must unlearn certain habits and learn to act unnaturally in order to become extremely alert, non-defensive, and resilient.

10 Taking the ontology and epistemology viewpoints into account, the scientific assumptions underlying the study combine a subjective dimension with an objective one. From an ontological viewpoint the stance is that reality is both as external to the individual as it is internal; reality is partly what is 'out there' in the world, and partly it is a product of the human mind. The epistemological stance of this study combines the ideas that knowledge is both objective on the one hand and subjective on the other; there are general facts and there are experiences and insights of a unique and essentially personal nature. Social change is not only, or is not merely, affected by universal laws or perceptions and interpretations, but the interaction of sustainable institutions and human action. The methodological approach that follows from these positions is a combination of interpretivist-ideographic and structural-nomothetic thinking. Human nature, the relationship between human beings and their (social) environment is therefore not fully voluntarist, nor fully deterministic. The methodology is critical-realist (O'Mahoney & Vincent, 2014), and pragmatic (Graff, 2013). Critical-realism is a reconciliation of positivist and interpretivist approaches and a general framework for research, but not associated with any particular set of

methods (Fletcher, 2016). Critical-realism differs from both in that it holds that humans cannot completely know (epistemology) all there is (ontology) (Graff, 2013). In this study, for example, tangible and intangible phenomena were investigated. Solving critical incidents through resilient team behaviours are examples of observable actions, while certain defensive behaviours from unconscious reasoning are non-observable examples, yet both are real and existing, but not knowledgeable to the same extent. Pragmatism acknowledges that seemingly opposing characteristics can have common ground and can to a certain degree be compatible, such as quantitative and qualitative methodologies, objective and subjective viewpoints, and hypothesis testing and deductive reasoning; there is not one truth but several explanations of reality.

11 That topic concerns the nature of the research object, teams and their projects. On the one hand there is a multitude of varying factors that cannot be controlled, which requires an in-depth qualitative approach to understand the social process on innovation in teams. On the other hand, there are constant and sustainable factors as well, and there is a desire to make generalisation possible, which demands a quantitative approach to analysing larger datasets of team populations. Our approach is receptive of events emerging unplanned during the study. Following our curiosity in studying defensive talk and reflective practitionership are examples of that (Chapter 5 and 6), and not of an insufficiently planned research process. At the same time, in explaining our research we strive to be parsimonious in the number of variables we need, in developing our theoretical framework.

12 One could reason that the presence of high IRB may prevent critical incidents occurring or escalating. A methodological issue asks under which conditions cases would be sampled without critical incidents, and thus be systematically overlooked. Would it mean that these are smoothly running projects because there are no problems, or because the team is highly IRB-qualified? In our sample there was at least one case with highly IRB-qualified team members where no critical incidents took place. From the gathered data we also know this team has a mindful infrastructure. The developed measuring instruments can thus be applied to all kinds of teams to assess their mindful infrastructure scores and IRB scores, regardless of whether critical incidents are present or absent.

13 "Although innovation journeys can follow many different paths and outcomes, the underlying pattern is remarkably alike. (…) we see a repetitive pattern", write Van de Ven et al. about the cultural side of the dynamics of innovations they studied (Van de Ven et al., 1999: 213). The similarity with our study is that precise configurations may differ, but that there is a robust overall pattern.

14 This counts for both the survey used in the pilot case study and the multi-case study.

15 To be sure that critical incidents can be signalled before they escalate, one could reason that solid mindful infrastructures should be in place, which make teams IRB-minded, even if they do not have to perform IRB when critical incidents do not occur. This would suggest that setting up such mindful infrastructures and making teams competent in IRB is a preventive strategy. This is exactly what HROs do.

16 "Intermediate theory describes a zone in which enough is known to suggest formal hypotheses, but not enough is known to do so with numbers alone or at a safe distance from the phenomenon (…) (i)ntermediate theory studies propose provisional models that address both variance- and process-oriented research questions. Using both qualitative and quantitative data, these studies can identify key process variables, introduce new concepts, reconceptualize explanatory frameworks, and identify new relationships among variables" (Edmondson & McManus, 2007: 1166-1167).

Chapter 9

Practical implications: the Resilient Innovation Team

Practical implications: the Resilient Innovation Team

Abstract[1]

This chapter describes the relevance of the research findings for practitioners and identifies the main target groups as top management and innovation leaders at the strategic level and team leaders and team members at the operational level. Other target groups are project-based organisations and HR specialists. Implications for practice and recommendations are presented and directed at these main target groups. The focus is innovation resilience behaviour and mindful infrastructure. A tool which teams can use to improve their innovation resilience is outlined.

Key words: innovation resilience behaviour, mindful infrastructure, defensive behaviour

1 Introduction

As with all innovations, one of the final phases is its valorisation, and a dissertation on new knowledge is no different. Unlike the meaning in Marxism, where valorisation of capital is the increase in the value of capital assets through the application of value-forming labour in production (Braverman, 1974: 251-256), in this case it refers to getting the maximum value and usefulness out of the study. What is the practical value of this study? To address this question we will focus on developing and implementing innovation resilience behaviour (Team IRB) in project-based organisations where teams are employed working on innovation. Innovation is an invention or renewal of a product, service or process with the aim of being implemented or launched. The purpose of this chapter is to translate the academic knowledge developed into actionable and added value for teams, their leaders and organisations (i.e. top management) and broader society.

The relevance of innovation resilience behaviour research is first highlighted and target groups are identified. The practical implications of the results of this thesis are discussed with regard to these target groups. This will lead to various suggestions of ways that top management (innovation leaders are regarded as being part of top management) can translate this into organisational design, HR practice and innovation management. Concrete suggestions will be offered for team leaders and teams and a tool will be outlined with which teams can start to improve their competencies in innovation resilient behaviour.

2 Relevance of the study

Apart from the relevance of this thesis to the scientific community, discussed in the preceding chapter, the research findings have practical implications. The main finding is that organisational facilitation - mindful infrastructure - can have a positive effect on team behaviour - innovation resilience behaviour - so as to prevent and solve critical incidents during an innovation project.

Relevant findings

Mindful infrastructure does not require a strict set of conditions. Instead it gives top managers the opportunity to develop unique variants. The study distinguished team psychological safety, team learning, team voice and complexity leadership as important elements of mindful infrastructure, but also showed that combinations of these elements may vary. For top management this implies the potential to design a tailor-made solution for their organisation. At the same time top management should be aware that the research found that some combinations have better chances of enabling innovation resilience behaviour than others. While there are many roads that lead to Rome, not all roads do so.

Innovation resilience behaviour is a combination of team behaviours that make teams alert to possible mishaps, and ensures they will handle them in such a way that the innovation project as a whole is not too badly disturbed and stays on track. The research suggested that such teams have a better chance of reaching their intended project goals. The presence of innovation resilience behaviour (in short Team IRB), which is enabled by the presence of mindful infrastructure, improves the chance that teams who are handling complex innovation projects will do this effectively. Those teams anticipate many possible issues and events, even unexpected ones. Complex projects are known for their unexpected events (Cicmil & Marshall, 2005). When teams are well equipped to handle such events the chances of a successful project increases.

Teams with higher levels of innovation resilience behaviour not only showed better project results, but also experienced less inconvenience from defensive behaviour. Organisational defensiveness means that when confronted with threat, incompetence, and uncertainty, teams may become more risk-averse than is desirable, especially innovation teams. This could harm the development of the desired innovation. The study showed that higher level IRB-teams reported less organisational defensiveness. This seemed to be associated with better project results. In practical terms this suggests that mindful infrastructures that support openness and trust enable teams to make complex issues and uncertainties discussable. Instead of becoming risk-averse such teams solve a project's risks with open eyes and in an effective way.

Another relevant insight of the thesis is that effective team leaders apply a way of working that appears highly research-oriented. These team leaders use the reflective practitioner approach, without being aware that they do, which means that they follow a number of systematic steps in dealing with critical incidents: they are inquisitive, develop new solutions, and test these solutions to draw validated conclusions (Schön, 1983). The research-driven means of mitigating critical incidents is very much in line with using a working method that seeks validated data, tests ideas and facts, and ensures that the acceptance of alternatives is shared by others (Argyris & Schön, 1974). Top management, team leaders and teams should look and learn from these practices, which involve countervailing powers of organisational defensiveness and risk-aversion.

Most people have substantial problems changing their own behaviour and being more open, vulnerable, and critical, when they feel threatened, incompetent or uncertain (Kegan & Lahey, 2009). Teams that succeed to be risk-taking in a way that enhances problem solving, may not be aware of the issue of organisational defensiveness, but value their open and safe working environment. Practitioners should be aware that organisational defensiveness largely works at the subconscious level, and that it requires quite some effort to make it discussable (Noonan, 2007; Smith 2008).

Those teams that show innovation resilience behaviour and recover from critical incidents are better at solving and containing them after incidents have occurred, than in preventing them. In this sense they differ from HROs (High Reliability Organisations), which excel in preventing critical incidents from unfolding or escalating (Weick & Sutcliffe, 2007). Innovation teams have much to win if they succeed in becoming better at preventing incidents as well as mitigating them. The study suggested that teams in an R&D context are better at preventing critical incidents from escalating than other teams in the study, because such R&D teams apply project management tools to monitor and manage risks. They also deploy special problem-solving teams when needed. In other words, practitioners should consider the application of specific project management tools (including special problem solving teams, so-called '8D-teams') that support innovation resilience behaviour.

Target groups

The most important targets groups for these findings are top management, including innovation leaders at strategic levels, and teams and their team leaders at operational levels. Top management is responsible for an organisation's strategy and performance. Innovation leadership and innovation management, as an extension of top management's responsibility, are aimed at the development and implementation of new products, processes, production and working methods and organisational forms. This role of top management not only involves these innovations, but also the support function of the organisational design and HR practices. Designing a mindful infrastructure and programmes to develop innovation resilience behaviour competencies are part of that role. HR officers are therefore implicitly a part of this target group. The task of top management is to build and support mindful infrastructures, and to train personnel in competences derived from the desired innovation resilient behaviour.

The role of the team and team leader is to acquire the competencies connected with innovation resilience behaviour, and perform the required innovation resilient behaviour during their innovation projects.

Other target groups that are directly or indirectly related to top management, teams and team leaders can also benefit from the practical implications noted below. These are, for example, managers of R&D organisations/departments, and operational managers to whom teams working on innovations are accountable. The findings are not only relevant to innovation projects, but also for the conduct of projects in general (and in other disciplines than innovation management or R&D). For this reason project-based organisations, project managers, project teams and project officers in general can all benefit to a certain extent from this thesis.

A Resilient Innovation Team is able to proactively handle unexpected, sometimes critical, events to continue pursuing its (project, innovation or team) goal without a significant disruption.

3 Practical implications for target groups

Recommendations will first be directed, at a strategic level, to top management. They should develop mindful infrastructures that enable innovation resilience behaviour. Recommendations are also formulated for operational agents, specifically team leaders and teams. They are the ones who should undertake innovation resilience behaviour when needed.

3.1 Recommendations for top management

The first step for top management is to assess whether team performance in innovation projects is an issue that should be improved. We assume that the answer is affirmative, based on the observation that a substantial share of projects and innovations fail. The second step is to acknowledge that apart from the 'hard factors' of project management the 'soft factors', such as human behaviour, also deserve full attention to improve this team performance (Crawford & Pollack, 2004). Top management should assess the presence and nature of mindful infrastructure in their organisation. They can do this by applying the survey developed for this thesis (See the questionnaire in Appendix 2) and using the results to design the appropriate mindful infrastructure. The survey offers the operationalisation of team psychological safety, team learning, team voice and complexity leadership. Conducting this survey and analysing the data is a task for the supporting HR department (and the consultants they may hire).

It should be realised that mindful infrastructure, which is a combination of structural and cultural aspects (semi-structure), is not a loose entity but based on preceding choices made about organisation design and the management approach. It matters, for example, if the dominant management approach is fuelled by a portrayal of humans that is derived from a centralised viewpoint (with governance oriented towards control) or a decentralised viewpoint (with governance oriented towards commitment and participation), because, as a consequence, the design of departments, teams and jobs will be either poor or rich in terms of autonomy and learning opportunities. Each organisational structure partly breeds it own type of behaviour and interactions between management, teams and team leaders, and as a consequence, team members will experience the presence or absence of an atmosphere in which they can either flourish or starve.

In other words, behaviours related to, for instance, leadership styles, organisational defensiveness and risk-aversion, are largely co-determined by former strategic and structural design choices. Having said that, we will only note that other studies deal with those matters (e.g. Achterbergh & Vriens, 2010).

Innovation resilience behaviour is a set of team behaviours to improve team performance in innovation projects. Operational managers and HR officers should analyse the extent to which the five HRO-principles, on which this innovation resilience behaviour rests, are relevant for realising the goals of innovation projects. This kind of analysis, such as a task analysis, should include the soft factors related to the failure of projects and innovations and related to dealing with critical incidents and critical recoveries. The survey in the appendix presents an operationalisation of the five HRO-principles into a large number of items, which is good starting point for such an analysis. The analysis should result in making visible the gap between needed and missing competences. In the next step the identified missing competencies should be part of a training programme for the team members.

Training teams in dealing with critical incidents from the perspective of team dynamics is very useful, especially when team members are not experienced with HRO-principles. In health care, for example, staff are being trained to become HRO-minded organisations. They learn from other sectors (like the military and other high risk organisations) to think less in professional silos, and to understand the relationship between organisations as complex systems with situations that demand quick decision-making despite an overload of variables, and still ensuring safety for patients and personnel (McKeon, Oswaks & Cunningham, 2006; see also Hines, Luna, Lofthus et al. 2008).

In sum, top management must be committed to the relevance of the 'soft side' of innovation management and be convinced that investing in innovation resilience is beneficial for the longer term of the innovative capability of teams and the organisation as a whole.

Organisational facilitation in addition to mindful infrastructure

Organisation facilitation is directed at top management in order to support innovation teams and their leaders, and to create conditions conducive to Team IRB. These conditions, below, can be regarded as additional to creating a mindful infrastructure.

- Innovation teams reporting critical incidents during teams during their project should be an activity agreed upon at organisational or team level and it is recommended that a database be designed for recording critical incidents and critical recoveries as a kind of knowledge bank.
- Reporting critical incidents should be aligned with reward systems that encourage speaking up. This requires psychological safety and trust, and leadership stimulating this behaviour.
- The framing of failure should be done in a positive sense (Edmondson, 2012). Failure may meet resistance (thus defensiveness) as it is often suggested that critical incidents are the result of someone's failure and therefore has an overtone of incompetence. Failure is a fea-

ture of the system as a whole, and is thus a system issue, and not per se an individual issue (Weick & Sutcliffe, 2007). Failure is also a natural by-product of a healthy process of experimentation and learning (Cannon & Edmondson, 2005). When failure or critical incidents are framed as learning opportunities they become more actionable and discussable (Sitkin, 1992). Reporting what has been done with failures is part of the reporting of critical incidents. Remember that most of us do not like to discuss what goes wrong, but are inclined to stress what goes right (Cannon & Witherspoon, 2005).

These suggestions are based on HROs where intensive briefing and debriefing helps teams to become more reliable and continually improve their work processes and methods (Weick & Sutcliffe, 2007; Tannenbaum & Cerasoli, 2013). This can easily be seen as overly bureaucratic behaviour, but the driver is the sense of urgency to prevent accidents to happen. The driver for innovation teams should be that much money is wasted due to overlooked small failures that possibly have large negative consequences at a later stage in the project.

3.2 Recommendations for teams and team leaders

The recommendations for top management are of a conditional and supporting nature. The recommendations for teams and team leaders are directed at their own practice. The first recommendations involve handling innovation resilience behaviour; this is followed by how to make defensiveness discussable; finally a tool is presented that can support these activities in practice. We present these recommendations by imagining that a team and team leader are at the start of a new project. What should they do to enhance innovation resilience behaviour in order to run a project that will achieve its intended goals? The assumption is that a mindful infrastructure is already present.

1. Preparation and actions by the team leader

- When starting a new project, make a risk analysis of your project and a consequence analysis. The studied teams from R&D environments especially applied risk and consequence analyses. In the study, teams were confronted with critical incidents related to either technical issues, decision-making issues, or a number of several smaller incidents adding up to critical incidents. Risks can, alternatively, be grouped in three areas: 1] technical and content-related issues point to the innovation itself and requires the expertise of the innovation leader and the team; 2] 'hard' issues point to time, money/budget, resources, requirements, goals, and so on, and are related to project management techniques and tools. These are among the standard equipment of project teams. We observed that teams in the study embedded in R&D organisations have systematically engrained habits of applying these tools; 3] 'soft' issues refer to almost anything else that is non-technical and not 'hard'. Soft issues basically deal with any human action, interaction and interrelation that forms the dynamics within the team and between the team and its environment. We will discuss innovation resilience behaviour as one of those sets of 'soft aspects' later. Obviously the behaviour of

stakeholders is an important soft aspect. Relevant stakeholders should be distinguished and risks related to their (conflicting) interests should be listed as completely as possible. A stakeholder analysis (several examples can be found on the Internet) must be related to the risks of the project and could include their power relations and options for trade-offs.
A consequence analysis should, for example, list 'what-if' options and the thinking out of consequences for stakeholders and how they might respond to things, for which subsequent 'what-if' options can be designed if necessary. Teams that applied consequence analysis were always a step ahead of their supervisors, in the sense that they always had a solution on offer when a problem was identified.

- If you are unfamiliar with risk management tools, consider making a table or matrix of the list of risks and consequences against milestones and moments of decision-making during projects. Consider formulating criteria for good decision-making. We present a simple instrument below to show what this might look like. At first glance it may seem trite, but being simple does not mean being simplistic (Pacanowsky, 1995). This instrument specifically trains people to undertake automatic behaviour to take decisions that are based on IRB-principles. This simple instrument implies that team leaders or teams do not have to receive special training. The characteristics of such training mean that participants are inspired by new ideas, but often lack actionable ways to put the new knowledge in practice once they are back in office or on the shop floor. Consequently they are inclined to forget most of it eventually. The instrument below is a checklist for the quality of decisions that are taken from the client or customer perspective (as important stakeholders):

Checklist to assess the quality of every major decision:
- Alertness: Are we aware of the wishes of our clients, and could this decision harm their interests?
- Simplification: Did we consider all possible alternatives and is our decision based on facts?
- Sensitivity: Have we checked the effect of the decision on the rest of the organisation, other teams, other aspects of the innovation, other projects for the same client?
- Resilience: do we know all the consequences of our decision and do we have alternative/restoring actions in place?
- Expertise: Do we know who to turn to in the case of every thinkable unwanted effect, and is this person/expertise available when we need it?

- Discuss the inventory of risks and consequences (above) and specify the mistakes the team definitely does not want to make; discuss the small failures that could grow into critical incidents; list them and check at every team meeting whether they might be present.

2. Innovation resilience behaviour in innovation project teams

Weick and Sutcliffe (2007; and Weick et al, 1999) divide their five HRO-principles into two clusters: principles of anticipation (failure, simplification, operations) and principles of containment (resilience, expertise). Each set will be discussed.

Anticipation means to foresee an unexpected critical incident based on small deviations by being mindful to failure, simplification and operations.

1. Preoccupation with failure
   Preoccupation with failure has the purpose of emphasising that small failures can result in critical incidents if ignored. The driving force of an innovation team and its leader, in order to deliver the extra psychological effort to be alert to weak signals, is the awareness that failing projects can threaten the competitive position of the organisation and that they involve investments with limited returns. Team leaders and their teams should learn from critical incidents that seldom occur. Events that deviate from what is expected might be signals of failures in the health of the project as a whole. Innovation teams should write rich reports about the limited available critical incidents for learning. This is what HRO teams do. They reward and encourage the reporting of events that mark larger incidents. Innovation teams should be aware of not regarding success as a reason for complacency and non-reflection.

   > Guiding questions to help team behaviour to be attentive to small events that may be forerunners of critical incidents are (Weick & Sutcliffe, 2007: 151-160):
   > - Preoccupation with failure: what must go right in this project; what could go wrong in this project; how could things go wrong; what things have gone wrong in the past?

2. Reluctance to simplify
   Teams should not jump to conclusions that are based on opinions rather than on facts. Be reminded that organisational defensiveness is characterised by not testing information and drawing conclusions on data that is not validated (Argyris, 1990).
   Looking for alternatives and gathering valid data, reduces simplifications in interpretations in order to enlarge the number of precautions and minimise surprises. Team leaders can encourage the questioning of assumptions and being open to multiple views (Wicklund, 1999). From an organisational perspective this requires the presence of choice options when events are rich and complex. In other words teams should have rich tasks and substantial autonomy to enlarge options for solving issues that may become critical incidents. Teams should possess enough 'slack', and room to manoeuvre. Innovation leaders (i.e. top management) could encourage team leaders and team members to explore options and design alternatives, allowing divergent perspectives and the incidence of disagreement and conflict, which can be managed by continual re-negotiation. This requires the ability for complexity leadership behaviour and interpersonal skills, not only from the team leader but from all team members, in order to create mutual respect, constructive negotiation, and to

maintain trust, and a flexible attitude to deference. Healthy scepticism counteracts complacency and improves the reliability of the innovation process.

> Guiding questions to help team behaviour to be attentive to small events that may be forerunners of critical incidents are (Weick & Sutcliffe, 2007: 151-160):
>
> - Resistance to (over)simplification: is our information valid; is there anything we have overlooked; can we think of an alternative explanation; what would falsify our assumptions; if we feel bad when someone challenges our idea, do we remain factual or do we get emotional; do we regard deviating answers as welcome information; do we share our doubts publicly?

3. Sensitivity to operations

   Innovation leaders and team leaders must ensure that they and their team have a continuous awareness of how the team process (i.e. their innovation project) connects with the organisational process and interacts with the environment, i.e. stakeholders. At the same time it is crucial that top management has a similar awareness of the link between organisational processes and what happens in innovation teams. Innovation leaders, team leaders, team and even top management must see the integrated big picture at all levels to be able to catch critical events when they occur, i.e. 'in the moment'. In such a state ongoing small adjustments can prevent critical incidents from growing and accumulating. Acquiring such sensitivity to operations is a shared accomplishment, when teams share mental representations, stories, and pictures. Sharing higher-level cognitive activities and emotions is an active process in which members are actively searching for answers, and in doing so, as an ongoing effort, they are socially constructing their awareness, called 'heedful interrelating' (Weick & Roberts, 1999). Sensitivity to operations thus builds social relations and gives practical meaning to present and future actions (Weick, 1995). Team leaders should encourage dialogue and conversation to strengthen this process.

> Guiding questions to help team behaviour to be attentive to small events that may be forerunners of critical incidents are (Weick & Sutcliffe, 2007: 151-160):
>
> - Sensitivity to operations: does management adequately know what goes on at the level of project teams; do we speak up when we should; do we encourage scepticism because it keeps us on the edge; do we use face-to-face interaction adequately because it is much richer than phone or email, and thus we can learn more from (nonverbal) richness of critical events; do we agree on what we must do and are we doing it?

In sum, anticipation requires innovation leaders and team leaders to direct team behaviour towards detecting small failures, to critically reflect on applied concepts that may simplify matters, and to look at how actual work performance deviates undesirably from intended goals. When, in spite of all this, critical incidents occur, the two principles of containment, resilience and deference, must stop escalation and ensure the innovation process is not disrupted.

4. Commitment to resilience
Commitment to resilience is both anticipation and resilience. Anticipation is the prediction and prevention of potential critical incidents before damage is done, whereas resilience is the capacity to cope with unanticipated critical incidents after they have become manifest, and learning to bounce back. Resilience is the ability to not only bounce back from errors, but also about coping with surprises in the moment, and responding as they occur. It is anticipation but at the same time being able to stop a surprise from escalating (containment). To be resilient means to also utilise the change that is absorbed. That is why team leaders and teams should learn from reflective practitioners who reflect-in-action and almost simultaneously develop solutions (Schön, 1983). They either apply an approved method or they design a new solution. The former is single-loop learning and the latter is double-loop learning (Chapter 6). Resilient team leaders and teams continually learn to mentally simulate innovation project operations and certain events. They learn this from training or practice. They make mental maps of how project issues can be unravelled and imagined solutions recombined; they develop their abilities to cope with disturbance in an ongoing fashion. Although HRO-teams must be able to do this instantaneously, because accidents can unfold very quickly in dramatic ways, innovation teams will have more time. Commitment to resilience means that team leaders and teams are able to avoid adjusting to surprises in ways that reduces adaptability and stops learning; they are receptive to the fact that the next critical incident will never be an exact copy of what they already know; they simultaneously both believe and doubt their past experience, because situations are both 'once-only' and 'seen-it-all-before' situations.

Guiding questions to help team behaviour to be attentive to small events that may be forerunners of critical incidents are (Weick & Sutcliffe, 2007: 151-160):

- Commitment to resilience: do we discuss what we learn from things that were different; do we have enough redundancy and slack to share experience and expertise; do we improve resilience by forming knowledgeable people into ad hoc networks that self-organise to provide expert problem solving; are we providing feedback quickly enough to detect the effects of improvisations and decide how to proceed; are we doubting what we belief enough; do we learn (enough)?

5. Deference to expertise
Innovation leaders (and top management) understand that situations at times require a looser designation of who the 'important' decision maker is, in order to allow decision making to migrate up and down hierarchical lines along with problems: it is not the highest in rank who decides, but the most expert. As a result critical incidents are contained, they cannot spread. Organisations that allow this to happen gain flexibility by enacting moments of organised hierarchy. Innovation leaders, team leaders and teams build abilities and commitments to take responsibility when needed and increase self-managing process inter-

ventions. Principles 4 and 5 increase the internal variety required to be able to deal with external variety (requisite variety). In other words, they build flexibility into the process by ensuring that the required resources are available at any time.

Guiding questions in order for team behaviour to be attentive to small events that may be forerunners of critical incidents (Weick & Sutcliffe, 2007: 151-160):

- Deference to expertise: are we aware that when we see ourselves as self-important we actually know less than we think we do; do we develop scenarios for alternative developments in our project; do we value expertise and experience enough compared to hierarchical positions; are we flexible in letting loose; do we really accept the advice of others?

3. A team tool to improve innovation resilience behaviour in innovation project teams

Team leaders and the teams should assess whether a team possesses 'collective mindfulness' or not. Weick and Sutcliffe (2007) warns us that, because we like to have our expectations confirmed, and because we overestimate how stable our working world is, we have a tendency to underestimate how much the unexpected will surprise us, until it does. They developed audits with which to self-assess the presence of organisational mindfulness and the five HRO-principles (Weick & Sutcliffe, 2007: 83-107). We have adapted those audits and the ideas about how to combat organisational defensiveness from Argyris (1993; 1996; 2002) into a change tool for developing Team IRB (Oeij, Preenen & Van der Meulen, 2014; Oeij, 2016). A summary of the change tool is attached as an appendix to this chapter. The change tool can be applied at the level of the organisation as a whole or to a team. Applying this change tool gives users insights about their weak and strong points as regards mindful infrastructure and Team IRB. Teams can discuss the 'gaps' and what kind of follow up action will be most useful. Top management and the innovation leader can provide support to make the follow up effective. The tool is intended to support the transition from automatic defensive routines to automatic learning routines (Sales, Vogt, Singer & Cooper, 2013).

4. Dealing with organisational defensive mechanisms in innovation project teams

Innovation resilience behaviour can suppress defensive behaviour. We suggest that teams become familiar with recognising and addressing organisational defence mechanisms and make these discussable (Ardon, 2009; McArthur, Putnam, & Smith, 1999; Noonan, 2007; Smith, 2008). An actionable way to start is by making the values of the espoused model concrete, for instance, again in relation to the example of team decision making in their project, is our decision based on valid data; did we base our decision on informed choices; has the implemented choice had the effects we expected (Argyris, 2002)? Team decisions can be evaluated against these criteria. If decisions do not meet those criteria, specific defensive strategies may be at play, either conscious or subconscious. Defensive strategies can make failures undiscussable and thus inhibit the learning of a team. To help a team detect defensive behaviours, an overview of fourteen strategies is presented in Table 1 (Ardon, 2009: 245; also Chapter 5). Be aware that these strategies are tacit and subconscious in order to protect the self[2].

Table 1 Fourteen defensive strategies and potentially observable behaviours

Defensive strategies	Possible observable behaviour
1. Comply strategy: if your superior persuades you to commit, say that you comply regardless of whether you really do	Adapt, refrain from uttering criticism ['Ok, I agree to do it']
2. Undergo strategy: if your superior initiates a change process, just undergo the interventions passively and do not make debatable that you don't think this going to work	Stay passive, refrain from uttering criticism ['Let's see what happens']
3. Plan strategy: agree to make a plan and act as if you comply with the plan; in this way you contribute to change and stay in your comfort zone	Active, quickly accepting ['Let's come back later to this point']
4. Blame strategy: if changing does not succeed, blame others and attribute negative intentions to them (scapegoating)	Active, aggressive, not self-reflective ['Employees don't want to change; managers never listen to us']
5. Assume strategy: keep your negative assumptions about another individual's intentions and situations private	Stay silent, not testing assumption, not asking questions
6. Withdraw strategy: in case of difficulties in communication, do not debate with the persons who are involved; rather, withdraw and think up a new initiative or discuss the difficulties with peers	Avoid discussing, not speaking up [thinking: 'how can I change this situation/their thoughts']
7. Ignore strategy: if you observe patterns that are difficult to deal with, (e.g. that your team/employees are not really committed), do not enquire; rather, increase pressure on them to comply (disregarding)	Offensive, pushy, inflexible ['Let's stick to what was earlier agreed upon']
8. Reduce strategy: if things become threatening or embarrassing, reduce the problem until it is controllable again	Downplaying, ridiculing, slicing ['Let's not overstate the problem']
9. Deny strategy: if things become threatening or embarrassing, deny the problem until it is controllable again	Counter-arguing ['I do not see that as an issue'; 'in my project we do not have such problems']
10. Distance strategy: if the discussion comes too close, change the subject to discuss 'other' parties or general observations, such as employees, middle management, or 'the organisation'	Changing the subject, getting out of the 'hot seat' ['the organisation should formulate clear values']
11. 'We' strategy: talk in terms of 'our responsibility' and 'what we should do'; as a consequence, nobody has to feel personally responsible	Avoiding personal responsibility ['We should pay attention to that problem']
12. Non-intervene strategy: keep quiet/don't confront others with their behaviour so they do not confront you with yours	Avoiding conflict ['I understand why he is busy, same here']
13. Joke strategy: if things become threatening or embarrassing, make a joke and change the subject	Changing the subject ['Don't worry; we are just much too old for all those changes"]
14. Shirking strategy: shift the responsibility to an 'outsider' and avoid sharing your own opinion about the process or colleagues.	Shifting responsibility, blaming others ['I think we all agree the problem is with the supplier']

- A team should agree to make defensiveness discussable during, for example, team meetings. However, the presence of psychological safety is a crucial condition. The great difficulty of defensive behaviour is that it is often impossible to observe. A useful instrument is to apply a 'virtual red button' if someone thinks they are observing defensiveness. This button could be any device that attracts the team's attention (a bell, a light, a sound). The reasoning is that assumed defensiveness should be tested in order to assess its validity, so, if someone during a team meeting is making a statement or behaving in a way that might be associated with defensiveness, and it is experienced as dysfunctional to the innovation project or the team process, the red button is pushed and the team discusses the event as if it was a time-out during a sports contest. Table 9.1 expresses possible examples of behaviours and speech associated with defensiveness. As noted, when psychological safety is not present, this exercise should not be executed, as it will only strengthen defensive behaviours. A safe mode in which to practice identifying defensive behaviour is to use video recorded footage of a team meeting and analyse the verbal and non-verbal behaviour afterwards (Chapter 2). Alternatively, an external process manager or consultant could support the team[3].

- Make a list of potentially mixed messages as a team that can hamper the innovation process by being ambiguous and causing defensive behaviour. Mixed messages can be dilemmas, paradoxes or contradictions, where the team is faced with goals or assignments that seem incompatible, such as 'be innovative, but keep it cheap and do it quick'. The function of listing them will not necessarily result in a solution, as some simply are incompatible, but by making them discussable the team can make it clear which options are available, who is responsible for what, what is being achieved and what is not, who is being served and who is not, and how the consequences are being dealt with. This can help a team to arrive at non-ambiguous decisions. Often mixed messages deal with resources, goals and expectations and decisions and agreements.

The purpose of these suggestions is to make teams aware of defensive mechanisms and to create the opportunity to choose specific options. Respondents in the study said that if they had known about certain defensive behaviours that were hampering the progress of the project, they would have made them discussable.

5. Summary

Having made recommendations for top management, team leaders and teams to improve innovation resilience behaviour and its organisational facilitation, a summary of the conditions for the implementation of Team IRB is presented in Table 2. The table sums up the elements of Team IRB, mindful infrastructure and aspects of organisational facilitation other than mindful infrastructure that need to be developed, in the first column. The second and third columns are respectively directed at teams and innovation, and at team leaders. The fourth column suggests points of interest to take into account when implementing Team IRB.

Table 2 Conditions for implementation of Team IRB

IRB, mindful infrastructure, other organisational facilitation	Competencies and tasks of innovation project teams	Actionable tips for innovation leaders	Points of interest
Management philosophy and main driver	Act to learn; be able to anticipate critical incidents and to operate with several outcome scenarios	Be receptive to multiple views and develop several routes with the team	Complexity leadership that is synergising multiple views; slack and requisite variety
Preoccupation with failure	Inventory of thinkable errors related to inputs, throughputs and outputs; risk & consequence management	Focus yourself and the team on small risks; be clear what cannot be overlooked	Climate for safety and learning and means for reporting and learning from incidents
Resistance of oversimplification	Check important team/project decisions against central project goals; seek alternative solutions before deciding	Ensure decisions are based on validated information; stimulate the team to get the best information	Room for experimentation, allow making 'intelligent' mistakes, resources for external knowledge absorption
Sensitivity to operations	Project goals are related to the overarching organisation goals or programme goals; there is awareness of how the two levels interact and there is sensitivity about its outcomes	Link the project progress to broader organisational goals and external goals and keep the team aware of the need to balance project goals and their tasks	Network of project leaders and linked programmes and connecting these to other organisational goals (notably business) and (steering) levels
Commitment to resilience	Back and forth thinking about wanted and unwanted outcomes and assessing how to act, including external effects on the project	Keep yourself and the team continuously learning and reflexive and think ahead	Longer term perspective on goals, opportunities and skills resulting in organisational adaptability
Deference to expertise	Peer review and intervision; absorption of external expertise; feedback from end-users	Organise critical outside-in feeds and allocate tasks to the right team members	Co-creation/co-innovation, team voice and flexible structures prevent rigidity
Mindful infrastructure	-Psychological safety, learning, leadership, voice -(Self-developed) project management tools that are simple but not simplistic and easily applied; application automates behaviour	Stimulate self-managing behaviour and initiative among team members creating commitment	Autonomy for teams to develop working modes and tools providing slack at the level where decisions must be made
Organisational non-defensiveness	-Create 'slack'; make ambiguity and mixed messaging discussable; celebrate constructive reporting of critical incidents	Exemplify espoused behaviour to the team by making yourself vulnerable and generating ideas to lead the way	Embrace espoused values and align systems and reward desired behaviours even if it concerns failures and critical incidents and make yourself visible as top management who are managing and reflecting by these values

4 Final word

The valorisation of this study addresses topics including teams, leadership and the project management of innovation. Organisations with project-based innovation teams can benefit from the results and use the recommendations to develop 'Resilient Innovation Teams'. The findings are furthermore of use for organisations executing change projects and change programmes. Even teams and leaders outside the field of innovation and projects may find insights applicable to their situations.

Annex Innovation Resilience Behaviour Tool/IRB Tool

Source: Oeij, Preenen & Van der Meulen, 2014 (Summary).

Description

The IRB tool is an instrument to improve Team IRB and can be used by teams. The IRB tool is in the first place a diagnostic tool to assess the present situation as regards three aspects:

1. the presence of defensiveness, and thus insight into possible causes for risk avoidance;
2. the presence of mindful infrastructure, in other words characteristics that facilitate innovation resilience behaviour;
3. the presence of innovation resilience behaviour, in other words the behaviours and competences to keep an innovation team on track and to get it back on track.

The IRB tool is also a guide for developing simple and applicable team meeting tools.

The IRB tool manual will guide users through these steps, during which six exercises are carried out. A team can do this in one day or in two separate dayshifts. Below the steps are summarised.

Step 1 is to 'Assess your present state of defensiveness and future state'. The purpose is to assess the presence of defensiveness, which can simply be understood as risk averse behaviour, that can negatively affect the innovation process. Making risk averse behaviour discussable will help a team to become transparent and better at recognising relevant bottlenecks in communication and collaboration. Exercise (1) is to 'Assess defensiveness'. Argyris and Schön (1974) developed the so-called 'two-column model' which allows you to make an inventory of things that have been said in difficult conversations, and defensive thoughts that were present but not uttered. The exercise helps to assess patterns of communication in teams, such as circular mechanisms (Smith, 2008). The theory-in-use is thus made visible.

An extra exercise (not in the Annex) could be to focus on the five HRO-principles, alertness for weak signals, reluctance to simplify, sensitivity to operations, commitment to resilience and deference to expertise. First, make an inventory of potential critical incidents (project risks) related to the innovation process of a project during which the five HRO-principles can play a role in order to guarantee the desired anticipatory and resilient team behaviour; second, for each of those incidents try to formulate the possible flaws in that specific kind of team behaviour (i.e. the opposite of alertness for weak signals is to ignore small deviations, or the opposite of reluctance to simplify is jump to conclusions, etc.); third, discuss the way in which organisational defence mechanisms can play a role in causing flawed team behaviour that causes risk-avoidance.

Step 2 is 'Move and go about it' which means you have decided to do something about the defensiveness that threatens the progress of projects. The purpose of this step is to assess whether a mindful infrastructure is present in your team. With this insight you can determine whether your team is well situated to be really resilient in the innovation process (are supportive facilities in place?). There are two exercises. The first is to ‘Assess the mindful infrastructure’ (Exercise 2) by completing three checklists for team (psychological) safety & team learning, leadership, and team voice and influence. Based on the completed checklists you can organise team discussions and assess the state of the mindful infrastructure. If you decide to improve the mindful infrastructure: you are advised to make a list of your actions. The second exercise is to ‘Assess the Innovation Resilience Behaviour (Team IRB)’ (Exercise 3) of the team, again by completing a checklist and discussing the findings with the team. This step helps you to gain insight into whether the team operates mindfully and alertly. With this insight you can determine whether your team is well equipped to really act resiliently in the innovation process.

An extra exercise (not in the annex) could be to discuss how team psychological safety and team learning, leadership and team voice can better enable the five HRO-principles that constitute team IRB. For example, team psychological safety can stimulate speaking up without being punished so as to improve alertness to weak signals and reluctance to oversimplify.

After Steps 1 and 2, in which you have assessed defensiveness and the presence of mindful infrastructure and Team IRB, the third step is called ‘Wrap Up’ and contains three more exercises: ‘Assess whether you are going to do it’ (Exercise 4), because it requires effort such as unnatural behaviour and deviating from the norm. In short: you are advised to validate your information, take facts-based decisions, ensure commitment to choices, and monitor effects. The second exercise is to ‘Assess which competencies to improve’ (Exercise 5), which means that the team should make a one-time inventory of tasks in the innovation process of a project and assess the team’s competency in carrying out each of these tasks. Where a team is not competent to act proactively or resiliently in terms of Team IRB when needed, one can decide which competencies must be improved at team or personal level. The third exercise ‘Develop your own tools’ (Exercise 6) is slightly different in nature, as this demands creativity. HRO-teams try to automate unnatural behaviour or organisational learning by creating procedures such as briefing and debriefing, and continuously improving processes and behaviours. Teams working on innovation could also do this, and develop their own briefing and debriefing tools. Think, for example, of processing a checklist of project management issues at the beginning of a project and evaluating the project afterwards with the intention of improving the checklist. It is possible to break he innovation process of a project into phases or steps, and scrutinise the requirements of each step, and make an inventory of them. Another way is to look at the relevant aspects of a project, such as project decision making, stakeholder management, requirements of the end-result, future market opportunities, and the development of a pilot to test the result. For each of these aspects a two-item question could be answered: what proactive team behaviour would this require from the perspective of each HRO-principle to prevent a critical incident to emerge (weak signals, oversimplification, sensitivity and so on); and, what resilient team behaviour would this require once a critical incident had occurred after all? The tools that the teams develop for themselves are made and owned by the teams, which enhances the likelihood of their application and team commitment. A golden rule is that you should design simple but not simplistic tools (Pacanowsky, 1995). To make tools so simple that they will be used and that it improves the work and an individual’s competences and skills the more they use them, means that their application is a task that becomes automated organisational learning. For example, if the team sums up the decisions that have been taken during their meeting, they could apply a checklist from the clients' perspective to assess the quality of every major decision (see main text):

- Alertness: Are we aware of the wishes of our clients, and could this decision harm their interests?
- Simplification: Did we consider all possible alternatives and is our decision based on facts?
- Sensitivity: Have we checked the effect of the decision on the rest of the organisation, other teams, other aspects of the innovation, other projects for the same client?
- Resilience: do we know all consequences of our decision and do we have alternative/restoring actions in place?
- Expertise: Do we know who to turn to in the case of every thinkable unwanted effect, and is this person/expertise available when we need it?

If project teams apply this during meetings the checklist eventually becomes automated behaviour that requires neither much time nor separate learning. The advantages of such tools are their low thresholds for creating a mindful organisational culture with limited effort.

Summary of the tool

When applying this tool a user will obtain:

- Insight into the presence of defensiveness, and so insight into possible causes for risk avoidance;
- Insight into the degree of the presence of mindful infrastructure, in other words into the presence of characteristics that facilitate innovation resilience behaviour;
- Insight into the presence of innovation resilience behaviour, in other words into the presence of behaviours and competences to keep an innovation team on track and to get an innovation team back on track;
- A guide with which to develop simple and applicable team meeting tools for own use.

The tool contains two parts:
The first is to assess the present state of defensive behaviours and how that affects the innovation process. It finishes by assessing where the teams want to go.
The second part concerns the issue of how to get to where the team wants to go. This mainly evolves around making simple instruments to apply during team work and meetings to keep track of the innovation process by paying attention to innovation resilience behaviour.

Steps:

Step 1: Assess your present state and future state

Exercise 1: Assess defensiveness (two-column model)

Step 2: Move and go about it

Exercise 2: Assess mindful infrastructure

- Team safety & team learning
- Leadership
- Team voice and influence

Exercise 3: Assess Innovation Resilience Behaviour

- Acting mindful and alert

Step 3: Wrap Up

Exercise 4: Assess whether you are going to do it

Exercise 5: Assess which competencies to improve

Exercise 6: Develop your own tools

Step 1: Assess your present state and future state

EXPLAIN THE STEP

The purpose is to assess the presence of defensiveness. Defensiveness can be understood as risk averse behaviour, and risk averse behaviour can affect the innovation process. Making risk averse behaviour discussable will help the team to become transparent and better at determining bottlenecks in communication and collaboration.

Exercise 1: Assess defensiveness

EXECUTE

First: Write down what was said in the right column as literally (verbatim) as you can remember. Write down everything said by you and your conversation partner in the sequence of that talk. Take a good look of what you have written, reread it, and assess whether it is complete according to your own memory.

Second: Now for each part of the dialogue, write in the left column what you were thinking, but did not say (exactly at the level of your own turns). These were probably thoughts that were emotionally-laden and it is likely that these thoughts could have a strong impact on the conversation if you had spoken them.

Third: Now please look at the following questions:

- Why did you not say what you were thinking?
- What might the consequences have been if you had spoken your thoughts?
- What is the deeper reason behind why you did not say what you were thinking?

Fourth: Look at the defence mechanisms in Table 3.1.

- In hindsight, did you, your conversation partners, or others who were present, undertake any of these defensive practices? If so, which one(s)?
- If so, can you explain applying this/these defensive behaviours(s)? What was the effect of its application?

Fifth: Take a step back from this concrete example, and reflect on the following question: to what extent could applying this/these defensive behaviours(s) affect the effectiveness of team work, especially with regard to performing an innovation project?

The same procedure can be used with your team as a whole, if it is safe to do so.

It could be helpful to collect all the team's experiences with defensive behaviours. Then you could discuss questions like these:

- Do we see a pattern in how we communicate or miscommunicate?
- Are we moving in circles from which we do not seem able to escape?
- Is defensiveness related to certain issues, problems, persons, situations?
- What does it say about our own ability to critically but constructively reflect on what happens?
- Are we self-critical or are we scapegoating our environment or 'others'?
- Are we addressing issues we can influence ourselves or are we addressing issues that lie outside our sphere of influence?
- Is there a group bias to stress confirmation with each other which excludes deviant thinking and thinking out-of-the box?
- Is this a way that we in fact keep mixed messages unresolved?

RESULT

The result of this exercise should be a personal or team awareness about your own defensiveness and how that possibly affects the innovation process of the project and/or the team. The fundamental question is: are you prepared to do something about it? If so, please continue reading.

Step 2: Move and go for it

Innovative behaviour is not just a matter of characteristics of the behaviour of individuals but also a matter of the issue or organisational design and the design of jobs, so-called active jobs (Karasek & Theorell, 1990). At a team level, a facilitating factor is the presence of a mindful infrastructure (Figure 2.2). Once this is at place, there is greater potential for the emergence of innovation resilience behaviour (Figure 2.2).

EXPLAIN THE STEP

The purpose of this step is to assess whether a mindful infrastructure is present in your team. With this insight you can determine whether your team is well situated to be really resilient in the innovation process. If that is not the case, you can decide what to improve.

Exercise 2: Assess mindful infrastructure

EXECUTE

- Team psychological safety & learning.

Answer the following questions for your team/department/organisation **Do you agree or disagree with the following statements about team safety and team learning?**	Agree = 1 Disagree = 0
If you make a mistake on this team, it is never held against you.	
Members of this team are able to bring up problems and tough issues.	
People on this team never reject others for being different.	
It is safe to take a risk in this team.	
It is easy to ask other members of this team for help.	
No one on this team would deliberately act in a way that undermines my efforts.	
Working with members of this team, my unique skills and talents are valued and utilised.	
We regularly take time to work out ways to improve our team's work processes.	
This team tends to handle differences of opinion privately or off-line, rather than addressing th directly as a group.	
Team members go out and get all the information they possibly can from others, such as custome or other parts of the organisation.	
This team frequently seeks new information that leads us to make important changes.	
In this team, someone always makes sure that we stop to reflect on the team's work process.	
People in this team often speak up to test assumptions about issues under discussion.	
We invite people from outside the team to present information or have discussions with us.	
Team Safety & Team Learning: Score: 10-14 = Present; 1-5 = Absent; 6-9 = Present to a limited degree	

RESULTS

- Draw your conclusions, based on data and discussion.
- Define future actions to take.

EXECUTE

- Leadership

Answer the following questions for your team/department/organisation **Do you agree or disagree with the following statements about leadership?** *(Remember: leadership can be performed by one individual but also by professionals and by the group as a whole)*	Agree = 1 Disagree = 0
Leadership concerning *collaboration* is:	
Making it legitimate to contribute opinions	
Maintaining an open climate for discussion	
Employing participative decision making	
Leadership concerning *creativity* is…	
Launching important new efforts	
Getting unit members to exceed traditional performance patterns	
Encouraging direct reports to try new things	
Leadership concerning *control* is…	
Keeping projects under control	
Ensuring that corporate procedures are understood	
Expecting people to get the details of their work right	
Leadership concerning *competition* is…	
Demonstrating full efforts on the job	
Getting work done quicker in the unit	
Providing fast responses to emerging issues	
Leadership concerning *tough issues* is…	
Ability to provide clear directions	
Ability to serve compatible needs in the organisation	
Ability to rule out ambiguity	
Leadership of the leader and the team: Score: 10-15 = Present; 1-5 = Absent; 6-9 = Present to a limited degree	

RESULTS

- Draw your conclusions based on data and discussion.
- Define future actions to take.

EXECUTE

- Team voice and influence.

Answer the following questions for your team/department/organisation **Do you agree or disagree with the following statements about team voice and influence?**	Agree = 1 Disagree = 0
Here each (team) member:	
Develops and makes recommendations concerning issues that affect this work group.	
Speaks up and encourages others in this group to get involved in issues that affect the group.	
Communicates their opinions about work issues to others in this group even if their opinion is different and others in the group disagree with them.	
Keeps well informed about issues where their opinion might be useful to this work group.	
Gets involved in issues that affect the quality of work life here in this group.	
Speaks up in this group with ideas for new projects or changes in procedures.	
Here in this organisation:	
We have a "we are together" attitude.	
There are real attempts to share information throughout the project team.	
We decide many issues together, or at least have influence on matters that concern us.	
Team Voice & Team Participative Decision Making: Score: 7-9 = Present; 1-4 = Absent; 5-6 = Present to a limited degree	

RESULTS

- Draw your conclusions based on data and discussion.
- Define future actions to take.

Based on these completed checklists and questions you should have a fair picture of the mindful infrastructure of your team. If you decide to improve the mindful infrastructure: make a list of your actions.

EXPLAIN THE STEP

A next step is to assess the presence of Team IRB. The purpose of this step is to assess whether Team IRB is present in your team. This step helps you to gain insight into whether the team operates as mindful and alert.

Exercise 3: Assess Innovation Resilience Behaviour (Team IRB)

EXECUTE

- Team IRB.

Answer the following questions for your team/department/organisation **Do you agree or disagree with the following statements about acting mindful and alert?**	Agree = 1 Disagree = 0
Preoccupation with failure	
We actively look for risks and try to understand them.	
We are keen for cues to understand why our expectations are not met.	
When members spot potential risks we discuss them extensively.	
Reluctance to simplify	
Members of this team never take things for granted.	
Team members listen carefully, and it is rare that someone's view goes unheard.	
We actively seek more explanations and viewpoints before taking a decision.	
Sensitivity to operations	
Team members put effort into building a clear picture of the current situation of the project.	
We constantly monitor the progress of the project in a profound manner.	
The team has discretion to resolve unexpected problems as they arise.	
Commitment to resilience	
We always learn from every mistake made.	
Most members have the skills to act on unexpected problems that arise.	
This team is extremely resourceful.	
Deference to expertise	
Team members typically "own" a problem until it is resolved.	
In this organisation expertise is valued over hierarchical rank in most decisions.	
Instead of muddling through, the team quickly obtains any external expertise if needed.	
Our Innovation Resilience Behaviour: Score: 11-15 = Present; 1-5 = Absent; 6-9 = Present to a limited degree	

RESULTS

- Draw your conclusions based on data and discussion.
- Define future actions to take.

The challenge here is to make a list of IRB-behaviours that could be improved by discussing them within teams or departments. The purpose of the discussion is to create a common awareness of what is needed. This could lead to an action list.

Step 3: Wrap up

EXPLAIN THE STEP

By now you should have a pretty good idea of the defensiveness, mindful infrastructure and Team IRB of your team/department or organisation. You may also have some suggestions about how to move forward. This step links back to the 'espoused model' and will help you to make your own tools.

The 'espoused model' will help you to combat defensiveness in your team. It tries to make defensiveness discussible. There is no easy guide for this: you and the team must be prepared to do this and find your own way in how to do it.

Exercise 4: Assess whether you are going to do it

EXECUTE

Are you prepared to apply the values of the 'espoused theory'? For example, in the situation of taking decisions during team meetings:

- Will you make the effort to gather valid information (evidence)?
- Will you make your decisions fact-based?
- Will you seek internal commitment?
- Will you monitor the effectiveness of actions?

RESULTS

- Draw your conclusions based on your answers and discussion.
- Define future actions to take.

This exercise should help you to come to a conclusion about what to do next.

Exercise 5: Assess the competences that need to be improved

RESULTS

- Draw your conclusions.
- Define future actions to take.

Exercise 6: Develop your own tools

EXPLANATION

HRO teams try to automate unnatural behaviour by creating procedures such as briefing and debriefing, and continuously improving processes and behaviours. Teams working on innovation could develop such tools as well.

PREPARE

- Choose domains of team work for which IRB-tools are helpful. For example: decision making, stakeholder management, requirements of the end-result, future market opportunities, development of a pilot to test the result.

EXECUTE

- Apply the five IRB-competencies to the tasks of the team/team members in relation to the selected domain(s): make a list that you can consult/walk through during a team meeting.

Notes

1 This chapter is partly based on Oeij, P.R.A. (2016). From automated defensive behaviour to innovation resilience behaviour: Improving the management of R&D and innovation projects. Invited paper for *IOSH 2016 Annual Conference "Influential leadership: delivering impact – sustaining change"*. IOSH, Institution of Occupational Safety and Health, ICC ExCel London, London, United Kingdom; that IOSH-paper has been accepted for publication in an adapted version as Oeij, P.R.A. (forthcoming 2017). "From automated defensive behaviour to innovation resilience behaviour: A tool for resilient teamwork as an example of workplace innovation", in P.R.A. Oeij, D. Rus & F.D. Pot (Eds.), *Workplace innovation: Theory, research and practice.* Heidelberg etc., Springer; the chapter is further based on Oeij, P.R.A. Oeij, Preenen, P.T.Y. & Van der Meulen, F.A. (December 2014). *From unnatural behaviour to Innovation Resilience Behaviour: Prototype of a change tool.* [ETP Behaviour and Innovation]. Leiden: TNO Healthy Living.

2 Should these strategies be applied explicitly and consciously to favour one's own interests at the detriment of those of others it would be better to speak of subversive behaviour or sheer power-play.

3 While our study mainly addresses organisational culture and team dynamics much defensive behaviour is caused by strategic choices and the organisational design of structures, teams, jobs and tasks. Strategic choices are associated with top management beliefs and their preference about how to structure and lead the organisational processes of producing goods, services, and innovations in projects. The choice, for instance, of designing an organisation as a matrix organisation, project-based organisation, professional bureaucracy or adhocracy, is implicitly a choice of leadership styles and of the degree of autonomy, self-management, and slack that employees experience in their jobs. Implicit preferences for centralisation versus decentralisation, top down versus bottom up steering and control versus commitment cultures determine the features of espoused models and theories-in-use. Controlled risk-taking in teams and innovation success through minimising critical incidents therefore also have structural causes, going beyond mindful infrastructure, that are underrepresented in this study.

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Appendices

Appendix 1 Research methodology

Methodology

The study applies a case study approach to investigate presumed causal links in real-life situations that are too complex for the survey method or experimental methods. Case studies are an appropriate research strategy because the main research question is a 'how' and 'why' question (instead of who, what, where, how much/many) for which we are not 'require[d] to control behavioural events' and for which we 'focus on contemporary events' (Yin, 2009: 8-9). The basic questions are 'why' innovation teams that perform innovation resilience behaviour have a specific combination of variables that constitute their mindful infrastructure, and 'how' can this be explained when we look at the type of innovation in their project and the way teams deal with critical incidents. 'How' and 'why' questions are appropriate in the situation of a contemporary set of events over which the investigator has little or no control, such as the innovation management process of teams responsible for innovation. Within this case study research, comprising multiple cases, several data collection methods were applied.

The case, or unit of analysis, is 'group behaviour within innovation teams of team members and their manager or leader, while executing an innovation project'. Innovation teams are teams responsible for delivering an innovation. To establish whether the innovation team was successful or failed, the innovation can be compared to the (specified) outputs or results that were defined in the project plan of the team, if available.

Case studies can be distinguished between the 'topic' of the research and the 'context'. The topic is the 'group dynamics' of the team and the subjects are team members and project leader; the 'context' refers to circumstances, like organisational characteristics and the complexity of the innovation projects.

The boundaries of the context - what is included in the study and what is not - must be clearly defined. For this purpose, first, the focus is on 'critical incidents' during the project, and how teams responded to or anticipated them. The intention is to assess the presence of mindful infrastructure and innovation resilience behaviour. This could best be done in relation to critical incidents, because we were only able to perform interviews at one moment in time, and could not perform longitudinal designs or 'shadowing' teams. In order to enhance a common understanding, a specific definition of critical incidents was applied in the interviews, presented later. A second boundary is the 'innovation project' in which the behaviours are studied. In this research an innovation project is defined as a renewal of a product or service or a working process or method that is being developed or implemented by the team in a project based environment. A third and last boundary is a restricted time period to keep retention bias to a minimum. The selected projects had to be either finished within the last six months when the interviews took place, or, during an ongoing project, they had to be in process for at least six months to ensure the possibility that critical incidents have occurred.

The focus of the unit of analysis is the dynamics of the project team members and the leader. They constitute failing innovations (a critical incident delaying the project) and successful innovation processes (a critical incident or a critical recovery, speeding-up the project) within the boundaries of a specified innovation project. A successful innovation process is characterised by the team's performance in staying on track or bouncing back to the intended track (or redefining a goal which still is in line with initial intentions). This is called a critical recovery. Thus, we are not interested in the eventual innovation itself (outcome, result), but in the innovation process of the team, and the team's ability to recover its track (process). We want to know if we observe innovation resilience behaviour, and, if so, how it is related to the presence of mindful infrastructure.

From a practical perspective, this study aims to minimise the gap between the project plan's goals and the actually achieved goal (Figure A1.1). Due to the failure of projects, which is a central concern of the study, reducing the gap is an important aspect of innovation management. Not only are organisations accruing costs for not achieving their goals (inefficiency), they are also missing income because, for example, their time-to-market is being delayed.

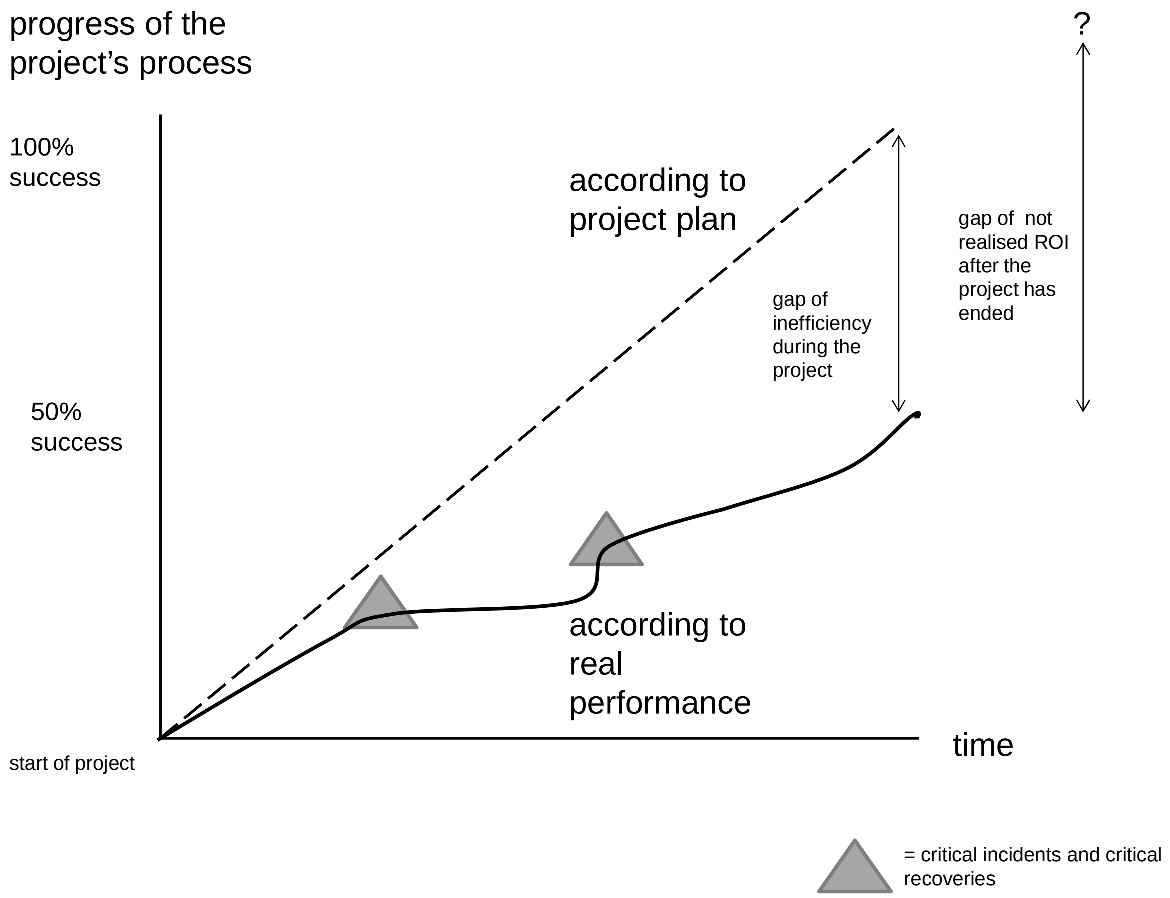


Figure A1.1 The practical problem visualised

Our study proposes that better team functioning through mindful infrastructure and innovation resilience behaviour ensures that teams deal more effectively with critical incidents, can overcome defensive behaviours and undertake risks in a sensible, balanced manner (i.e., no risk averse behaviour, but also not overconfident and no 'sensation seeking' behaviour).

Criteria

Gibbert and Ruigrok (2010) distinguish four criteria to assess the quality of rigorous and relevant case study research: reliability and consistency, validity, and generalisability. We will assess our own study against these criteria in the conclusions chapter. Internal validity points to the causal relationships between variables and results and the conclusions about these relations based on the whole research design. The construct validity in case studies concerns the extent to which a research procedure leads to an accurate observation of reality, thus the quality of the conceptualisation or operationalisation of the main concepts. External validity or generalisability means that findings in the researched setting are applicable to other settings. Reliability refers to the consistent assignment of instances to the same category by different observers, or by the same observer on different occasions.

Case selection

Case studies can be rich and 'thick' with a variety close to infinity. Nonetheless, in order to focus the research much of the variety should be controlled, otherwise arriving at a certain degree of generalisation becomes an ordeal. In defining the research population and selecting cases in order to control for too much variation, a MSDO-design, a Most Similar cases with a Different Outcome design (Marx & Dusa, 2011), is advised. The selection of cases is guided by two principles:

1. maximise the variation in the outcome and explanatory conditions under investigation, and
2. homogenise (hold constant) other explanatory conditions which are not under investigation.

The guidelines allow limiting the number of variables which facilitates the interpretation of results. The requirement of homogeneity states that the cases should be identical in all relevant aspects except for the outcomes (dependent variable) and the conditions of interest (independent variables). The purpose is to enable a comparative case approach by identifying comparable instances of a phenomenon of interest and then analysing the theoretically important similarities and differences among them. In order to select comparable cases, they should be similar on many conditions, but should display variation on the conditions under investigation (Marx & Dusa, 2011). This ideal type situation was, however, not fully achievable in practice. For the study, we selected cases of 'innovation projects' that are carried out by 'project-based teams', and it was assumed that the dynamics within the teams could vary across those projects. More conditions were intended to be held constant, but this proved unfeasible in practice. For example, the industrial sector, the type of innovations, or the size of teams could not be influenced in the process of case selection. To a certain extent we had to be happy with those organisations that were willing to participate. Nevertheless, other selection criteria were applied to maximise the homogeneity of case, as discussed below.

The cases were selected on the basis of purposive or theoretical sampling, namely with the goal of investigating theoretical relations. The purpose is a first step in analytical generalisation, and not in statistical generalisation to populations (Silverman, 2013). Nonetheless, comparison across cases remains highly desirable. The purpose in selecting cases for comparison is to strive to keep as many factors constant as possible. The ideal situation to select cases is the criterion that they are either 'roadmap', 'adjacent', or 'breakaway' innovations (Seebode, Jeanrenaud & Bessant, 2012), and that these innovation types differ in 'complexity' – with breakaway projects being the most complex – and in which the team members presumably will all have to deal with conduciveness to defensive behaviour in tense situations. This, however, proved to be impossible in practice, as it was too complicated to first select projects and then convince companies to participate in the research. We therefore followed a reversed strategy. After making a long list of organisations that were known to house project-based innovations, these organisations were one-by-one approached with the request to participate. In many cases this was a labour intensive and time consuming process - the period of case selection covered two years - which entailed several steps:

1. listing candidate organisations and fine-tuning along the way which of them to approach depending on cases acquired and cases desired. This was an ongoing process. Once the first cases were acquired, the fieldwork started as soon as possible. Along the way, more and more cases were acquired. Case selection and case study took place in simultaneous steps;
2. acquiring the name and details of a contact person from an organisation via the network of acquainted persons ('warm contacts');
3. making contact by phone or via email, followed up by sending material (a flyer of the research) and in almost all eventually acquired cases giving a presentation on the research and having discussions with decision makers;
4. selecting projects that could serve as a suitable case study on the basis of several process criteria:
    a. a project that had recently been finished in order to avoid memory retention problems, and/or that was underway for a substantial period of time to ensure that the project had 'enough history', and of which the majority of crucial agents were still available for an interview;
    b. the project's process should have been conducive to learning, meaning it should not be a process that was very plannable, went smoothly, and was like a routine operation;
    c. selecting projects that could serve as a case study, on the basis of several content criteria, such as an innovation ranging from at least an (incremental) improvement to a (radical) innovation as a product, services or new way of working/organising the working process;
    d. selecting innovation projects that were carried out by project-based teams. Case-organisations that are appropriate must have a team type of working, although some variety of team type is acceptable. Team type may vary across several dimensions, including cross-functional versus single-function, time-limited versus enduring, and manager-led

versus self-led (Edmondson, 1999). These dimensions in different ways form varying types of teams, for example, a time-limited new product development team or an on-going self-directed R&D team.

The essence of mindful infrastructure is that social psychological mechanisms are at the core, which means that people are taking action in the interaction with others. The salience of inter-personal tensions, conducive to defensiveness, is assumed to be present across team type set-tings. Therefore, although team types may vary and consequently the strength of relations be-tween team members are not similar, the mechanisms of a mindful infrastructure to enact mindful acting of team members should apply across different team types. Thus, the effects of team type on innovation resilience behaviour should be insignificant, when all elements of mindful infrastructure are assessed together. For the 'innovation project teams' responsible for innovation, innovation may be one of several different tasks of teams (e.g., an operational team that innovates while executing a commercial project for a client), and team members may par-ticipate in several teams at the same time, also performing different kinds of tasks in each of these teams. The intended innovation should be organised within projects and teams (project-based or team-based dedicated innovation departments and teams). The objective of such pro-jects should be to develop an 'innovation' according to the requirements of a 'purpose', a 'plan' or a 'target', often laid down in a project plan or a management intention.

The number of cases was not fixed beforehand. Although the research is explorative, there is always a discussion about how many cases are needed (Small, 2009). A rule of thumb for the number of cases is the saturation of results, that is when further cases do not add significant information any longer concerning the research questions and the hypotheses being investi-gated. But in this research the focus is on generalisation towards theory, not populations, therefore numbers, i.e., statistical inference, sample-based logic, and representation (Small, 2009), are not a determining factor. It is therefore difficult to say if, for example, whether five, twenty or one hundred cases suffice beforehand. Moreover, and to partly overcome the issue of numbers, this research applied a technique where the number of cases is not decisive for making sense out of a limited number of observations. This technique, Qualitative Comparative Analysis (QCA), enables drawing conclusions of 'limited generalisability' which is very suitable for ex-plorative research, especially when encompassing theories are not yet available, and the study has an explorative nature (Berg-Schlosser, 2009). A further advantage of QCA is that comparison is possible with our 18 cases, where pairwise comparison gets rather complicated with this number of cases (Ragin, 1987; 2008; Schneider & Wagemann, 2012).

Data collection

Another way to create a reliable view of reality that is verifiable rather than via the number of cases, is through combining several data gathering methods. Two data-collection methods were used extensively, namely oral interviews and surveys, and one method in a limited way, namely observation. For the interviews, an extended checklist was constructed and applied to face-to-face interviews and group interviews. The survey was designed around the same topics of the checklist, and disseminated online. Both data-sources could strengthen each other in this way. The oral interviews were held with the project team members (as a group), with the project or team leader, with the project team members and the project team leader together (as a group), and with the project manager (the superior of the team and/or team leader). The invitation for the longer version of the survey was sent to the project team members and the project team leader, and 'other organisation members in similar positions/jobs', while the invitation for the shorter version of the survey was sent to the project manager, and 'other project managers of the same organisation in similar positions/jobs'. The shorter survey consisted of comparable topics on the longer version. The reason why 'other' members and managers were invited was to build up a larger response group, on which statistical procedures could be performed that require a minimum number of observations, such as regression analysis. Observation was applied in a pilot-study. A team meeting was observed to study behaviours. At a later stage, some of the interviews were re-analysed where observational data were used. In this case the observational data included the researcher's recollections of how interviewees behaved during a specific phase in the interview, namely the point when defensive behaviours were discussed. To analyse these extracts, the data of the audio-recorded talk were combined with the recollected observations of the researcher (Chapter 4).

Three data-collection techniques or sub-instruments were applied. First, to assess critical incidents of projects we used the critical incident technique. An incident or event is an observable activity sufficiently complete in itself to allow inferences on the team performance; to be critical, an incident must have a clear intent and a clear effect. Through the use of the critical incident technique one may collect specific and significant behavioural facts, providing a sound basis for making inferences regarding requirements for typical team performance (i.e., criteria) (Flanagan, 1954). Critical incidents are occurrences or conditions that interrupt the normal procedure of the project. Critical incidents are significant deviations from the project plan possibly resulting in setbacks, delays or termination of the project. Critical recoveries imply getting back on track toward the intended or adjusted goal caused by a 'speeding up' activity, such as a solution, decision or serendipity. Critical incidents causing delay and critical recoveries for speed-up situations and getting back on track were assessed with the project team leader. Applying critical incident method ensures the focus on the unit of analysis in the case study, namely to study situations in which mindful infrastructure and innovation resilience behaviour matter most. It compensates for the impossibility to longitudinally follow a project from start to finish. Second, based on an overview of possible types of defence mechanisms (as derived from Ardon, 2009) a card was made with fourteen defensive behaviours that was used during the interviews. Third, we made use of the calendar method, often used in life course studies (Glasner & Van der Vaart, 2009). With this method we can study if team members and team leaders show consensus about the timing of critical incidents and if they weigh those incidents identically. In the cases of differences of opinion, there were two possibilities. After the initial round of interviews, the researcher returned to discuss the observations. Discrepancies were made discussable. Respondents either created a consensus, or they made explicit why they differed in opinion. This way of applying the techniques and sub-instruments ensures inter-interviewee reliability across interviews with team members, project leaders and project managers, ultimately with the purpose of enhancing the comparability, reliability and quality of the data. The procedure of the fieldwork below will help to clarify why individual interviews, group interviews and a survey were held, and how these data sources relate to each other, which will be presented later.

Procedure and fieldwork

The fieldwork took place beginning in 2014 to mid-2015, in which 18 case studies were performed, after the instruments had been tested. For this testing a number of colleagues (researchers/consultants) completed the survey and an experienced colleague-project manager allowed one of his projects to be used as a test case (pilot). On the basis of these experiences, modifications were made to improve the instruments. What these instruments are measuring will be explained hereafter. The following procedure was applied in carrying out each case study.

Phase 1: Face-to-face and group interviews

First, a face-to-face interview was held with the (top) manager of the project teams in order to investigate how this person assessed the project complexity, the progress of the projects, the (expected) project results, and the type of innovation, to gather external measures (for each project). This person, called project manager, is the one who is ultimately responsible for the project; often the project leader is accountable to this project manager. This step was meant to minimise the disadvantage of common method bias by acquiring an external evaluation on the project and the process (Chapter 3).

Second, an in-depth interview was held with the project leader. First, we examined the project in terms of its content, the outcome, the innovation type and the perceived project complexity. Together we then assessed the critical incidents of the project in terms of delays and speed-ups, which were subsequently pointed out on the time-line of the project (calendar method). Delay incidents are critical events that evoke a project to go in a direction that is unfavourable to its innovative outcomes, whereas speed-up incidents are the opposite; these are critical events that direct the project in a favourable direction, possibly after a mishap. This second kind of event could possibly indicate the bouncing back on track of the project. The project leader subsequently selected the most significant delay and speed-up incidents. Both types of incidents were discussed. The delay incident was studied to assess the reasons why the team deviated from the plan and whether or not this was associated with defensive behaviour. The speed-up incident or critical recovery was examined based on the presence of innovation resilience behaviour in getting back on track. For both kinds of incidents, we discussed whether the elements of mindful infrastructure (team psychological safety, team learning behaviour, complexity leadership, organisational politics) were absent or present. The number of critical incidents and recoveries varied across teams; it could not be used as a selection criterion, because the presence of such incidents can only come to the surface during the interviews.

Third, in-depth group interviews were held with project team members which followed the same topics as the interview with the project leader. The project leader's assessment of the critical incidents and the time-line were presented to the team members to reassure that there was agreement on these incidents and their importance to the project.

Subsequently, a project narrative was constructed as desk research by the researcher using the data of these interviews. The narrative, which was a drawing on a time-line, was discussed afterwards with the project leader and the project team members to assess the extent of consensus in a second interview. This second interview was held with the project leader and the project team together. During this interview, the researcher could check if the narrative was correctly reflecting what was said. Extra information was also acquired on missing issues. In this interview the researcher also explained the background and purpose of the research.

Phase 2: Internet survey

A survey was developed for (1) (top) managers and for (2) project leaders and project team members. The manager's survey intended to measure project complexity, project progress, project success, and type of innovation. The project leader and member survey included these four aspects, as well as the elements of mindful infrastructure, namely team psychological safety, team learning behaviour, complexity leadership, team voice, and team climate. It further addressed innovation resilience behaviour.

The survey of managers functioned as an external measure of complexity, outcomes and innovation type. The group of project leaders and project team members comprises a larger group than the interviewees of phase 1. More respondents of the same company were invited to join the Internet survey, provided they had the same kind of jobs and projects. This had the purpose of creating a larger response group to enable statistical analysis. In doing so, a response group of more than 260 respondents was created as a basis for the construction of research scalars. The data of the larger group were not intended to be used to generalise the findings of the case studies to their organisations as a whole. The survey was completed after the first interview but before the second interview.

The survey of team members/leaders was quite long because several constructs were included for exploratory reasons, namely to investigate how those constructs functioned. Consequently, in the phase of analysing the data, not all constructs proved to be equally useful and for reasons of parsimony and redundancy the constructs team climate, mindful organising, and type of innovation were discarded in an early phase.

Data

In the period January 2014 - May 2015 eighteen case studies were carried out in 11 organisations.

Table A1.1 Nett response group

Cases Innovation team/project	Organisation	Total	Number of team members including team leaders	Number of managers (to whom team is accountable)	Number of 'other team members and team leaders' of same company participating in survey	Number of 'other managers' of same company participating in survey
Data sources A= face-to-face interview B= survey team leader & members C= survey project managers			A + B	A + C	B	C
Profit - services						
Team02	I	23	5	1	12	-
Team03			4	1		
Team04	II	35	6	2	27	-
Team08	III	6	4	1	1	-
Profit - manufacturing and process industry						
Team01	IV	6	5	1	-	-
Team15	V	53	6	1	29	-
Team16			15	2		
Team05	VI	22	4	1	7	-
Team06			5	1		
Team07			3	1		
Team13	VII	18	8	2	-	
Team14			6	2		
Team17	VIII	20	4	1	7	-
Team18			7	1		
Non-profit						
Team09	IX	27	4	1	21	1
Team10	X	82	5	1	65	3
Team11			7	1		
Team12	XI	17	3	1	13	
Total 18	**11**	**309**	**101**	**22**	**182**	**4**

In total 398 respondents started with the surveys and 309 were completed of which 101 by team members and team leaders of the 18 innovation teams under study; by 22 managers to which these 18 teams were accountable; by 182 other team members and team leaders and 4 managers of the company to which the 18 teams belonged. Of the 309 respondents, 283 (71%) completed the survey fully (with no missing values on important variables), of which 38% were a project or team leader and 53% a team member, while about 9% reported having another function. The average team size was 5.9 persons, ranging from 3 to 16 persons.

Measures

The measures discussed were developed for the surveys for (top) managers and for project leaders and project team members. The measures also served as a basis for the checklists used for the semi-structured in-depth interviews to maximise consistency in treating topics. Both measuring instruments are included in the appendices.

Mindful infrastructure was measured with five constructs, namely team psychological safety, team learning behaviour, behavioural complexity in leadership, team voice and team climate.

'Team psychological safety' and 'team learning behaviour' were measured by scales developed by Edmonson (1999) and also applied in the pilot-study (Chapter 2). Team psychological safety is the shared belief that the team is safe for interpersonal risk taking, and suggests a sense of confidence that the team will not embarrass, reject, or punish someone for speaking up, implying mutual respect and trust; team learning is the ongoing process of reflection and action, by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions (Edmondson, 1999). Respondents were asked to evaluate statements on both topics on a 5 point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (5).

'Behavioural complexity in leadership' is an instrument to measure the capacity to exhibit a broad array of contrasting or competing behaviours (Quinn, Faerman, Thompson, McGrath & St. Clair, 2010), which is at the very heart of leading complex projects. An instrument based on the 'competing values framework' (Quinn et al., 2010) was developed by Lawrence, Lenk and Quinn (2009). The competing values framework is defined by two dichotomous (competing) values: flexible versus stable structure and internal versus external focus. Together they result in four theoretical quadrants, but also in a circular structure, a 'circumplex', representing 12 subscales (roles with behaviours) as depicted in Table A1.2. Complexity leadership comprises several roles and behaviours which are measured by asking respondents to self-report how skilled they are on these aspects on a 5 point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (5), comprising 36 items.

Table A1.2 The Competing Values Framework: dimensions values, roles, behaviours (Lawrence et al., 2009: 88)

Structure dimension		Focus dimension: Internal (-)	Focus dimension: External (+)
	Flexible (+)	**Collaborate** (human resource model) Facilitator: encouraging participation Empathiser: showing concern Mentor: developing people	**Create** (open systems model) Innovator: initiating significant change Visionary: anticipating customer needs Motivator: inspiring people to exceed expectations
	Stable (-)	**Control** (intern process model) Monitor: expecting accurate work Coordinator: controlling projects Regulator: clarifying policies	**Compete** (rational goal model) Producer: modelling a hard work ethic Competitor: focusing on the competition Driver: emphasising speed

'Team voice' and 'team climate' are constructs that indicate constructive organisational politics, as it measures the extent to which team members participate in decision making, collaboration and commitment. 'Team voice' measures the participation of team members by examining voice and helping and to what extent team members have a say in daily routines. We used the voice-scale developed by Van Dyne and LePine (1998), with which respondents evaluate statements on a 5 point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (5). 'Team climate' is a scale developed to measure the climate for innovation within groups at work (Anderson & West, 1990), which was made more concise in a short version by Kivimäki and his colleagues (Kivimaki & Elovainio, 1999; Kivimäki, Vanhala, Pentti, Länsisalmi, Virtanen, Elovainio & Vahtera, 2007) that we applied in our study. Respondents were asked to evaluate the applicability of 14 statements on team climate to their own team on a 7 point scale that ranged from 'not at all' (1) to 'to a very great extent' (7). Team climate was discarded for reasons of parsimony and redundancy.

'Mindful organising' is measured by Weick and Sutcliffe's 'Mindfulness Organizing Scale' (2007). This scale was validated in a situation-specific context for hospitals as the 'safety organizing scale' by Vogus and Sutcliffe (2007). The present scale deviates from the 'team mindfulness scale' that was applied in the pilot-study (Chapter 2). Respondents were asked to what extent the statements characterise their current project team on a 7 point scale ranging from 'not at all' (1) to 'to a very great extent' (7). Mindful organising climate was discarded for reasons of parsimony and redundancy.

'Team innovation resilience behaviour' was measured by a short version (18 items) of the five Audits of Resilient Performance of Weick and Sutcliffe (2007: 94-102) consisting of 48 items, and an empirical application of these audits by Ray, Baker and Plowman, who developed one singular instrument from these five audits into their 'measure of organizational mindfulness' that comprises 43 items (2011: 201). The scale was made context-specific for teams and respondents were asked to what extent the five HRO-principles (in these five audits from Weick & Sutcliffe, 2007) are present in their project team on a 7 point scale ranging from 'not at all' (1) to 'to a very great extent' (7). The five HRO-principles are preoccupation with failure, reluctance to simplify, sensitivity to operations, commitment to resilience, and deference to expertise.

Four other measures were developed, namely perceived project complexity, perceived project progress, perceived (expected) project success, and type of innovation. These were 'external to team measures' in the sense that they were measured by (top) managers. The measures were also included on the project leader & team members' survey to study whether inconsistencies between team and external management were associated with certain characteristics of the project.

'Perceived project complexity' was measured with the project complexity index from Vidal, Marle and Bocquet (2001) which consists of four elements, namely project size, project variety, project interdependencies and project context-dependence. Respondents were asked to evaluate the contribution of each factor to the complexity of the project on a scale of '1' (very easy) to '10' (very difficult).

'Perceived project progress' measures how respondents evaluate the progress of the project's process, and not its end-product. Respondents were asked to score the project's progress on a self-developed 10-item scale, which was inspired by Shenhar and Dvir (2007) and Mulder (2012), and ranged from '1' (very bad) to '10' (very good).

'Perceived (expected) project success' was measured using a scale from Müller and Turner (2010) in which respondents could assess the success of their project against ten criteria, calculated as a composite measure (also Müller & Turner, 2007). Project success measures end-state or expected-end-state of the project in terms of these criteria, and not the process of the project. 'Expected' is added as most projects had not yet been finalised during the research.

'Type of innovation' was measured by depicting the following diagram and asking respondents to classify their project (Seebode, Jeanrenaud & Bessant, 2012). The diagram in Figure A1.2 combines the market life cycle of an innovation with the proposition that an innovation represents. Types of innovation differ with respect to incremental (roadmap) versus radical (breakaway) innovations and in being either more routine (roadmap) or more complex (breakaway).

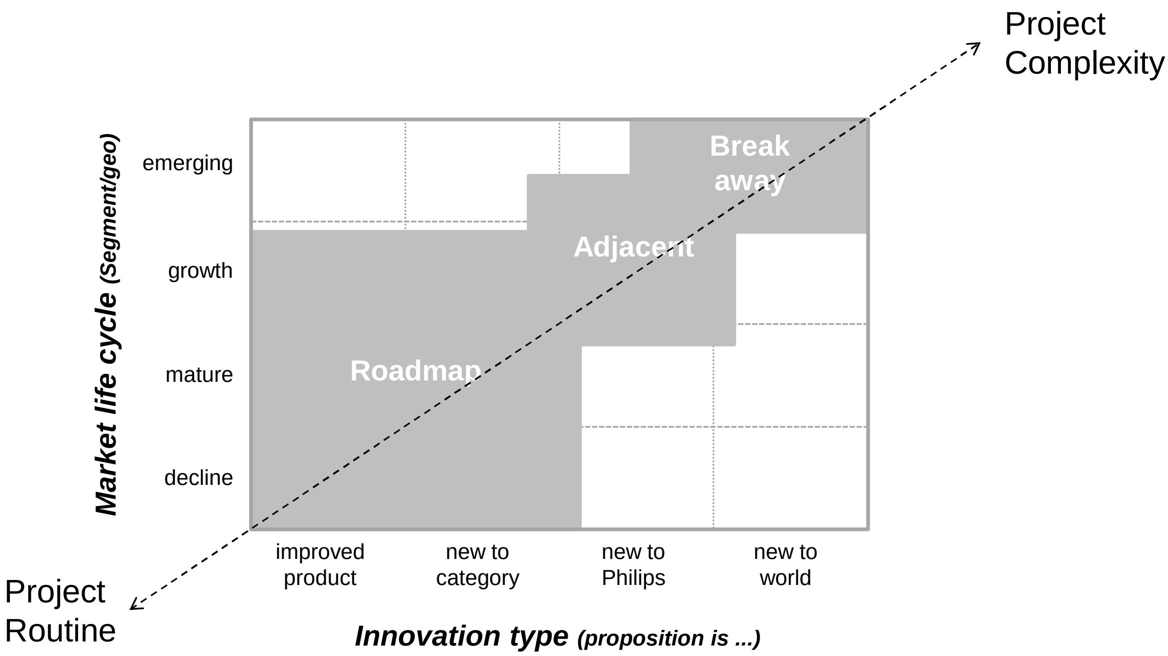


Figure A1.2 Market life cycles and innovation type (Seebode, Jeanrenaud & Bessant, 2012)

Analysis

In Chapters 3 and 4, we investigated the relation between mindful infrastructure and Team IRB. Inspecting the correlations (Table 1 in Chapter 3 and in Chapter 4) we suspected a multicollinearity risk (which can occur when bivariate correlations are .70 or higher) due to the high correlation between the independent variables team climate and team learning behaviour (.63). Team climate is not reported in this thesis but was one of the variables that was part of the applied questionnaire. Team climate had a very high correlation with team innovation resilience behaviour (.70) which may indicate that both concepts are measuring the same phenomenon (redundancy). We decided to exclude team climate from further analyses. The correlations of the remaining variables were not above .50. The bivariate correlations between mindful infrastructure variables on the one hand and Team IRB on the other, with project outcomes (i.e., perceived project progress and perceived project success) showed enough variation to assess that their relation is not problematic in the sense that these concepts are theoretically identical. Subsequently, factor analyses both with and without a fixed number of factors were performed to further inspect the theoretical structure of the data. Only when we fixed the number of factors analogous to the theoretical constructs did the theoretically intended solution more or less emerge. We did use exploratory factor analysis and not confirmatory factor analysis, because we expected that the large number of items in our original and lengthy questionnaire, in addition to the situation of having a specific sample of innovation team respondents, could result in solutions that were deviating from the theoretical assumptions. Moreover, our purpose was to keep the elsewhere validated constructs and their scales intact (Edmondson, 1999), apply them, and therefore we focused on their reliability in our dataset.

Pre-study and main study

The discussed research methodology stresses the main study of the 18 case studies. For completeness we mention that the pre-study (reported in Chapter 2) and its fieldwork was carried out in 2011 and applied a different survey from the one mentioned in Appendix 2. However, Chapter 2 has its own Appendices and Appendix 1 contains the questionnaire items used for that particular pre-study.

Appendix 2 Survey

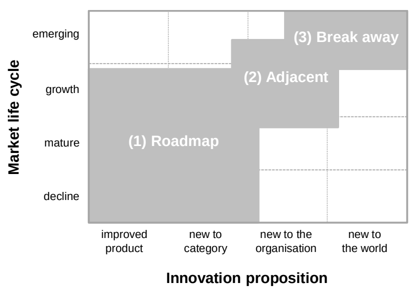
Team Innovation Resilience Behaviour [Source: Mindfulness Organising Scale; Vogus, T. J., & Sutcliffe, K. M. (2007). The safety organizing scale: development and validation of a behavioral measure of safety culture in hospital nursing units. Medical care, 45(1), 46-54; Weick, K. & Sutcliffe, K., 2001, 2007. Managing the unexpected. San Francisco: Jossey-Bass; Ray, J.L., Baker , L.T. & Plowman, D.A. (2011).Organizational mindfulness in business schools. Academy of Management Learning and Education, 10 (2), 188-203 In the occurrence that this project needs / needed to take another course rather unexpectedly in order to optimize reaching its targets, how would you assess the presence of the project team's ability to respond adequately, when you look at:	1=not at all 2=to a very little extent 3=to a limited extent 4=to a moderate extent 5=to a considerable extent 6=to a great extent 7=to a very great extent
Preoccupation with failure 1. We actively look for risks and try to understand them 2. We are keen for cues why our expectations are not met 3. When members spot potential risks we discuss them extensively	
Reluctance to simplify 1. Members of this team never take things for granted 2. Team members listen carefully, and it is rare that someone's view goes unheard 3. We actively seek for more explanations and viewpoints before taking a decision	
Sensitivity to operations 1. Team members put effort in building a clear picture of the current situation of the project 2. We constantly monitor the progress of the project in a profound manner 3. The team has discretion to resolve unexpected problems as they arise	
Commitment to resilience 1.Resources are continually devoted to enhance people's expertise 2.We always learn from every mistake being made 3.The organisation encourages challenging "stretch" assignments 4. Most members have the skills to act on unexpected problems that arise 5.This team is capable to always arrive at an appropriate solution 6.This team is extremely resourceful	
Deference to expertise 1. Team members typically "own" a problem until it is resolved 2. In this organisation expertise is valued over hierarchical rank in most decisions 3. Instead of muddling through, the team quickly obtains the external expertise if needed	
Team Psychological Safety [Source: Edmondson, A. (1999). Psychological safety and learning behavior in work teams. Administrative Science Quarterly, 44(2), 350-383]. To what extent do you agree or disagree with the following statements: - If you make a mistake on this team, it is often held against you (rc) - Members of this team are able to bring up problems and tough issues - People on this team sometimes reject others for being different (rc) - It is safe to take a risk on this team - It is difficult to ask other members of this team for help (rc) - No one on this team would deliberately act in a way that undermines my efforts - Working with members of this team, my unique skills and talents are valued and utilized	1=strongly disagree 2=disagree 3=neither agree/disagree 4=agree 5=strongly agree

Team Learning Behaviour [Source: Edmondson, A. (1999). Psychological safety and learning behavior in work teams. Administrative Science Quarterly, 44(2), 350-383]. To what extent do you agree or disagree with the following statement: -We regularly take time to figure out ways to improve our team's work processes -This team tends to handle differences of opinion privately or off-line, rather than addressing them directly as a group (rc) -Team members go out and get all the information they possibly can from others – such as customers, or other parts of the organisation -This team frequently seeks new information that leads us to make important changes -In this team, someone always makes sure that we stop to reflect on the team's work process -People in this team often speak up to test assumptions about issues under discussion -We invite people from outside the team to present information or have discussions with us	1=strongly disagree 2=disagree 3=neither agree/disagree 4=agree 5=strongly agree
Behavioral complexity in leadership [Source: Lawrence, K. A., Lenk, P., & Quinn, R. E. (2009). Behavioral complexity in leadership: The psychometric properties of a new instrument to measure behavioral repertoire. The Leadership Quarterly, 20(2), 87-102.] The following questions concern the type of leadership within the project team of this project. If you are a project team leader: "I would describe myself as being skilled in the following…" If you are a project team member: "I would describe the project team leader as being skilled in the following…"	1=strongly disagree 2=disagree 3=neither agree/disagree 4=agree 5=strongly agree 6=don't know
Relating to People/collaborate 1. Encouraging participation 1a. Making it legitimate to contribute opinions. 1b. Employing participative decision making. 1c. Maintaining an open climate for discussion. 2. Developing people 2a. Encouraging career development. 2b. Seeing that everyone has a development plan. 2c. Coaching people on career issues. 3. Acknowledging personal needs 3a. Being aware of when people are burning out. 3b. Encouraging people to have work/life balance. 3c. Recognizing feelings.	
Leading change/create 4. Anticipating customer needs 4a. Meeting with customers to discuss their needs. 4b. Identifying the changing needs of the customer. 4c. Anticipating what the customer will want next. 5. Initiating significant change 5a. Initiating bold projects. 5b. Starting ambitious programs. 5c. Launching important new efforts. 6. Inspiring people to exceed expectations 6a. Inspiring direct reports to be creative. 6b. Encouraging direct reports to try new things. 6c. Getting unit members to exceed traditional performance patterns.	

Managing Processes/control 7. Clarifying policies 7a. Seeing that corporate procedures are understood. 7b. Insuring that company policies are known. 7c. Making sure formal guidelines are clear to people. 8. Expecting accurate work 8a. Emphasizing the need for accuracy in work efforts. 8b. Expecting people to get the details of their work right. 8c. Emphasizing accuracy in work efforts. 9. Controlling projects 9a. Providing tight project management. 9b. Keeping projects under control. 9c. Closely managing projects.	
Producing Results/compete 10. Focusing on competition 10a. Emphasizing the need to compete. 10b. Developing a competitive focus. 10c. Insisting on beating outside competitors. 11. Showing a hard work ethic 11a. Showing an appetite for hard work. 11b. Modeling an intense work effort. 11c. Demonstrating full exertion on the job. 12. Emphasizing speed 12a. Getting work done quicker in the unit. 12b. Producing faster unit outcomes. 12c. Providing fast responses to emerging issues.	
Team voice [Source: LePine, J. A., & Van Dyne, L. 2001. Voice and cooperative behavior as contrasting forms of contextual performance: Evidence of differential relationships with Big Five personality characteristics and cognitive ability. Journal of Applied Psychology, 86: 326–336; L. Van Dyne and J. A. LePine (1998). Helping and Voice Extra-Role Behaviors: Evidence of Construct and Predictive Validity, Academy of Management Journal; Van Dyne and LePine' s (1998) 6-item scale of Voice was based on a modification of the Van Dyne, Graham, and Dienesch (1994) Advocacy Participation Scale.] To what extent do you agree or disagree with the following statements? In this project team each team member:	1=strongly disagree 2=disagree 3=neither agree/disagree 4=agree 5=strongly agree 6=don't know
(1) develops and makes recommendations concerning issues that affect this work group (2) speaks up and encourages others in this group to get involved in issues that affect the group (3) communicates his/her opinions about work issues to others in this group even if his/her opinion is different and Others in the group disagree with him/her (4) keeps well informed about issues where his/her opinion might be useful to this work group (5) gets involved in issues that affect the quality of work life here in this group (6)speaks up in this group with ideas for new projects or changes in procedures.	
Perceived Project Complexity [Source : Vidal, L. A., Marle, F., & Bocquet, J. C. (2011). Measuring project complexity using the Analytic Hierarchy Process. International journal of project management, 29(6), 718-727.] The aim of this next question is to assess how you, evaluate the complexity of the innovation project. On a scale of 1 (very easy) to 10 (very difficult) please evaluate the contribution of each factor to the complexity of the project	1=very easy 2 to 9 10=very difficult 11=I do not know
-With regard to Project Size Number of stakeholders	

-With regard to Project variety Variety of information systems to be combined Geographic location of the stakeholders Variety of the interests of the stakeholders	
-With regard to Project interdependencies Dependencies with the environment Availability of people, material and (of any resources) due to sharing Interdependence between sites, departments and companies Interconnectivity/Feedback loops in the project networks Team cooperation and communication Dependencies between schedules Interdependence of information systems Interdependence of objectives The interrelations between phases The interdependence of specifications	
-With regard to Project context-dependence Cultural configuration and variety Environment organisational complexity Environment technological complexity	
Project progress [Source: self developed based on Musallam, 2011; Oeij et al., Chapter 2] On a scale of 1 (very bad) to 10 (very good) how would you evaluate the process / progress of this project in relation to: (this is not concerning the end product but the process) ?	1=very bad 2 to 9 10=very good 11== I do not know/not applicable
Stay within the budget Delivering on time / speed Performance / quality of the content of our task Meeting requirements of the (initial) project plan When necessary, appropriate deviation from the project plan When necessary, flexible adaption with regard to emerging requirements Meeting targeted market opportunities Risk management The availability of expertise Quality of project management	
Project success [Source: Müller, R. & Turner, R. (2010). Leadership competency profiles of successful project managers. International Journal of Project Management, 28, 437-448.] To what extent do you agree or disagree with the success of the project against the following statements: The project was a success with respect to the (expected):	1=strongly disagree 2=disagree 3=neither agree/disagree 4=agree 5=strongly agree 6=don't know/not applicable
-end-user satisfaction with the project's product or service -suppliers' satisfaction -project team's satisfaction -other stakeholder's satisfaction -meeting project's overall goal performance (functionality, budget and timing) -meeting user requirements -meeting the project's purpose -client satisfaction with the project results -reoccurring business with the client -meeting your own self-defined success factor	

Team climate [Source: Kivimäki, M., Vanhala, A., Pentti, J., Länsisalmi, H., Virtanen, M., Elovainio, M., & Vahtera, J. (2007). Team climate, intention to leave and turnover among hospital employees: Prospective cohort study. BMC Health Services Research, 7(1), 1-8. Kivimaki, M., & Elovainio, M. (1999). A short version of the Team Climate Inventory: Development and psychometric properties. Journal of occupational and organizational psychology, 72(2), 241-246; Anderson, N. R., & West, M. A. (1998). Measuring climate for work group innovation: development and validation of the team climate inventory. Journal of organizational behavior, 19(3), 235-258.] To what extent are the following statements applicable to your project team?	1=not at all 2=to a very little extent 3=to a limited extent 4=to a moderate extent 5=to a considerable extent 6=to a great extent 7=to a very great extent
1. How far are you in agreement with the objectives of your project team? 2. To what extent do you think objectives of your project team are clearly understood by other members of the project team? 3. To what extent do you think objectives of your project team can actually be achieved? 4. How worthwhile do you think these objectives are to the organization? 5. We have a "we are together" attitude 6. People keep each other informed about work related issues in the project team 7. People feel understood and accepted by each other 8. There are real attempts to share information throughout the project team 9. Are members of your project team prepared to question the basis of what the project team is doing? 10. Does the project team critically appraise potential weaknesses in what it is doing to achieve the best possible outcome? 11. Do members of the project team build on each other's ideas to achieve the best possible outcome? 12. People in this project team are always searching for fresh, new ways of looking at problems. 13. In this project team we take the time needed to develop new ideas. 14. People in the project team cooperate to help develop and apply new ideas.	
Mindful organising Assess the degree to which you and your team members engage in the following behaviours and practices: [Source: Vogus, T. J., & Sutcliffe, K. M. (2007). The safety organizing scale: development and validation of a behavioral measure of safety culture in hospital nursing units. Medical care, 45(1), 46-54; Weick, K. & Sutcliffe, K., 2001, 2007. Managing the unexpected. San Francisco: Jossey-Bass; Ray, J.L., Baker , L.T. & Plowman, D.A. (2011).Organizational mindfulness in business schools. Academy of Management Learning and Education, 10 (2), 188-203; Oeij et al., Chapter 2]	1=not at all 2=to a very little extent 3=to a limited extent 4=to a moderate extent 5=to a considerable extent 6=to a great extent 7=to a very great extent
1. Team members have a good “map” of each person’s talents and skills. 2. Team members talk about mistakes and ways to learn from them. 3. Team members discuss their unique skills with each other so that we know who has relevant specialized skills and knowledge. 4. Team members discuss alternatives as to how to go about our normal work activities. 5. When reporting emerging problems to team members, we usually discuss what to look out for. 6. When attempting to resolve a problem, team members take advantage of the unique skills of our colleagues. 7. Team members spend time identifying activities we do not want to go wrong. 8. When errors happen, as team members we discuss how we could have prevented them. 9. When an unexpected situation like a sudden change or project mishap occurs, as team members we rapidly pool our collective expertise to attempt to resolve it.	

Type of innovation [Source: Seebode, D., Jeanrenaud, S., & Bessant, J. (2012). Managing innovation for sustainability. R&D Management, 42(3), 195-206.] How would you classify this project within the innovation typology used in this diagram (below)? This project fits (mostly) into the type of: - 1] Roadmap, namely strengthening the core business - 2] Adjacencies, namely new to our firm / company and creating profitable adjacent business - 3] Breakaway, namely new to the world - 4] Neither a, b or c	

Appendix 3 Teams and projects

Teams, industrial sector, embedment, and innovation project

Team	Sector, department / organisational embedment of team, and project
Team01	-R&D department in agribusiness -an R&D team in the dairy industry; co-innovation with another company -the project/innovation was to deliver an ingredient for a food product
Team02	-Consultation firm in engineering -a temporary innovation team composed of members from different business units -the project/innovation is to develop an integral method for Life Cycle Costing and database to generate new business
Team03	-Consultation firm in engineering -a temporary innovation team composed of members from different business units -the project/innovation is to develop a method for Virtual Design and Construction of roads and buildings, make it applicable for existing projects to generate new business
Team04	-Consultation firm in IT/ICT -a project team of an IT-consulting company. -the project/innovation was to develop services for customers based on Big Data and to develop tools to analyse Big Data
Team05	-R&D department in food and cosmetics -an R&D team -the project/innovation was to timely implement/deploy a new range of products of a specific brand in a specific local market
Team06	-R&D department in food and cosmetics -an R&D team -the project/innovation was to deploy a new product significantly faster than according to the usual standard
Team07	-R&D department in food and cosmetics -an R&D team -the project/innovation was to ‘silently’ relaunch a product to regain and improve its market position
Team08	-Training firm for organisational change professionals -a project team of an education centre in the field of management, consultancy and change -the project/innovation was design a massive open online course (mooc)
Team09	-IT department of education organisation -an IT team and part of the support department in IT & Facilities management -the project/innovation was to deliver a management information system, based on a new combination of existing software and hardware technologies
Team10	-Governmental organisation in construction/engineering -a core team coordinating half a dozen specialist teams -the project/innovation was to develop a method that integrates cooperation between the public commissioner and private contractor, both as a new way of commissioning assignments and resulting in better quality against lower costs
Team11	-Governmental organisation in construction/engineering -a core team coordinating and representing half a dozen regional specialist teams -the project / innovation was to develop and test a flexible framework contract for the maintenance of roads, fly-overs, etcetera

Team12	-Change team of a municipality -a project team of a public organisation -the project/innovation was to implement Lean Six Sigma (LSS) in the organisation’s departments
Team13	-Manufacturer of medical equipment -a project team making laboratory equipment and laboratory systems in the medical technology sector -the project/innovation was to standardize a specimen processing system for automatic inoculation and adapt it for a global market
Team14	-Manufacturer of medical equipment -a project team making laboratory equipment and laboratory systems in the medical technology sector -the project/innovation was to develop medical equipment for the incubation of samples, like tissues and bacteria
Team15	-R&D department in manufacturing -a team forming part of the R&D Department developing components for electronic devices -the project/innovation was to develop new packaging for microchips
Team16	-R&D department in manufacturing -a team forming part of the R&D Department developing components for electronic devices -the project/innovation was a new generation of transistor (performance), and to prepare its readiness for production
Team17	-Manufacturer of transport equipment and automated material handling systems -a multidisciplinary project team within the R&D department - the project/innovation was to develop a reliable detection system for humans by measuring and analyz-ing form and heat
Team18	-Manufacturer of transport equipment and automated material handling systems -an R&D team especially composed to solve problems (Kanban team) -the project was to improve the functioning of products that had been delivered to customers, namely recovering installed automated material handling systems for the post and parcel process of sortation on site

Participating national and multi/international enterprises and organisations based / with a site in the Netherlands

-Agribusiness enterprise, dept. R&D (anonymous)

-Avans Hogeschool (University of Applied Sciences), dept. Diensteenheid ICT & Facilitair (unit Facility Management & ICT)

-Becton Dickinson Diagnostics, corporation BD Life Sciences^, dept. R&D

-Gemeente Amersfoort, dept. Facilitaire Zaken (municipality, general and technical services)

-KPN Telecom & ICT Services, KPN Consulting, anonymous dept.

-Ministerie van Infrastructuur en Milieu, Rijkswaterstaat, Grote Projecten en Onderhoud (ministry of infrastructure and the environment, dept. of waterways and public works, large projects and maintenance)

-NXP Semiconductors, dept. R&D & Application Support*

-Royal Haskoning DHV, dept. Business Development & Innovation

-SIOO, Centrum voor Organisatie- en Veranderkunde (education centre in change management and organisational processes)

-TNO Innovation for Life, team members of Enabling Technology Programme 2011-2014 'Behaviour and Innovation' [#]

-Unilever, dept. Vlaardingen R&D

-Vanderlande Industries, dept. R&D

^the company name during the research was BDKiestra / Kiestra Lab Automation

*after the research the department became part of the new organisation Ampleon Netherlands

[#] Pilot study

Summary

The study *The resilient innovation team: a study of teams coping with critical incidents during innovation projects* (P.R.A. Oeij, 2017) is rooted in the author's fascination about why so many innovations seem to fail. Innovations, in this study, are understood as new products, new services, new processes, or new working methods that are being developed in projects. Apart from the many reasons for innovation failure that can be traced back to the role of markets, finance, technology, consumer demands and organisational developments, this study focuses on team behaviour as a reason for innovation failure. The researcher's curiosity was driven by initial questions such as: do innovation projects fail because such projects are complex? Do they fail because people in teams become defensive when there is tension, uncertainty and fear? Somewhere, outside the world of innovation management, there are teams that hardly ever fail. These are teams working in high-risk situations, namely teams in nuclear plants, on aircraft-carriers, in operating rooms, and in fire-brigades. Such teams are called HRO-teams after the High Reliability Organisations (HROs) that they are part of. HROs are studied in fields of safety and crisis management. Why do such teams hardly ever fail? Moreover, can innovation teams learn from HRO-teams? These questions led to the assumptions behind this study, namely, that it should be beneficial for innovation success to transfer that knowledge to the field on innovation management and that HRO-principles could be applied to this field.

What basically characterises HRO-teams is summarised in the following diagram: they are embedded in an organisational context that nourishes trust, learning, commitment and supportive leadership: a mindful infrastructure. Due to that context, a certain kind of team behaviour is enabled that minimises making mistakes and gets a team back on track should a mistake or accident occur. That type of team behaviour is based on five HRO-principles, namely: 1. Be very alert to things that go wrong or indicate negative consequences; 2. Do not accept simple answers but try to validate the facts; 3. Rule out doubt by unambiguously connecting the broad organisational goal and the team work; 4. Anticipate possible and unexpected failure and ensure resilient responses; 5. Rank expertise higher than hierarchy. We mapped this team behaviour to innovation teams and called it *innovation resilience behaviour*. HRO-teams are able to minimise accidents and contain their escalation should they nonetheless occur: they have excellent team results. However, team results of innovation teams are different, namely achieving progress and positive results instead of failure of innovations. Therefore, the research is directed at the applicability of HRO-principles in the context of innovation.

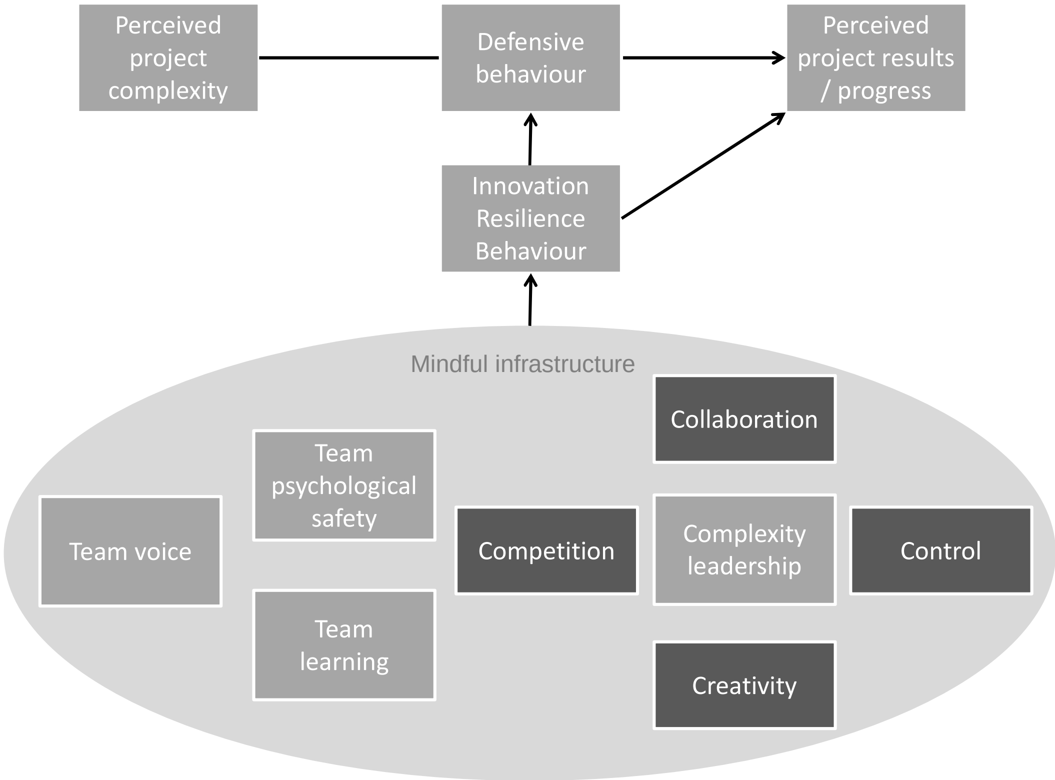
The **central question** of the study is: *How do project teams deal with critical incidents during their innovation projects?*

A critical incident is an event or situation that could cause a project to fail. What do these teams do in their projects when they encounter such critical incidents? And what characteristics do such teams have? Are these teams embedded in a mindful infrastructure? To investigate this, the study looks into the presence of team psychological safety, team learning behaviour, team voice and complexity leadership. These are the research variables of the above mentioned trust, learning, commitment and supportive leadership. Do teams perform innovation resilience behaviour (Team IRB)? To investigate this, the study assesses the presence of the five HRO-principles that were modified by team behaviour in innovation teams.

This study assumes that complexity of projects and defensive behaviour of team members could affect the innovation project in a negative way. Defensive behaviour is risk-avoiding behaviour that is caused by feelings of threat and incompetence. A possible cause for defensiveness is project complexity, which refers to unpredictable and unexpected situations that emerge from the interaction of many factors in innovation projects. Talking about complexity, one can, for example, think about intricate technological and intellectual demands related to the innovation goal, differing interests of stakeholders of the innovation, external influences due to decisions about strategy and finance, priorities taken by others outside the team, and team conflict. If project complexity induces defensive behaviour, then perhaps the presence of mindful infrastructure and IRB could keep the team and the project on track, in order to still achieve a desired outcome (the perceived project results or progress). It should be mentioned that project outcomes are determined by factors other than mindful infrastructure and Team IRB alone, which are not part of this study. IRB can also directly lead to good project outcomes. That is why there is in the following figure also a direct arrow from IRB to perceived project results/project progress. The figure below depicts the theoretical framework of the research.

The **overall hypothesis** of the PhD thesis is that mindful infrastructure enables IRB, and that IRB has positive effects on project outcomes. The main question is divided into seven research questions:

1. What is mindful infrastructure and what is Team IRB? What is their relationship?
2. Does IRB affect perceived project results and perceived project progress?
3. Do teams have different configurations of mindful infrastructure?
4. Is IRB associated with defensive behaviours?
5. How do project leaders manage innovation projects?
6. How do teams respond to critical incidents during innovation projects?
7. What can innovation management teams learn from HRO teams?



The research took place among eleven Netherlands-based organisations, some of them are multi-nationals. These organisations are selected from the manufacturing sector, services and education; some are profit organisations, others are non-profit organisations. In these eleven organisations, eighteen teams and their innovation projects are studied as cases studies, and additionally team members working in similar projects in those companies participated in a survey. A pilot study preceding the main study was executed in a Dutch research and technology organisation.

The thesis consists of six studies. Study 1 is a pilot study of a single case, namely an innovation programme in a research and technology organisation. Based on this study, the framework model above was developed. The study combines survey data, in-depth face-to-face interviews, and the observation of a project team, and concludes that there are positive associations between team mindfulness, team psychological safety, and team learning behaviour. To the degree that more team mindfulness, team psychological safety, and team learning behaviour are present, there are better project results, in terms of more team innovativeness, and team external and team internal effectiveness. A relation with the type of project (innovation project or regular, non-innovative project) and project complexity was not found.

Study 2 explores the main relations of the model based on survey data from innovation teams from eleven companies where project teams are working on innovations (study 2 addresses questions 1 and 2). The elements of mindful infrastructure - team psychological safety, team learning behaviour, team voice and the leadership style control – were associated with Team IRB. Similar to study 1, this study found perceived project complexity did not influence Team

IRB. Further, mindful infrastructure was positively associated with project outcomes (perceived project success and perceived project progress), but this relation was significantly stronger when Team IRB was present at the same time. Team IRB mediated the relation between mindful infrastructure and project outcomes.

Study 3 investigates patterns of mindful infrastructure, that is, the presence in teams of combinations of (seven) variables of mindful infrastructure (see Figure above), so-called 'configurations' (this study addressed question 3). Based on 18 cases of innovation projects of just as many teams, there were eight different combinations of mindful infrastructure variables discovered that have a similar result, as it happens to be that each of those patterns was related to the presence of Team IRB in these teams. This implies that teams can have a different design of mindful infrastructure to achieve Team IRB. However, the eight patterns found suggest that those combinations have a better chance to enable Team IRB than other combinations. One should realise that seven variables can lead to 128 possible configurations, thus 120 configurations are not 'true'.

Study 4 investigates defensiveness in teams (and addressed question 4). Indications were found that teams that were less capable of Team IRB were more inclined to show defensive behaviour, which means these teams were more conducive to try to be in control, to prevent losing control and to avoid feelings of embarrassment. It seems that teams less capable of Team IRB were more risk-avoiding. The study seems to point out further that teams capable of Team IRB have more project success. The research also led to the development of an instrument to measure certain defensive behaviours when analysing conversations.

Study 5 researches how project leaders manage their innovation projects (research question 5). Some project leaders implicitly applied a rigorous research methodology when they have to deal with critical incidents. They followed specific steps: recognise the problem, investigate the problem, develop alternative solutions, test their validity, try out and experiment solutions, select and apply one solution, and evaluate the completed process. Surprisingly these project leaders applied the model of the 'reflective practitioner' developed by Schön, who contended that experienced professionals use that model tacitly, without being aware of it. Theorising on what we observed, in a subsequent conceptual step, we linked the reflective practitioner model to the control cycle that is part of the organisational learning model, which integrates single, double and triple loop learning. By making the combined model explicit, assistance was provided for developing ways to train project leaders in becoming more rigorous whilst learning in leading their innovation projects, and thus reducing the chance of project failure.

Study 6 explored how teams deal with critical incidents during innovation projects (research question 6). Focusing on the twelve out of eighteen teams that were capable of performing Team IRB, the main finding was that these twelve teams were better at managing and mending critical incidents than in minimising critical incidents. One can say that, unlike HRO teams, who excel in preventing incidents from escalating, the innovation teams capable of Team IRB were more responsive than pro-active, except for those teams embedded in an R&D environment. In these R&D-embedded teams specific project management tools were present, which might explain a more pro-active position and attention toward risk management.

In the concluding chapter, the question of what innovation management teams can learn from HRO teams is addressed (question 7). The answer is found in the HROs' emphasis on the psychology of mindful acting and the organisational discipline to systematically embed organisational routines such as dedicated briefings and debriefings. HROs excel in creating space for learning and speaking up, and to meticulously improve the work process wherever possible, and in so doing test and redesign their routines; their routines never stay the same for long, as they continuously evolve. Paradoxically, HROs are capable of balancing between required rule-based routines and the emerging need to adapt those routines. HROs inform innovation management with its attention toward the psychology of avoiding mistakes and putting effort in unnatural human behaviour. The psychological concepts of reliability and mindfulness, underlying the five HRO-principles, explain the motivation to continuously be aware of unforeseen situations, and ensure continuous learning from events that each time unfold in slightly different ways. Applying these insights can support the signalling of weak signals of failure by innovation team members and suppress defensive, risk-avoiding behaviour, and therefore ultimately enhance the chance of innovation success.

The main conclusion of the study is that, indeed, mindful infrastructure and Team IRB are concepts that can be applied to innovation management and project teams working on innovation. Innovation teams that do apply these insights seem to be less defensive and report positive project outcomes more often. While this insight is instructive to innovation management as a field, the findings also add to the knowledge of safety and crisis management, in the sense that mindful infrastructure consists of the elements of team psychological safety, team learning behaviour, team voice and complexity leadership. These are building blocks for the HRO-principles already applied.

Recommendations to develop 'The Resilient Innovation Team' are formulated in the chapter about practical implementation (so-called valorisation). The research suggests that mindful infrastructures, that support openness and trust, enable teams to perform Team IRB and be less defensive, are all helpful in making complex issues and uncertainties discussable. Instead of becoming risk-averse such teams are solving the project's risks and critical incidents with openness and effectiveness. Some project leaders deploy a research-driven perspective to solve critical incidents with the kind of transparency and validation of solutions that helps to overcome defensive routines as well. Some project teams, notably those embedded in R&D organisations, are better at preventing and minimising critical incidents than other teams. HRO-teams are still even better at minimising incidents and accidents, which means that for innovation teams much is to be won in this regard. The Resilient Innovation Team is able to proactively handle unexpected, sometimes critical, events to continue pursuing its (project, innovation or team) goal without significant disruption. Practical guidelines and a tool are provided to develop both mindful infrastructure and Team IRB, and to combat defensive behaviour.

Samenvatting

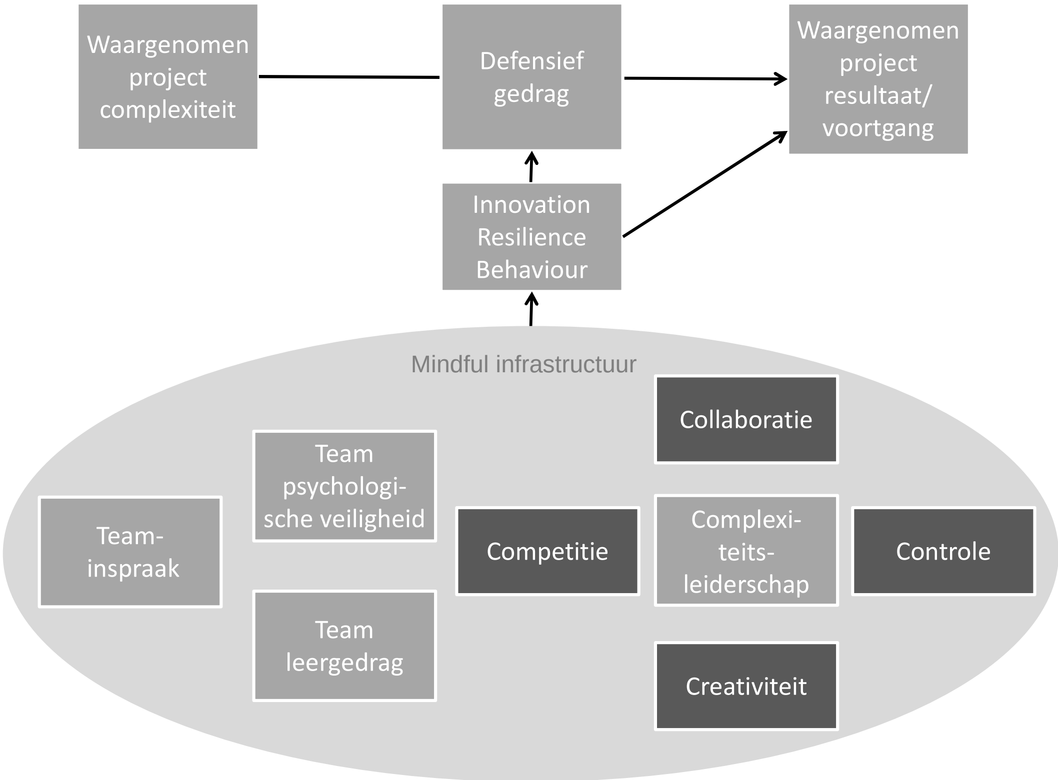
De studie *The resilient innovation team: a study of teams coping with critical incidents during innovation projects – Het veerkrachtige innovatie team: een studie over teams en hoe zij omgaan met kritieke incidenten in hun innovatie projecten* (P.R.A. Oeij, 2017) is geworteld in de fascinatie van de auteur waarom zoveel innovaties lijken te mislukken. Innovaties kunnen in deze studie nieuwe producten, diensten, processen en werkmethoden zijn die op projectbasis worden ontwikkeld. Naast de vele redenen van het mislukken van innovaties die zijn terug te voeren tot de rol gespeeld door markten, financiering, consumentenwensen en organisatorische ontwikkelingen, concentreert dit onderzoek zich op teamgedrag. De nieuwsgierigheid van de onderzoeker werd aanvankelijk gedreven door vragen, zoals: mislukken innovatieprojecten vanwege hun complexiteit?, en: falen ze doordat mensen in teams defensief worden als er sprake is van spanning, onzekerheid en angst? Elders, in een andere wereld dan die van innovatie-management, zijn teams die zelden falen. Het gaat om teams die functioneren in hoge risico-situaties, zoals teams in kerncentrales, op vliegdekschepen, in operatiekamers en bij de brandweer. Zulke teams zijn HRO-teams, zo genoemd naar hun afkomst uit High-Reliability Organisations (HRO's) (Hoge Betrouwbaarheids-Organisaties). HRO's worden bestudeerd binnen het domein van veiligheids- en crisismanagement. Hoe komt het dat zulke teams zelden falen? En: kunnen innovatie teams leren van HRO-teams? Deze vragen hebben geleid tot de veronderstelling die ten grondslag ligt aan deze studie. Namelijk, dat de transfer van deze kennis naar het domein van innovatiemanagement van nut is voor innovatiesucces, en dat de HRO-principes toegepast kunnen worden op dit domein.

Hetgeen HRO-teams kenmerkt is samengevat in de volgende figuur: zij zijn ingebed in een organisatorische context die vertrouwen, leergedrag, betrokkenheid en ondersteunend leiderschap bevordert: een 'mindful infrastructure' ofwel een 'opmerkzame team- of werkomgeving': we vertalen dit als *mindful infrastructuur*. Daardoor kan bepaald teamgedrag ontstaan dat fouten maken minimaliseert en teams de veerkracht verschaft om terug te keren naar het oorspronkelijke functioneren, indien er toch fouten ontstaan of ongelukken gebeuren. Dit type teamgedrag is gebaseerd op vijf HRO-principes, te weten: 1. Wees zeer alert op zaken die fout kunnen gaan of die duiden op negatieve gevolgen; 2. Accepteer geen simpele antwoorden maar probeer feiten te onderbouwen; 3. Ban elke twijfel uit door een ondubbelzinnige link tussen de bredere organisatiedoelen en het team werk; 4. Anticipeer op mogelijke en onverwachte mislukkingen én wees ervan verzekerd om veerkrachtig te kunnen reageren; 5. Sla expertise hoger aan dan rang. Deze principes voor teamgedrag hebben we toepasbaar gemaakt op innovatieteams en er de naam *innovation resilience behaviour (Team IRB) - veerkrachtig gedrag binnen innovatie teams (letterlijk 'veerkrachtig innovatie-gedrag')* aan verleend: in het kort *Team IRB*. HRO-teams zijn in staat om ongelukken te minimaliseren en kunnen escalatie ervan voorkomen als deze desalniettemin zouden ontstaan: zij hebben excellente teamresultaten. Het is echter zo dat teamresultaten van innovatieteams van een andere orde zijn, namelijk het bereiken van voortgang en positieve resultaten, in plaats van falende innovaties. Om die reden richt deze studie zich op de toepasbaarheid van HRO-principes in de context van innovatie.

De **centrale vraag** van de studie is: *Hoe gaan projectteams om met kritieke incidenten tijdens in hun innovatieprojecten?*

Een kritiek incident is een gebeurtenis of situatie die een oorzaak kan zijn voor het mislukken van een project. Wat doen deze teams in hun projecten als zo'n kritiek incident zich voordoet? Wat kenmerkt dergelijke teams? Zijn deze teams ingebed in een 'opmerkzame werkomgeving'? Om dat te onderzoeken, bekijkt deze studie de aanwezigheid van psychologische veiligheid in teams, leergedrag in teams, teaminspraak, en complexiteitsleiderschap. Deze onderzoeksvariabelen vertegenwoordigen het hierboven genoemde vertrouwen, leergedrag, betrokkenheid en ondersteunend leiderschap (in complexe situaties). Zijn teams in staat tot veerkrachtig innovatiegedrag - kortweg Team IRB - en vertonen zij dit gedrag,? Om dat te onderzoeken bekijkt de studie de aanwezigheid van de vijf HRO-principes die wij hebben aangepast voor teamgedrag in innovatieteams.

In de redenering die ten grondslag ligt aan de studie veronderstellen we dat complexiteit van projecten en defensief gedrag van teamleden een negatief effect kunnen hebben op het innovatieproject. Defensief gedrag is risicomijdend gedrag dat wordt veroorzaakt door gevoelens van bedreiging en incompetentie. Een mogelijke oorzaak voor defensiviteit is project complexiteit, hetgeen verwijst naar onvoorspelbare en onverwachte situaties die ontstaan vanuit de interacties tussen vele factoren in innovatieprojecten. Hierbij kan bijvoorbeeld worden gedacht aan ingewikkelde technologische en intellectuele eisen gerelateerd aan het innovatiedoel, uiteenlopende belangen van belanghebbenden van de innovatie, externe invloeden vanwege besluiten over strategie en financiering, prioriteiten gesteld door anderen buiten het team en teamconflicten. Als projectcomplexiteit aanleiding kan geven tot defensief gedrag, dan kan de aanwezigheid van een opmerkzame werkomgeving en Team IRB het team en het project wellicht op het juiste spoor houden, zodat nog steeds een gewenst resultaat wordt gerealiseerd (waargenomen project resultaten / voortgang). Opgemerkt wordt dat projectresultaten niet alleen door een opmerkzame werkomgeving en Team IRB worden bepaald, maar ook door andere factoren die niet zijn onderzocht in deze studie. Team IRB kan overigens ook rechtstreeks goede projectresultaten beïnvloeden. Daarom staat in de volgende figuur ook een directe pijl van veerkrachtig gedrag binnen innovatieteams naar waargenomen project resultaten / voortgang. De onderstaande figuur beeldt het theoretisch raamwerk van het onderzoek uit.



De *centrale hypothese* van dit proefschrift is dat opmerkzame werkomgevingen Team IRB mogelijk maken, en dat Team IRB positieve effecten heeft op projectuitkomsten. De centrale vraag is onderverdeeld in zeven onderzoeksvragen:

1. Wat is 'mindful infrastructure' (opmerkzame werkomgeving) en wat is 'innovation resilience behaviour' (Team IRB) en wat is hiertussen de relatie?
2. Heeft Team IRB invloed op waargenomen project resultaten en waargenomen project voortgang?
3. Verschillen teams in hun configuratie van de opmerkzame werkomgeving?
4. Is Team IRB gerelateerd aan defensief gedrag?
5. Hoe managen projectleiders innovatieprojecten?
6. Hoe reageren teams op kritieke incidenten tijdens innovatieprojecten?
7. Wat kunnen innovatiemanagement-teams leren van HRO-teams?

Het onderzoek vond plaats onder elf in Nederland gevestigde organisaties, waarvan enkele multinationals. Deze organisaties zijn geselecteerd uit de industrie, dienstverlening en onderwijs; sommige zijn profit-organisaties, andere non-profit organisaties. In deze elf organisaties zijn achttien teams en hun innovatieprojecten onderzocht als case studies, en in aanvulling daarop participeerden teamleden die werken in vergelijkbare projecten in deze bedrijven in een vragenlijstonderzoek. Een proef-casestudie voorafgaand aan het hoofdonderzoek werd uitgevoerd bij een Nederlandse organisatie voor toegepast onderzoek.

De thesis beslaat zes onderzoeken. Studie 1 is een proefstudie of pilootstudie van een enkele casus, namelijk een innovatieprogramma van een organisatie voor toegepast onderzoek. Op basis van deze studie is het raamwerk hierboven ontwikkeld. De studie combineert vragenlijst-onderzoekgegevens, een-op-een diepte-interviews, en de observatie van een projectteam, en concludeert dat er een positieve relatie is tussen team mindfulness (opmerkzaamheid), team psychologische veiligheid, en team leergedrag. Naarmate er meer sprake is van team mindfulness, team psychologische veiligheid, en team leergedrag, zijn er betere projectresultaten, in termen van meer innovativiteit, en meer team-externe en team-interne effectiviteit. Een relatie met het type project (innovatieproject of regulier, non-innovatie-project) en project complexiteit kon niet worden vastgesteld.

Studie 2 exploreert de centrale relaties van het model gebaseerd op vragenlijstgegevens van innovatie-teams van elf bedrijven alwaar projectteams werken aan innovaties (studie 2 behandelt vragen 1 en 2). De elementen van mindful infrastructuur – team psychologische veiligheid, team leergedrag, teaminspraak en de leiderschapsstijl 'controleren' – hangen samen met Team IRB. Net als in studie 1, heeft waargenomen project complexiteit geen invloed op Team IRB. Daarnaast is waargenomen dat mindful infrastructuur positief is gerelateerd aan project uitkomsten (waargenomen project resultaten en waargenomen project voortgang), maar dat deze relatie significant sterker is wanneer tegelijkertijd sprake in van Team IRB. Team IRB medieert de relatie tussen mindful infrastructuur en projectuitkomsten.

Studie 3 onderzoekt patronen of zogeheten 'configuraties' van mindful infrastructuur, namelijk de aanwezigheid in teams van combinaties van de (zeven) variabelen van mindful infrastructuur (zie bovenstaande figuur)(deze studie behandelt vraag 3). Gebaseerd op achttien casussen van innovatieprojecten van evenzoveel teams zijn er acht verschillende combinaties van mindful infrastructuur-variabelen ontdekt met een vergelijkbaar resultaat, want elk van deze patronen is gerelateerd aan de aanwezigheid van Team IRB in deze teams. Dit impliceert dat teams een verschillend ontwerp van mindful infrastructuur kunnen hebben om Team IRB te realiseren. Echter, het is wel zo dat de acht gevonden patronen suggereren dat deze combinaties meer kans hebben om Team IRB mogelijk te maken dan andere combinaties. Bedenk dat zeven variabelen kunnen leiden tot 128 mogelijke configuraties en dat 120 configuraties derhalve 'onwaar' zijn.

Studie 4 onderzoek defensiviteit in teams (en adresseert vraag 4). We vonden aanwijzingen dat teams die minder capabel zijn in Team IRB vaker geneigd zijn om defensief gedrag te vertonen, hetgeen erop wijst dat deze teams meer tenderen naar winst en invloed, het voorkomen van controleverlies en het vermijden van gevoelens van schaamte. Het lijkt er op dat teams die minder capabel zijn in Team IRB meer risicomijdend zijn. De studie lijkt er verder op te wijzen dat teams die capabel zijn in Team IRB vaker projectsucces hebben. Het onderzoek leidt tevens tot de ontwikkeling van een instrument waarmee bepaalde defensieve gedragingen in conversaties kunnen worden gemeten en geanalyseerd.

Studie 5 onderzoekt hoe projectleiders hun innovatieprojecten managen (onderzoeksvraag 5). We observeerden dat sommige projectleiders impliciet een rigoureuze onderzoeksmethodologie toepassen wanneer zij moeten omgaan met kritieke incidenten. Zij volgen specifieke stappen: herken het probleem, onderzoek het probleem, ontwikkel alternatieve oplossingen, test de validiteit daarvan, experimenteer met oplossingen, selecteer een oplossing en pas die toe, en evalueer het gehele proces. Tot onze verrassing bleken deze projectleiders het door Schön ontwikkelde model van de 'reflectieve professional' toe te passen; Schön beweerde dat ervaren professionals dit model onbewust (tacit) toepassen. Op basis van deze observatie theoretiseerden we vervolgens over de conceptuele relatie tussen het model van de reflectieve professional en de controle cyclus (de regelkring), die een onderdeel is van het model van de lerende organisatie – dat model integreert enkelvoudig, dubbelvoudig en drievoudig cirkelleren (single, double en triple loop learning). Door dit gecombineerde model te expliciteren, bieden we hulp voor het trainen (het al doende leren) van project-leidersvaardigheden om projecten beter te managen, en aldus de kans op project-falen te verkleinen.

Studie 6 houdt zich bezig met hoe teams omgaan met kritieke incidenten gedurende hun innovatieprojecten (onderzoeksvraag 6). Ons richtend op de twaalf van de achttien teams die capabel zijn in Team IRB is de hoofduitkomst dat deze twaalf teams beter zijn in het managen en herstellen van kritieke incidenten dan in het minimaliseren (en voorkomen) van kritieke incidenten. Anders dan bij HRO-teams het geval is – die excelleren in het voorkomen dat ongelukken escaleren – zijn innovatie-teams die vaardig zijn in Team IRB eerder responsief dan proactief, behalve die teams die zijn ingebed in een Research & Development omgeving. Deze R&D-ingebedde teams beschikken over specifieke projectmanagement gereedschappen (tools), die mogelijk een meer proactieve houding en aandacht voor risicomanagement verklaren.

In het conclusie-hoofdstuk wordt de vraag wat innovatiemanagement-teams van HRO-teams kunnen leren, aan de orde gesteld (vraag 7). Het antwoord is gevonden in de nadruk die HRO's leggen op de psychologie van opmerkzaam gedrag (mindful acting) en op de organisatorische gedisciplineerdheid om stelselmatig organisatorische routines in te slijpen zoals gerichte instructie-bijeenkomsten (briefings en debriefings). HRO's excelleren in het creëren van ruimte om te leren en om transparantie te bewerkstelligen (bijvoorbeeld het stimuleren van kritiek uiten), om heel nauwkeurig werkprocessen te verbeteren waar mogelijk, en al doende, hun eigen routines telkens te toetsen en te herontwerpen; hun routines blijven nooit hetzelfde voor lange tijd, doordat zij deze continu verder ontwikkelen. Paradoxaal genoeg zijn HRO's in staat te balanceren tussen de vereiste, gereglementeerde routines en de steeds opdoemende noodzaak om deze routines aan te passen aan veranderende omstandigheden. HRO's leren innovatiemanagement het belang in te zien van de aandacht voor de psychologie van het vermijden van fouten en de noodzakelijke moeite die moet worden gestoken in tegennatuurlijk gedrag. De psychologische concepten van betrouwbaarheid en opmerkzaamheid (reliability en mindfulness), de basis voor de vijf HRO-principes, verklaren dat het noodzakelijk is om continu bewust te zijn van onvoorzienbare situaties, en om zo continu leren te verzekeren van gebeurtenissen die zich telkens opnieuw in net iets andere gedaantes ontvouwen. Het toepassen van deze inzichten kan bij leden van innovatie-teams het opmerken van zwakke signalen over fouten ondersteunen, en defensief, risicomijdend gedrag onderdrukken, zodat uiteindelijk de kans op innovatiesucces wordt vergroot.

De hoofdconclusie van deze studie is dat mindful infrastructuur en Team IRB inderdaad concepten zijn die toepasbaar zijn op innovatiemanagement en projectteams die werken aan innovaties. Innovatieteams die zulke inzichten toepassen lijken minder defensief te zijn en rapporteren vaker positieve projectuitkomsten. Terwijl deze inzichten informatief zijn voor het domein van innovatiemanagement, voegen de resultaten ook kennis toe aan het domein van veiligheids- en crisismanagement, in de bevinding dat mindful infrastructuren bestaan uit de elementen team psychologische veiligheid, team leergedrag, teaminspraak en complexiteitsleiderschap. Dit zijn bouwstenen voor de HRO-principes die reeds worden toegepast.

Aanbevelingen om Resilient Innovation Teams (veerkrachtige innovatie-teams) te ontwikkelen, zijn geformuleerd in het hoofdstuk over praktische implicaties, de zogeheten valorisatie. Het onderzoek suggereert dat mindful infrastructuur - die transparantie en vertrouwen ondersteunt - het teams mogelijk maakt om Team IRB te vertonen en minder defensief te zijn, en dat mindful infrastructuur en Team IRB helpen om complexe issues en onzekerheden bespreekbaar te maken. In plaats van risicomijdend te worden, lossen zulke teams projectrisico's en kritieke incidenten op met een open vizier en op een effectieve wijze. Sommige projectleiders hanteren een onderzoeksgedreven manier om kritieke incidenten op te lossen, gekenmerkt door openheid en het valideren van oplossingen, waardoor defensieve routines overwonnen worden. Sommige projectteams, vooral die zijn ingebed in R&D organisaties, zijn beter in het voorkomen en minimaliseren van kritieke incidenten dan andere teams. HRO-teams zijn zelfs beter in het minimaliseren van incidenten en ongelukken, hetgeen impliceert dat er voor innovatieteams nog steeds veel te winnen valt in dit opzicht. Het Resilient Innovation Team is in staat om proactief om te gaan met onverwachte, soms kritieke gebeurtenissen, waardoor het project kan voortgaan zonder een significatie onderbreking. Praktische richtlijnen en een tool worden aangeboden om opmerkzame werkomgevingen en Team IRB te ontwikkelen en om defensief gedrag tegen te gaan.

About the author

Peter Robert Arthur Oeij (1960) was born in Rotterdam, Netherlands. He obtained a Master of Arts in History (Maatschappijgeschiedenis) and another in Sociology (Arbeids- en Organisatiesociologie) from Erasmus University Rotterdam in 1988 and 1989, respectively. In 2005 he obtained his Master of Science in Work and Organisation Psychology from Open University of the Netherlands.

He began to study Philosophy at Leiden University in 1980, but soon realised he was not yet ready for such an abstract field of study. He was drafted into the army fulfilling his compulsory military service until 1982. From 1989 to 2001 he was employed by IVA Tilburg, Institute for Social Scientific Research of Tilburg University, and since 2001 by TNO Innovation for Life, The Netherlands Organisation for Applied Scientific Research. Peter began as a researcher of labour market issues, and the relation between such issues and education on the one hand and work organisations on the other. His work was dominated by issues at the macro and meso levels (i.e., society and industrial sectors & policy fields). At a later stage, the focus shifted to work organisation level issues, and managers and employees (micro). Topics dominating his work by that time were quality of work, organisation of work and work processes, and company policies related to employment, sickness absence and stress. This shift from macro and meso level-topics to micro level-topics reflects Peter's study profile. At first he was driven to know what people did and had done, and started to study history. Then he wanted to understand what people do in more theoretical frameworks and integrated his sociological inspirations into his study activities. When Peter sought to understand why people did what they did, he decided to study psychology. Besides intellectual drivers to complete these studies, there is a link with how his work developed over time. As previously stated, Peter commenced as a researcher. But at a certain point in his career, clients started to ask him how he looked at the research results from his studies himself. That is when he started to become a consultant to companies and an advisor to policy. His work career of societal issues to organisational and individual issues aligns with his study career.

Today Peter's sphere of professional interest is too broad to mention here, but his work is dominated by topics at the intersection of work organisation and people in organisations, or, briefly, in organising and teaming. Innovation management and team work, the topic of the thesis, is a good example. Two other topics that dominate his present work are social innovation and workplace innovation.

Peter sought to complete a dissertation for two reasons. Firstly, Peter wanted to dive into the topic of growing social and technical complexity in society, related to human behaviour of failure and defensiveness. Focussing on innovation projects and teams seemed to fit well with this endeavour, also with what TNO stands for, namely to support successful innovation. Secondly, Peter wished to undertake a project that was fully ‘my own thing’ and acquire the professional freedom that comes with doing such a dissertation that you design yourself. Peter has learned that acting as a professional requires sufficient resourcefulness, luck, perseverance, and resilience to stay on track, which are necessary conditions to work in a mindful social and professional environment.

List of publications

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Oeij, P.R.A., Dhondt, S., Gaspersz, J.B.R. & De Vroome, E.M.M. (2016). Can teams benefit from using a mindful infrastructure when defensive behaviour threatens complex innovation projects?, *International Journal of Project Organisation and Management, 8*(3), 241-258.

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Confidential reports

Of each case study confidential reports have been written for the participating companies.

Team08 (April 2014), version 1.0
Team12 (May 2014), version 1.0
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Team09 (October 2014), version 1.0
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Team11 (October 2014), version 1.0
Team01 (October 2014), version 1.0
Team05 (October 2014), version 1.0
Team06 (October 2014), version 1.0
Team07 (October 2014), version 1.0
Team16 (November 2014), version 1.0
Team15 (April 2015), version 1.0
Team04 (May 2015), version 1.0
Team17 (May 2015), version 1.0
Team18 (May 2015), version 1.0

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Organising in a mindful way is key to helping innovation teams become more resilient and thereby increases the chances of innovation success. Organising as such, called *mindful infrastructure*, implies creating the right conditions for teams to excel.

To this end, four elements are crucial. When teams are 1) feeling psychologically safe, 2) experience a learning environment, 3) have a say in decision-making, and 4) see that leadership creates synergy, the foundation is laid for resilient team behaviour. In turn, this *team innovation resilience behaviour* enables teams to successfully deal with critical incidents, which, otherwise, could lead to innovation failure.

Resilient innovation teams are extremely alert to small things that can become big problems, hate to jump to conclusions, link management goals with operational practice, value expertise stronger than rank, and can radically change course if required. This helps them keep their innovation projects on track and thus improve the chances of innovation success.

This study has sought to investigate the scientific underpinnings of mindful infrastructure and team innovation resilience behavior. In addition, it provides practical guidelines for building a Resilient Innovation Team.

Read what anonymous reviewers have to say about this work:

"The topic is quite interesting. Indeed, I think the resilience behaviour during incidents in innovation's situations is very important, for practitioners as for academics."

"…the conceptual development and the findings are really fascinating. A big progress in project management research."

"You've done a very nice job here, and your enthusiasm for the material comes clearly through in the latter parts of the paper."

"An interesting subject. Theoretically well-explored."

"…an interesting contribution as it uses a relatively original methodology (QCA) and studies some less studied topics in the innovation literature."

"The authors' serendipitous discovery of this phenomenon points to their curiosity and interest in solving a problem with a contribution to theory and with managerial application."

"…very interesting: I learnt a lot, including recognizing some behaviour at work ;-) thank you :-)."

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