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Going the extra mile: Managing individual motivation in radical innovation development

Abstract

Developing radical innovations is highly demanding because of high uncertainties which give rise to unanticipated problems and discoveries. Managing individual motivation is therefore an important component of the radical innovation capability. This study presents a theoretical model of managing individual motivation in radical innovation development. The model is tested and elaborated by investigating four incumbent companies. The findings indicate that managers may influence the initial level of individual motivation and its effect on the success in development tasks by assigning external goals and providing organizational support. These methods can be found at multiple levels: individuals, project teams, and the organization.

Keywords: Innovation management; Radical innovation; Motivation

JEL classification: O3; O31; O32

1. Introduction

Many companies seek radical innovations to find new sources of growth. Especially in highly dynamic environments, sustainable competitive advantage is often dependent on the capability to develop highly novel products and services (O'Connor, 2008; Teece et al., 1997). Radical innovation development typically requires working with new markets and technologies, which brings about high levels of uncertainty and risk (O'Connor and Rice, 2013). Incumbent companies tend to excel at managing for efficiency and risk avoidance but at the same time perform poorly in contexts of high uncertainty. To create the capability to develop radical innovations, companies

need to undergo changes at the levels of strategy, structures, processes, culture, and leadership (Slater et al., 2014).

The development of incremental innovations can be fairly well governed with explicitly defined procedures in a top-down fashion but in radical innovation development these are of little use (Alexander and van Knippenberg, 2014; McCarthy et al., 2006). Instead, radical innovation is highly reliant on the initiative of individuals (Benner and Tushman, 2003; Day, 1994; Leifer et al., 2000) and successful breakthroughs can often be traced back to the workings of highly-driven developers with exceptional commitment (Chakrabarti, 1974; Ettlie et al., 1984; Reid and de Brentani, 2004).

Radical innovation processes include many unanticipated challenges, which makes them very demanding for the employees. Developers need to deal with unexpected obstacles, absorb diverse knowledge from many sources, and propose creative solutions (Day, 1994). Maintaining employees' motivation towards radical innovation has therefore been identified a significant challenge in large, established companies (Kelley et al., 2011; O'Connor and McDermott, 2004; Stringer, 2000). There is, however, a lack of research which addresses the motivational issues in radical innovation development (Alexander and van Knippenberg, 2014; Poskela and Martinsuo, 2009). This study sets out to investigate how managers may motivate individuals towards radical innovation work.

Drawing on the literature on work motivation and radical innovation, a theoretical model of individual motivation in radical innovation development is developed. In the empirical part of the study, the model is tested by investigating four large firms that are developing radical innovations. Furthermore, the study reports on how the case companies have approached motivational issues in practice. Finally, the significance of the findings, the limitations, and the implications for further research are discussed.

2. Theoretical background

2.1 Radical innovation capability

Successful large firms have typically developed a few strong organizational capabilities with which they can sustain a leadership position over time (Dosi et al., 2000; Prahalad and Hamel, 1990). The capabilities rarely stay completely static. Instead, they are improved along predictable development paths by the means of incremental innovation. To support incremental innovation, firms may build codified processes and complex sets of routines to create organizational memory and improve predictability and diagnosis in case of errors (O'Connor, 2008).

Radical innovations are here defined as products, services, or processes which encompass novel technologies or require new market structures and which have the potential to create paradigm shifts at world, market or industry level. They therefore cover the categories of radical innovation and really new innovation as proposed by Garcia and Calantone (2002). In contrast to incremental innovations, radical innovations typically encompass novel features with substantial business potential or significant performance effects compared to existing products, services, and processes (Leifer et al., 2000). They have been found to entail great financial rewards (Kyriakopoulos et al., 2016; Rubera and Kirca, 2012), and provide competitive advantages for the developing firm (Christensen, 1997; Hill and Rothaermel, 2003) and significant benefits for its customers (Sorescu et al., 2003). They are also often disruptive in that they undermine existing products and competences and disturb consumer habits (Christensen, 1997; Markides, 2006). Radical innovations have, however, been proved difficult to develop. Incumbent firms often find themselves unable to introduce anything other than incremental improvements to their existing offering (Henderson, 1993; Stringer, 2000). As a result, a large part of radical innovations originate in a small set of firms (Sorescu et al., 2003).

The inability to develop radical innovations has been explained in several ways. Radical innovations often include new technologies and aim for new markets, which makes their development process highly uncertain (Garcia and Calantone, 2002; O'Connor and Rice, 2013). They may also require new business models, as existing value chains may not be applicable (Eisenhardt and Martin, 2000; O'Connor, 2008). Hence, developing radical innovations requires

different routines and structures to incremental innovation (Barczak et al., 2009; Leifer et al., 2000; Phene et al., 2006). The organizational routines of many firms do not support the exploration of new opportunities, which restricts them to predetermined development paths (Bessant et al., 2010; Koberg et al., 2003; Lynn et al., 1996). They may also lack suitably skilled employees (Stringer, 2000) or have an exploitation-oriented organizational culture (McLaughlin et al., 2008). Also, radical innovations are dependent on the availability of new knowledge (Maillat, 1991) and established routines may be organized around a limited set of external partners which may limit companies in their use of external knowledge sources in developing innovations (Birkinshaw et al., 2007).

Extant studies have investigated the antecedents of radical innovation capability. A structural separation of radical and incremental innovation activities has been proposed to reduce tensions between their often conflicting aims, leading to better performance in both respects (Chandy and Tellis, 2000; Herrmann et al., 2007; O'Connor, 2008; O'Connor and DeMartino, 2006; O'Reilly and Tushman, 2008; Slater et al., 2014). Forming new networks and utilizing weak links to gain access to multiple knowledge bases has been suggested in order to increase radical innovation success (Bessant, 2008; Birkinshaw et al., 2007; Phillips et al., 2006; Schoenmakers and Duysters, 2010). Also, routines for rapid experimentation with new opportunities (Koberg et al., 2003; Lynn et al., 1996) and working with users (Abrell et al., 2016) and customers (Gassmann et al., 2006) have been proposed to improve radical innovation outcomes.

2.2 Individuals in radical innovation development

Whereas incremental innovations typically originate top-down from strategy planning processes (Koen et al., 2005; Reid and de Brentani, 2004) or from interactions between a company and its customers (Leifer et al., 2000), radical ideas come from the opposite direction; ideas are typically generated by individuals, developed by teams, and do not reach the organizational level until the decision of whether to start a development project is to be made (Reid and de Brentani, 2004). Skilled employees are needed to locate and interpret knowledge from multiple sources, make decisions with limited understanding of both the problem and its solution, as well as proactively propose creative ideas (Day, 1994). Working in such an environment demands a lot of the developers. They need to endure ambiguity, have a high tolerance for failure, work with open-

ended operating routines, and know their way across functions and knowledge bases (Bessant et al., 2005).

Due to the limited effectiveness of rigid process management methods (Benner and Tushman, 2003; O'Connor, 2008), many authors argue that the employees should be trusted and given the freedom to experiment and discover breakthroughs without much managerial control (Hill and Rothaermel, 2003; Koen et al., 2005; McGrath, 2001; Poskela and Martinsuo, 2009). In fact, individuals working with radical innovation are widely characterized as independent and highly motivated and thus suitable for self-directed work (Assink, 2006; Kelley et al., 2011; O'Connor and DeMartino, 2006). However, although empowering individuals to renew the company may lead to radical developments, it may be difficult to define the boundaries of their freedoms and responsibilities (Leonard-Barton, 1992). Furthermore, the high levels of individual motivation are often taken as granted and little is known about managerial actions to influence them (Poskela and Martinsuo, 2009).

O'Connor and McDermott (2004) report that many key radical innovation team members have resigned from their jobs because of a lack of recognition, jealousy from the rest of the organization, or the organization's bureaucratic mindset. Other studies have mentioned unsuitable reward systems (Burgelman, 1985; Leifer et al., 2001) and lack of tolerance of failure (Aagaard and Gertsen, 2011; Alexander and van Knippenberg, 2014; Bessant et al., 2005) as reasons for decreased motivation. Moreover, radical innovation development often requires sourcing knowledge from external sources, such as customers, suppliers, and research organizations (Pilav-Vecic & Marjanovic 2016; Zang et al. 2014; Cheng & Shiu 2015). Sometimes it is also beneficial to seek collaborative arrangements in commercializing new technologies (Inauer & Schenker-Wicki 2012). Adopting such open innovation practices can, however, be inhibited by negative individual attitudes (de Araújo Burchart et al. 2014; Lichtenthaler & Ernst 2006). Therefore it is important to find out how managers can enhance and maintain the motivation of employees engaged in radical innovation development (Kelley et al., 2011). For these reasons, there is a need for more understanding of the relationships between employee motivation and managerial methods in the context of radical innovation (Poskela and Martinsuo, 2009).

2.3 Theoretical model for individual motivation in radical innovation development

Radical innovation development is a goal-oriented process in which performance is dependent on individual learning and motivation (Alexander and van Knippenberg, 2014). Motivation for radical innovation development here refers to factors which impel action and may affect the acquisition and use of an individual's skills and abilities (Locke and Latham, 2004) to conduct job tasks which promote radical innovation performance, such as idea generation, concept development, and overcoming organizational barriers. Drawing on goal-setting theory (Locke and Latham, 1990) and social cognitive theory (Bandura, 1997), this study proposes a model for examining the determinants of motivation in radical innovation (see Figure 1).

According to Locke (2001), the most immediate motivational determinants of action are personal goals and self-efficacy, which comprise the so-called *motivational hub*. Personal goals encompass the interest and appreciation towards work tasks. They concern the issue of, "Do I want to do this?" Self-efficacy, on the other hand, refers to the employees' beliefs in their capabilities of successfully reaching desired goals, that is, "Can I do this?" (Bandura, 1997).

Personal goals drive action in two ways. First, reaching goals provides self-satisfaction and increases interest in the work (Wood and Bandura, 1989). Second, a mismatch between the goals and current performance creates dissatisfaction, which motivates corrective actions (Bandura, 1977). Specific goals may be set based on how enjoyable working towards them is, what the costs of engaging in related activities are, whether reaching the goals provides rewards or facilitates the reaching of other goals, and whether they support an individual's self-image (Eccles, 2005).

Self-efficacy is a key concept in social cognitive theory which emphasizes the role of individual cognition in motivational issues (Bandura, 1977). It reflects to what extent employees believe they can produce desired results and prevent detrimental ones (Bandura, 2001). Self-efficacy impacts how much effort employees will expend and how well they endure obstacles and setbacks (Bandura, 1982). As a result, people with high self-efficacy are more likely to develop effective task strategies to reach their goals (Locke and Latham, 2002). Self-efficacy is critical in reaching organizational goals since externally set incentives are not effective unless people believe they have the ability to take the actions to reach them (Bandura, 1986; Locke, 2001). Self-efficacy

beliefs are improved by experiences of successfully overcoming obstacles, by observing others succeed by perseverant effort, by social persuasion and by reducing general anxiety and depression (Bandura, 2012).

The motivational hub affects individual performance in four ways (Locke and Latham, 2002). First, it directs attention towards relevant activities. Second, it determines the amount of effort an individual is willing to invest in reaching goals. Third, it influences persistence, that is, how long an individual maintains effort when working on a task. Finally, it facilitates the search and use of task-specific knowledge and strategies. Via these mechanisms, personal goals and self-efficacy mediate the effect of the organization's goals and success in radical innovation development tasks. Individual success in these tasks is an important antecedent of project level outcomes (Alexander and van Knippenberg, 2014; O'Connor and McDermott, 2004) and ultimately of a firm's performance (Sorescu et al., 2003).

[INSERT FIGURE 1 ABOUT HERE]

Next, propositions are formulated concerning 1) the effects of external goals on the motivational hub and 2) aspects of organizational support which moderate the effects of the motivational hub on the success of radical innovation development tasks. The propositions address the phenomenon at three levels: individuals, project teams, and the organization (Figure 1). Examining the antecedents and moderators of individual motivation at multiple levels of analysis provides a richer understanding compared to studies which are confined to a single level (Hitt et al., 2007).

2.3.1 Goal assignment

Assigning goals to employees is a method to direct them to productive tasks. Assigned goals typically correlate with personal goals but sometimes there may be discrepancies if the employees are not committed to managerial visions (Locke, 2001). Different kinds of goals may have varying effects on individual motivation (Locke et al., 1981). Difficult goals may encourage employees to higher levels of effort and performance (Hollenbeck et al., 1989; Locke and Latham, 1990) and have been associated with increased creativity (Amabile et al., 1996; Shalley et al., 2000) and psychological meaningfulness (Kahn, 1990) as they may be perceived as expressions of confidence (Locke, 2001) and hence encourage employees to surpass themselves (Hollenbeck et al., 1989;

Locke and Latham, 1990). Radical innovations are in general considered very challenging to develop (O'Connor, 2008). However, setting too demanding goals may reduce the developers' beliefs in their ability to reach the goals, which might lead to organizational misbehaviour and reduced performance (Vardi and Wiener, 1996). Setting the level of individual goals may thus necessitate a balance between too easy and too challenging goals.

Proposition 1: Moderately challenging goals relative to individual skills and abilities increase individual motivation for radical innovation.

Due to inherent uncertainty in radical innovation development, project outcomes cannot be fully predicted and the development trajectories are likely to change in response to unanticipated discoveries (Leifer et al., 2000). Too specific goals may hinder learning and the discovery of novel concepts (McLaughlin et al., 2008). On the other hand, employees are reported to be more motivated when they have clear goals (Halachmi and van der Krogt, 2005). If employees do not know what they should do, it is impossible to evaluate whether they have the abilities to do so (Bandura, 1997). Thus self-efficacy seems to benefit from a moderate level of specificity in goal setting.

Proposition 2: A moderate level of specificity in project goals increases individual motivation for radical innovation.

Organizations rarely aim exclusively for radical innovations. Instead, they try to be ambidextrous, that is, try to reach exploratory and exploitative goals at the same time (Tushman and O'Reilly, 1996). These goals are often conflicting, which may reduce the effectiveness of both of them (Austin and Vancouver, 1996; Reichers, 1986). Goal conflict is a prevalent problem in radical innovation development (Andriopoulos and Lewis, 2009). It can be a very stressful state for employees as they may be torn regarding where to direct their energies and loyalties (Reichers, 1986). This may lead to reduced commitment and even to leaving the company (O'Connor and McDermott, 2004; Reichers, 1985).

Proposition 3: Conflicting goals decrease individual motivation for radical innovation.

2.3.2 Organizational support

Another way to influence employee motivation is to support them in reaching their goals. Organizational support refers to how much the organization values its employees' contributions, rewards increased work effort, provides aid to help carry out job tasks, and meets the employees' socioemotional needs (Rhoades and Eisenberger, 2002). Perceptions of organizational support are strengthened by fairness in resource distribution, supervisor support, rewards, and job conditions (Rhoades and Eisenberger, 2002).

In radical innovation development, managers tend to rely on sponsorship and empowerment of their employees instead of control (Kelley et al., 2011). Especially the early stages of radical innovation are characterized as *fuzzy* — i.e. chaotic, unpredictable, and unstructured (Koen et al., 2005). Managers who have experience of multiple successful radical innovation projects are often valuable in defining the right problems, finding solutions, and negotiating organizational politics to cross the bridge from a solution to implementation (Griffin et al., 2012; Vojak et al., 2012). Executive innovation champions are managers who are intensely interested in new ideas and willing to foster, nurture, and promote them through critical stages (Chakrabarti, 1974; Howell and Higgins, 1990). Such champions may motivate employees by demonstrating enthusiasm and belief in them and by reducing organizational barriers which hinder the development process (Gemünden et al., 2007). Many of these barriers are specific to radical innovation (Assink, 2006), which is why champions are found to be particularly important in this context (Gemünden et al., 2007; Kelley et al., 2011).

Proposition 4: The involvement of experienced and skilled executive innovation champions increases individual motivation for radical innovation.

Experiences of success are one of the key mechanisms for improving self-efficacy (Bandura, 1977; Locke, 2001; Wood and Bandura, 1989). The high failure rates of radical innovation projects (Aagaard and Gertsen, 2011; Bessant et al., 2005; Deszca et al., 1999) therefore make maintaining high levels of motivation difficult (Alexander and van Knippenberg, 2014). Radical innovation projects tend to take longer than incremental ones (Leifer et al., 2000) and long-term goals are likely to be too distant to be effective motivators (Wood and Bandura, 1989). Extant literature has

acknowledged the value of iterative processes in providing frequent feedback in radical innovation projects (Lynn et al., 1996; McGrath, 2001). As the employees successfully complete learning cycles, they become aware of their progress. This indicates that they are capable of approaching their ultimate goals (Schunk, 1989). Perceived learning progress is therefore important in maintaining motivation over long time periods (Schunk, 2012). Breaking the development process up into smaller cycles may provide opportunities for experiences of success and have positive motivational effects.

Proposition 5: Breaking radical innovation projects into smaller sub-goals increases individual motivation for radical innovation.

Employees' self-efficacy beliefs are not only dependent on how they perceive themselves but also how they perceive the means and resources at their disposal. If radical innovation projects need to compete for resources with incremental innovation projects, they are at risk of ending up under-resourced (Chang et al., 2012; O'Connor and DeMartino, 2006). As radical projects typically have many technological and market uncertainties, idea evaluation and testing takes much longer than in moderate-to-low risk projects (Cooper, 2008). Therefore, they are more likely to be hindered by the lack of resources. Insufficient resources may diminish the employees' beliefs in their capability to successfully carry out radical innovation projects.

Proposition 6: Providing sufficient resources for radical innovation projects increases individual motivation for radical innovation.

Radical innovation has also been found to create requirements for project team composition. The teams need to have broad experience and familiarity with different technologies and markets (McDermott and O'Connor, 2002). Variety in perspectives and knowledge bases facilitates problem solving (Frishammar et al., 2016), decision-making and analysis (Altman and Haythorn, 1967), and eventually radical innovation outcomes (Miron-Spektor et al., 2011) by enabling lateral thinking (McLaughlin et al., 2008). Cross-functional team composition may help reduce uncertainties associated with radical innovation (Govindarajan and Trimble, 2005). Belonging to a project team with diverse means to approach complex problems may hence increase the individuals' belief in their ability to reach project goals.

Proposition 7: A project team composition with a variety of perspectives and expertise increases individual motivation for radical innovation.

Detailed management systems have been reported to lead to employee frustration, as the employees feel that formal procedures reduce the organization's openness to innovation (Green and Cluley, 2014). Stage-gate systems, for example, may require laborious effort to prepare plans and paperwork at each gate (Cooper, 2008). Not only may these efforts be burdensome but they may also be inherently unsuitable for projects of high uncertainty (Bessant et al., 2010). Bureaucratic management systems may thus contribute to inertia and inhibit riskier ventures (Hill and Rothaermel, 2003). This may result in reduced creativity and innovativeness, risk aversion, and negative attitudes among employees (Assink, 2006; Poskela and Martinsuo, 2009).

Proposition 8: Bureaucracy decreases individual motivation for radical innovation.

Organizational culture — that is the pattern of shared concepts, values, and beliefs (Schein, 2010) — can significantly influence individual attitudes towards radical innovation development (O'Connor and Ayers, 2005; Slater et al., 2014). O'Connor (2008) suggests that to support radical innovation, a blame-free culture needs to be established which does not only tolerate but actively promotes risk taking (Herrmann et al., 2007; Kyriakopoulos et al., 2016). Low motivation due to career risks is likely if failures are not tolerated (O'Connor and McDermott, 2004). If employees feel unsafe in their jobs, they are likely to take fewer risks and perform worse (Kahn, 1990; Rich et al., 2010). Organizational culture should therefore allow individuals to try their ideas without sacrificing their career (Koen et al., 2005).

Proposition 9: An organizational culture which promotes risk-taking and tolerates failure increases individual motivation for radical innovation.

Organizational culture should also incorporate views of radical innovation as a key caretaker of the firm's future health (O'Connor, 2008). The culture should incorporate long-term orientation and emphasize learning (Herrmann et al., 2007) and the acceptance of new ideas (Green and Cluley, 2014). Radical innovation developers are more likely to experience purposefulness and consider their job meaningful (Martins and Terblanche, 2003) in companies which encourage curiosity-driven behaviour (Bessant et al., 2005) and thinking beyond what currently exists

(McLaughlin et al., 2008). If radical innovation is poorly valued as a strategic priority, the developers are deprived from potential social image gains from doing their jobs well, which may reduce their interest in putting in a lot of effort (Yuan and Woodman, 2010).

Proposition 10: A positive organization-wide view of radical innovation increases individual motivation for radical innovation.

Rewarding employees for increased effort is a common way to increase their interest towards specific tasks (Amabile et al., 1996; Locke, 2001). Managers may direct employees towards relevant directions by reinforcing the kind of behaviour they expect (Alexander and van Knippenberg, 2014). Recent empirical results suggest that the importance of rewards is especially high with radical projects (Sergeeva, 2015). Often in the case of radical projects there is, however, a mismatch between risks and rewards (O'Connor and McDermott, 2004), in that the reward systems favour the status quo (Birkinshaw et al., 2007). If bonuses are dependent on project success, uncertain projects become less attractive and generate risk-averse behaviours (Atuahene-Gima, 2005; Cabrales et al., 2008). The design of suitable reward systems thus becomes a key issue for radical innovation (Leifer et al., 2001).

Proposition 11: Rewarding developers for succeeding in radical innovation development tasks increases individual motivation for radical innovation.

3. Research design

In the empirical part of the study, four case companies are investigated. The cases are used, first of all, to test the research model developed in the previous section by examining empirical support for the propositions in the model. Furthermore, the theory is elaborated by investigating managerial approaches that the companies have adopted to increase individual motivation for radical innovation. This enriches the theoretical contribution and helps formulate implications for managers.

Case studies are often thought to be poorly suited for the testing of propositions (Johnston et al., 1999). This view is, however, arguably limited and has been characterized as a widespread misunderstanding (Flyvbjerg, 2006). Case study methodology is widely in use in theory testing in

many social sciences (Bryman, 1988) and its value has been recently acknowledged also in management research (Ketokivi and Choi, 2014). Case studies have been argued to be even better suited for testing causal relationships than surveys (Johnston et al., 1999). In studies such as the present one, in which the propositions are grounded on a specific context, case studies have certain strengths (Ketokivi and Choi, 2014). First, as the propositions are formed based on general motivation theories as well as situationally-grounded theory on radical innovation, the study may incorporate idiosyncrasies arising from the context while establishing a sense of generality. Second, the approach allows data collection specifically on the context in question. Third, while the study is driven by deductive theory-testing, it is not limited to it, and the rich data allows the inclusion of inductive elements when analysing the data and presenting conclusions.

3.1 Data collection

The case companies were selected on the basis of theoretical sampling. In theoretical sampling, cases are selected because they are suitable for illuminating and extending relationships and logic among constructs, for example, by revealing unusual phenomena, replicating findings from other cases, contrary replication, elimination of alternative explanations, and elaboration of the emergent theory (Eisenhardt and Graebner, 2007). Multiple cases are investigated to generate more accurate and generalizable results as the cases complement each other in providing a more detailed picture of the studied phenomenon (Eisenhardt, 1989; Eisenhardt and Graebner, 2007; Yin, 2009).

To be selected for the case study, the companies needed to have radical innovation activities and an interest in pursuing radical innovation. The companies were required to have ongoing innovation projects which were believed to have the potential to induce discontinuous changes at the macro level, that is, result in technological leaps and/or a new market infrastructure at the world, market, or industry level (Garcia and Calantone, 2002). Fulfilment of this criterion was evaluated in each organization, based on conversations with a senior R&D manager with a good overview of the organization's innovative activities. While radical innovation projects are not always easy to identify, they are typically associated with high levels of uncertainty in multiple dimensions (O'Connor, 2008; O'Connor and Rice, 2013), which was emphasized during the conversations. All organizations were incumbent companies of a reasonable size ranging from 3 000 to 20 000 employees. Company size is considered to provide robust findings that are

applicable to a specific domain (Yin, 2009). The companies were chosen from different industries and with different emphasis and experience in developing radical innovations to identify contrasting patterns in data within the general context.

Interviewees were selected in two ways. First, a senior R&D manager was asked to suggest interviewees from different levels of the hierarchy. These interviewees included radical innovation project team members and project leaders who possessed first-hand experience of motivational issues in radical innovation development work. Also managers from higher hierarchy levels were included because of their good understanding of the managerial methods in use and the state of radical innovation in the organization. Second, a recent radical innovation project was identified in each company and several employees working with the project were interviewed. In all organizations, these two samples overlapped to some extent. These selection criteria resulted in 7 to 18 interviewees from each organization with titles such as R&D manager, specialist, R&D director, technology manager, technology director, and new business development manager.

The interviewees were asked open-ended questions about their work related to radical innovations and managerial actions and policies in their organization. Open-ended questions are suitable when aiming to access the perspective of the interviewed person (Qu and Dumay, 2011). The aim was to indirectly acquire knowledge about their attitudes towards and evaluations of radical innovation and associated tasks, how radical innovation is managed in the organization, and how they perceive related managerial actions. Also, the company strategy was discussed to acquire an understanding of the role of radical innovation in each organization. Interviewees associated with the projects were asked to describe the development process of the project, its challenges and successes, how the work environment and managerial actions influenced the project, and how the project compares to other radical and incremental innovation projects in the organization. Investigating a recent project has the benefit of acquiring understanding about the respondents' experiences of concrete events from cognitive, affective, and behavioural viewpoints (Gremier, 2004). The interviews lasted typically between 1 and 1.5 hours. All interviews were recorded and transcribed verbatim in order to establish a chain of evidence and strengthen the validity of the results (Yin, 2003). At least two researchers took part in the interviews to increase the reliability of the study (Yin, 2003).

3.2 Analysis

Data analysis started with a within-case analysis (Eisenhardt, 1989), in which the interview transcripts were read multiple times for the purpose of becoming familiar with each organization. Details of the management systems of the organizations and the employees' perceptions were written down. After this, relevant passages of the data were coded with the Atlas.ti program. A passage is here defined as the entire segment of speech until the interviewer asks the next question. Coding was based on the elements of the research model introduced above. The codes were compared to data to check their consistency and ensure internal validity. The frequencies of the codes are reported in Table 3. While the frequencies do not necessarily imply relative importance (Bazeley, 2006), they reflect which issues the interviewees wanted to raise during the conversations.

This study focuses on the proposed causal links between different elements of the research model. The analysis was conducted by qualitative pattern matching between theory and data (Yin, 2003). Support for the propositions was evaluated by examining the coded transcripts and seeking instances where the informants explicitly or implicitly suggest links between the elements of the model. The element "Success in RI development tasks" was measured based on comments which addressed the outcomes of the developers' actions. The comments were typically about explaining how the developers succeeded or failed in advancing radical innovation projects, distinct project phases (e.g. idea generation), or the company's overall radical innovation performance. Since the financial benefits of radical innovation projects may take years to realise and the projects themselves may take a long time, the measure is largely based on the informants' perceptions of their learning progress. It therefore includes not only assessments of reaching outcome and performance targets but also of learning: e.g. success in finding relevant knowledge and suitable task strategies.

The model is elaborated by the reporting of managerial methods that the informants consider promote motivation for radical innovation development. The identification of such concrete methods enriches the model by 1) increasing its practical relevance by relating its elements to concrete managerial actions and 2) allowing the establishment of further linkages to existing management theory.

3.3 Case descriptions

The study data was collected from four European companies: Steel Inc., Forestry Inc., Process Inc., and Broadcasting Inc. The names of the companies are anonymized because of reasons of privacy. Characteristics of the companies are presented in Table 1. Short descriptions of each company follow below.

Steel Inc. is a multinational steel company. Its main innovation focus has, for a long period, been on the incremental improvement of existing products. In the early 2000s, Steel Inc. developed a radical process innovation which led to significant renewal of the company's offering. Many of its current innovation projects still focus on developing new applications based on the past breakthrough. Demand for Steel Inc.'s products is relatively steady and there is no urgent need for new breakthroughs. Nevertheless, the company has several ongoing radical innovation projects, although limitedly resourced. Steel Inc. does not have a separate organizational unit for radical innovation projects. However, occasionally some projects may be separated from the business units and provided supervision and resources directly by the executive team.

Forestry Inc. produces wood based products and materials. Its main emphasis is on paper products but it also has business in fields such as bioenergy and biocomposites. Because of the global downturn in paper demand, Forestry Inc. is experiencing a burning platform situation where it has to find new sources of growth. Therefore, radical innovation has become a key strategic goal. Forestry Inc. has established an organizational unit which pursues radical innovations independently of the goals of existing business divisions.

[INSERT TABLE 1 ABOUT HERE]

Process Inc. provides process and automation technologies and services for industrial customers that operate in industries such as chemical, oil, pulp and paper, power generation and mining. Process Inc. is adapting to increased competition by cutting costs and focusing on efficiency. There are a few ongoing radical innovation projects which aim to provide new-to-the-industry products and components but the focus of R&D is mostly on updating the existing offering. In the past, Process Inc. has had a separate organizational unit for radical innovation but it was shut down

several years ago as a cost cutting measure. Currently, radical innovation projects are implemented within business units similarly to other innovation projects.

Broadcasting Inc. provides television, radio, and digital media services. Rapid changes in media use, together with swift progress in related technologies, have led Broadcasting Inc. to renew its offering in significant ways. Recently, Broadcasting Inc. has established an organizational unit responsible for radical innovation to limit the influence of day-to-day business on the development of high-impact innovations. Moreover, its emphasis has moved towards open innovation where outside experts are actively used to complement internal capabilities.

4. Findings

This section presents the key empirical findings of the study. First, the existence and nature of the motivational hub is investigated to validate the mediating effects of individual motivation on the success of radical innovation development tasks. Then support for the 11 propositions concerning the antecedents and moderators of the model are evaluated.

4.1 Motivational hub

The constituents of the motivational hub — self-efficacy and personal goals — were clearly identifiable from the data. High self-efficacy was evident in comments such as, “I don’t think there’s another factory in the world where researchers are able to experiment like this. From top to bottom, the whole organization really believes in this.” Conversely, low self-efficacy is observable in sentences such as, “I might be a bit pessimistic, but I just don’t believe that the idea will stay alive for long.” The following quote is an example of high personal goals in the context of radical innovation development: “We have to be forerunners and we have to figure out how to use these new technologies.” On the other hand, low level of personal goals can be detected from a comment by an experienced R&D manager: “Last spring I realized that I have been spending too much time and effort on this. OK, it’s fun, but then I considered how the company acknowledges it. In practice, it doesn’t.”

The model proposes that personal goals and self-efficacy influence radical innovation performance through four mechanisms: direction, effort, persistence, and task strategies. All of these

mechanisms were found to be relevant based on the data. Table 2 collects representative quotations which illustrate how the motivational hub influences the success of radical innovation development tasks. Direction is important, as developing radical innovations was considered to have inherently different targets than developing incremental innovations. Often there is considerable pressure to address short-term goals at the expense of radical projects. Developing radical innovations was also widely thought to be especially demanding and to require additional effort from the developers. The informants emphasized that radical innovation projects are often so challenging that it is necessary to push hard and put in extra hours to succeed.

In addition to the intensity of the effort, the interviewees suggested that it needs to be maintained over long periods of time. Radical projects were reported to be longer than incremental ones and to include more obstacles and setbacks, which may be detrimental for motivation. Interestingly, persistence was less often mentioned by the informants at Broadcasting Inc., which may reflect the broadcasting industry's shorter development cycles. Innovation in the industry is increasingly software-based, which allows rapid experimentations which exceed the pace of the other studied industries. Finally, because of the high uncertainties, finding the best task strategies was thought to be very challenging. A high level of motivation was considered to be beneficial for finding the best strategies for resolving issues that arise during the development process.

[INSERT TABLE 2 ABOUT HERE]

4.2 Support for the propositions

Strong empirical support for the propositions was observed across the cases (Table 4). Almost all propositions were observed in every company, with proposition 11 as an exception. While the majority of support for the propositions was direct, indirect support was also observed — in some instances both were present in the same company. No instances were found where the data would contradict the propositions. Representative quotations which illustrate direct and indirect support for the propositions are collected in Table 5.

[INSERT TABLES 3 AND 4 ABOUT HERE]

Proposition 1. There was a wide agreement among the interviewees across the companies that radical innovation development requires specific characteristics from the employees, such as creativity, a long-term perspective, an intrinsic interest in development tasks, low self-restraint, emotionality, broadmindedness, and the ability to think outside the box. These characteristics are bound to be scarce. In general, the development tasks in radical innovation projects were considered highly challenging and the informants described several instances where the developers were not capable of carrying them out, leading to frustration. Finding ways to match individual goal difficulty with each employee's abilities must therefore be understood as an important managerial task for maintaining motivation for engaging in development tasks.

Proposition 2. Balancing between clarity and ambiguity in defining project level goals was found to be an interesting dilemma. Too specific goals were considered to reduce the employees' abilities to explore novel approaches and limit them in predefined directions. Too ambiguous goals, on the other hand, were found to make it difficult for the employees to direct their efforts towards promoting breakthroughs. In these cases, radical innovations were viewed as desirable but there was a lack of vision regarding what they could be about. As a result, employees might propose radical ideas to the managers but get rejected with arguments such as, "Good idea, but this is not our business." Forestry Inc. solved the tension between goal clarity and ambiguity by setting several strategic goals to guide radical projects. The goals, described as opportunity fields, are defined based on the company's growth strategy and synergies with current businesses and capabilities. They are simultaneously abstract enough to allow experimentation but specific enough to guide development projects and be of use in decision making. In Broadcasting Inc., the new organizational unit is responsible for proposing long-term visions and goals for the executive team and other functions.

Proposition 3. Managing goal conflicts was considered an inherent part of developing radical innovations. Forestry Inc., Broadcasting Inc., and Steel Inc. have structurally separated radical and incremental development activities, either by establishing separate organizational units or independent project teams for radical innovation projects. With such arrangements, motivation towards radical innovation may increase as personal goals are not challenged by conflicting external goals. A director at Forestry Inc. commented that, "Without this kind of unit, our mind-set would be much more linked to the current businesses." Interestingly, in Broadcasting Inc., after

the formation of the radical innovation unit, the employees had to be pushed to adopt new goals, as they had difficulties letting go of the priorities that were dominant elsewhere in the organization.

[INSERT TABLE 5 ABOUT HERE]

Proposition 4. Experienced executive champions were widely thought to be important enablers of radical innovation. They both increased the enthusiasm of the developers by encouraging them and facilitated the development process by leveraging their resources, capabilities, and position in the organization. Champions were identified at different hierarchical levels. Project leaders have direct contact with the developers and are able to support them in their daily tasks. Champions higher in the hierarchy, on the other hand, are able to keep radical innovation on the company's strategic agenda and ensure wider organizational support for the projects.

Proposition 5. Many interviewees mentioned that maintaining enthusiasm and a good spirit is challenging since radical innovation processes are full of disappointments. Interestingly, the majority of the case organizations have adjusted their innovation processes in ways that pay more attention to successes. Broadcasting Inc., Forestry Inc., and Process Inc. have adopted iterative innovation processes for radical projects. These processes include setting short-term development goals that are feasible to reach. After seeing concrete results in the form of a functioning pilot or a prototype, the developers are likely to become convinced of their ability to finish the project.

Proposition 6. The lack of resources was found to influence motivation in two ways. First, it may limit the actions the employees are able to take. A radical innovation project team member at Broadcasting Inc. illustrated this issue: "Because of my role, I have not been able to put as much effort into the project as I would have wanted. There are simply not enough hours in a day." Second, their efforts might not make a difference because of a lack of resources in other parts of the organization. An example of this was found at Steel Inc., where an R&D manager reported that radical ideas often go to a steering group meeting for a go/no-go decision too early while there are still lots of unresolved issues. As a result, radical ideas are usually rejected because they are considered too immature. His colleague working as an application manager described the issue from another viewpoint: "Cultivating the ideas is the responsibility of just a few employees. When the same people have to take care of patent monitoring and day-to-day project work, it is a real

juggling act.” The lack of resources leads to the experience that the efforts of the developers are in vain. This issue reflects the differences in resource requirements that radical innovation projects may have compared to conventional development projects. To ensure resources for radical innovation, Forestry Inc. and recently also Broadcasting Inc. have separated the development processes and the resourcing of radical and incremental innovation projects. Process Inc., on the other hand, has adopted a portfolio management approach, where a certain share of resources is allocated to radical innovation projects. At Steel Inc., radical innovation projects are sometimes given the status of a strategic project and transferred under the direct governance of the executive team.

Proposition 7. Team composition was observed to have similar motivational role as resources. Cross-functional teams with diverse expertise were considered an important factor in reaching the project goals. Resolving the uncertainties in radical innovation projects was thought to require diversity in expertise and personalities on the basis that broader backgrounds enable a wider range of problem solving approaches. In all of the companies, radical innovation teams had more diversity than incremental innovation teams. At Steel Inc., radical concepts are developed by two-member teams where one person is older with lots of experience and the other younger and often more enthusiastic. Their complementary attributes make reaching the goals easier, while the age difference reduces internal competition. Managers at Forestry Inc. emphasized that the same people who perform well during the early stages of the radical innovation process might not be the best choices for the later stages. Therefore, the team composition should be adjusted according to the requirements of each process stage.

Proposition 8. There was a wide consensus that the formal innovation processes in use in the companies had requirements which were not compatible with the development of radical innovations. Forestry Inc. and Broadcasting Inc. have greatly reduced the amount of bureaucracy in radical innovation development by increasingly relying on qualitative assessments of idea quality and project progress instead of detailed business plans. In Steel Inc. and Process Inc., high bureaucracy was considered a significant obstacle in implementing radical ideas, which discouraged employees from even proposing their ideas.

Proposition 9. When describing their organization's innovation culture, the interviewees often referred to past successes and failures. A senior R&D manager at Steel Inc. told of a failed project to support his evaluation of the organization's poor risk-taking ability: "A year ago, we had a great idea; it was supposed to be a piece of cake. We evaluated the potential as huge and were going to put it into practice. But then the management ran out of courage and the required investments we're never made." According to another R&D manager at the company, few have the courage to put forward radical ideas or promote radical innovation projects because of the fear of failure: "The more radical an idea is, the more likely it is to fail. And if a failure costs the company a lot, few dare to vouch for out-of-the-box ideas." At Forestry Inc. and Broadcasting Inc., this issue was addressed by explicitly treating failures as opportunities for learning and hence as an inevitable part of the radical innovation process. This arguably diminishes their negative influence on employees' motivation. A technology director at Broadcasting Inc. suggested that emphasizing the learning aspects of failures is a good way to change employees' attitudes: "When failures happen, it is extremely important not to blame the people in charge but emphasize that failures are an inherent part of trying out new things and they should be seen as learning opportunities."

Proposition 10. The overall views of how important radical innovation is for a company were found to influence how the individual employees and their skills, characteristics, and work roles are appreciated. Employees working with radical innovation often have particular abilities and personalities which set them apart from the majority of their colleagues. These characteristics are in some cases seen in a positive light. For example, an R&D director at Steel Inc. noted that, "There has to be room for visionaries who are able to think beyond what's needed today." However, at the same time, these individuals are often not taken seriously. A senior R&D manager at Steel Inc. explained this: "If you want to come across as convincing, you have to act in a very no-nonsense way and can't get too carried away." Likewise, the way they go about their job tasks may be frowned upon. They may be considered inefficient and wasteful by working on projects with "no practical relevance".

Motivation to pursue radical innovation may also be hampered if radical innovation has a low strategic priority for the firm. In Forestry Inc., radical innovations are at the core of the strategy, as the company needs to renew its core products and competences to adapt to the changing business environment. As a result, the developers are valued across the organization and cross-functional

collaboration works very well. A technology director at Forestry Inc. described the situation: “Everything new which could create new growth gets an enthusiastic response. Everyone is willing to help.” In Steel Inc. and Process Inc., radical innovation has a much lower priority and the developers face a lot of resistance and suspicion, which makes it difficult to implement radical ideas. Appreciation towards radical innovation therefore seems to facilitate carrying out projects and is likely to increase the developers’ self-efficacy. Open communication, transparency, and internal presentations of interim results were proposed as solutions for breaking down the barriers between radical innovation developers and the rest of the organization. Prejudices towards the radical innovation teams are likely to perish as they come down from the “ivory tower” and make their operations visible.

Proposition 11. At Steel Inc. and Process Inc., bonus systems which reward inventors for successful innovations are considered to increase motivation to propose new radical ideas. However, according to some interviewees, the reward systems perform poorly when it comes to radical innovation. Sometimes radical ideas may lead to substantial profits for years to come. Especially in these cases, small one-time rewards may feel insufficient. At Steel Inc., the inventors of a major breakthrough bitterly complained that the rewards they received were not in line with the magnitude of the innovation. Another concern was over getting credit for the inventions. Some interviewees were anxious of others “stealing their ideas”. To tackle these issues, interviewees suggested complementing monetary rewards with public recognition and publicity. Public acknowledgement of the inventors’ expertise, by means such as coverage in the company’s internal media channels, may be a better incentive than small monetary rewards. This way managers may reduce dissent about the correct amount of compensation for radical innovations.

5. Discussion

Even though the value of individual motivation is often acknowledged in the studies on radical innovation, its management has gained limited attention. Previous studies have identified lack of motivation as a key obstacle to radical innovation and emphasized the need to manage it (Alexander and van Knippenberg, 2014; Kelley et al., 2011; O’Connor and McDermott, 2004). This study contributes to understanding of the management of radical innovation in three ways. First, it proposes a multi-level model of individual motivation in radical innovation development,

which draws from goal-setting theory, social cognitive theory, and innovation management theory. Second, it provides empirical support for the model on the basis of a multiple case study. Third, it elaborates the model by reporting on managerial actions that have been adopted in incumbent organizations to improve individual motivation to develop radical innovations (Table 6).

Radical innovation development was found to have characteristics which make maintaining individual motivation more challenging than incremental innovation development. First of all, its inherent uncertainties make finding the best task strategies difficult, often requiring extensive skills and effort. Second, the development processes are typically long and non-linear, characterized by setbacks and changes of direction. Furthermore, their success rate is low. For these reasons, radical innovation development requires high persistence from the developers. Third, radical innovation developers often have difficulties in legitimizing their work, fighting for resources, and gaining appreciation and respect from the organization.

The findings suggest that there are multiple factors which influence the initial level of individual motivation for radical innovation development and, on the other hand, moderate its effect on success in radical innovation development tasks (Figure 1). These factors can be found at the individual, project team, and organization level, which indicates a high complexity in managing motivational issues. By adopting a multi-level perspective, the study extends previous research which has focused on single levels of analysis, such as individuals (Kelley et al., 2011) and teams (Alexander and van Knippenberg, 2014).

There are reasons to believe that the development of incremental innovations also benefits from a lack of conflicting or too challenging goals, as well as forms of organizational support, such as experienced managers, sufficient resources, cross-functional expertise, supporting culture, and rewards (Barczak et al., 2009; Crossan and Apaydin, 2010). Nevertheless, because of the abovementioned characteristics of radical innovation and the dominance of incremental innovation in most organizations, it is likely that the issues are more pressing in the case of radical innovation. Furthermore, some other issues, such as, goal ambiguity, maintaining motivation over very long projects, and dealing with bureaucracy, are likely to arise from the uncertainty related to radical innovation projects and be largely limited to them. There is, therefore, a particular need for managerial actions which address motivational issues when developing radical innovations. It

should, however, be noted that while the classification into radical and incremental innovations is useful in highlighting particular aspects of innovation management, in practice, innovation projects tend to share characteristics with both of the two types. Therefore, managers may find the results of the study useful also in an incremental context when, for example, dealing with unsuccessful projects or an organization that is unappreciative of innovation.

Goal assignment has been previously identified as an area where the majority of companies have room for improvement (Barczak et al., 2009). The results of the current study stress the complexity of assigning goals for radical innovation due to multiple levels of such goals. First of all, managers should identify “strategic arenas” (Cooper and Edgett, 2010), which determine the conditions under which radical ideas may be considered for development while leaving enough room for experimentation. Such goals are important in radical innovation projects since their outcomes are difficult to predict (Leifer et al., 2000). Managers should also acknowledge that radical innovation development may be challenged by incremental improvement goals, which are often dominant in incumbent companies (Andriopoulos and Lewis, 2009), and provide employees with methods to prioritize them. Third, special attention should be paid to employee evaluation and matching individual abilities to suitable tasks, since radical innovation development is a challenging process (Alexander and van Knippenberg, 2014) and suitable skills are scarce.

[INSERT TABLE 6 ABOUT HERE]

Analysis of organizational support validates the important roles of executive champions, iterative processes, sufficient resourcing, team composition, low bureaucracy, organizational culture, and reward systems for the development of radical innovations. These factors have been widely acknowledged in the literature on radical innovation (Assink, 2006; Leifer et al., 2000; O’Connor, 2008; Slater et al., 2014). This study adds to these studies by suggesting that their observed success may be partly due to their positive motivational effects. As an example, iterative innovation processes have been found to be successful in reducing uncertainty in radical innovation development (Lynn et al., 1996; McGrath, 2001). The findings suggest that they might also help maintain individual motivation over unanticipated challenges that are prevalent in radical innovation projects (Alexander and van Knippenberg, 2014).

Managerial methods in use in the companies also provide support for structural ambidexterity, where separate organizational structures, systems, incentives, and processes are put in place for exploration and exploitation oriented goals (Herrmann et al., 2007; O'Reilly and Tushman, 2008). Arrangements that provide radical innovation teams with independent status, for example in separate organizational units (Leifer et al., 2001), were found to increase motivation by reducing goal conflicts and improving resource allocation. However, the downside of structural separation is that others may become suspicious or envious of teams who play by different rules. Managers should therefore focus not only on those who are responsible for developing radical innovations but consider also how the rest of the organization perceives them and their work. Making radical innovation teams' operations transparent within the company may dispel perceptions of them as working in an ivory tower disconnected from practical problems.

5.1 Limitations and suggestions for future research

The study has several limitations which should be acknowledged. First of all, while the results are strongly grounded in empirical data, the sampling strategy may have biases, which limits their generalizability. All of the case companies are located in Europe. Studies in other regions would be interesting since the cultural context is likely to affect the determinants of individual motivation (Latham and Pinder, 2005). Similarly, the industrial context is found to influence innovation management methods (Knudsen, 2007; Kurkkio et al., 2011) and thus investigations into more industries could provide a richer understanding of the managerial challenges related to motivation.

In dynamic industries, managers face frequent technological and market crises which create opportunities for radical innovation (Tushman and Anderson, 1986) and increase the pressure to introduce them (O'Connor, 2008; Van Doorn et al., 2013). In such environments, the goals may be set at a very high level and managers may be more likely to provide organizational support and reduce goal conflicts (Jansen et al., 2005). On the other hand, goal ambiguity might increase as there may not be dominant product designs which to adopt (Utterback and Kim, 1985). It has been suggested that individual initiatives have a crucial role in responding to such crises (Hill and Rothaermel, 2003) and that the role of managers is to translate threats into learning opportunities (Kim, 1998). How crises affect individual motivation and how managers may help employees maintain it is an area which warrants further attention.

In smaller companies, such as start-ups, the motivational issues may differ from the incumbents investigated in this paper. Start-up environments may be more fruitful environments for radical innovation than bigger companies that tend to be rigid and bureaucratic (Lee et al., 2011). On the other hand, single radical projects may mean make-it-or-break-it for small companies. Therefore, the levels of goals and required motivation may be even higher than with incumbents (Baum et al., 2014; Locke and Baum, 2014). This may lead to extremely high workload intensity which can manifest itself in employee burnout (Stayton and Mangematin, 2016). Comparisons between these two environments could provide valuable insights.

Other limitations arise from the level of analysis. Individual level performance is an important antecedent of both project and firm level performances (Abell et al., 2008; Fulmer et al., 2003; Mollick 2012). It is individuals, who are the foundation of gathering and combining knowledge, coming up with new perspectives on problems, producing ideas, and evaluating them (Amabile et al., 1996) – tasks that are essential for the success of innovation projects, that in turn contribute to financial performance (Sorescu et al., 2003; Tellis et al., 2009). It should be, however, noted that performance effects on other levels may not be fully reducible to individual-level performance. As organizational systems and innovation are complex social phenomena there may be emergent properties which appear only due to the collective behavior of individual elements (Colbert 2004; Hargadon and Bechky, 2006; Maguire et al. 2006).

It should be noted that the findings do not distinguish between different tasks related to radical innovation development. Different motivational issues are likely to be present, for example, in promoting new ideas (Sijbom et al., 2015) than one would expect to find in commercialization (Rice et al., 2002). Furthermore, the analysis focuses on identifying general patterns across the interviewees and companies and does not concentrate on how the motivational issues may vary from person to person. Further research could look into how personality and the level of intrinsic motivation affect the management of individuals in radical innovation. Finally, the analysis focuses on particular motivational theories. Although goal-setting theory and social cognitive theory are among the most influential ones in contemporary discussions on work motivation (Latham and Pinder, 2005), acknowledging other motivational theories could further enrich understanding of the topic.

This study mainly focused on the ‘internal matters’ of organizations. Many authors, however, report that radical innovation often goes hand in hand with embracing open innovation: integrating knowledge and ideas from external sources, and using partnering and licensing arrangements in the commercialisation stage (Abrell et al., 2016; Chang et al., 2012; West and Bogers, 2013). The cases hinted that increased collaboration with partners, networks, and ecosystems is likely to bring about additional issues related to motivation. For example, employees in Broadcasting Inc. were enthusiastic in extending their networks to innovative start-ups. Interviewees in Process Inc., on the other hand, were stressed about finding pilot partners needed for launching new products. In the literature, it is acknowledged that negative attitudes such as the Not-Invented-Here or Not-Shared-Here syndromes may inhibit open innovation (de Araújo Burchart et al. 2014; Lichtenthaler and Ernst 2006). The diffusion of open innovation practices opens interesting avenues for future research. For example, what kind of demands open innovation imposes on employees? Are there changes to perceptions of job safety and stability in situations where R&D is partly outsourced?

6. Conclusions

Managing motivation is an important part of the management of radical innovation since radical innovation development is highly dependent on the efforts of individuals. This study proposes that managers may influence the initial level of individual motivation towards radical innovation development and its effect on the success in radical innovation development tasks by 1) goal assignment and 2) providing organizational support. Both of these methods can be found at the levels of individuals, project teams, and the organization. It can be concluded that the management of individual motivation is an important component of the radical innovation capability. Furthermore, the findings provide further understanding of the working mechanisms of such best practices as structural ambidexterity and iterative innovation processes.

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Table 1. Case company characteristics.

Company	Process Inc.	Steel Inc.	Forestry Inc.	Broadcasting Inc.
No. of interviews	13	19	7	18
Industry	Technological components and systems	Steel	Pulp and paper	Broadcasting
Employees	16 000	7 000	20 000	3 000
Primary innovation goal	Cost cutting and efficiency focus	Exploiting previous breakthroughs	Burning platform – redirecting business	Increasing focus on radical innovation

Table 2. Representative quotations related to the motivational hub

Mechanism	Representative quotations
Direction	<p>“We need to have people who concentrate more and more on looking into the future and investigating and evaluating new opportunities. It is not enough to just put out fires every day, which is the typical operating logic of this kind of technology organization.” — Broadcasting Inc.</p> <p>“At least 5 to 10 percent of the work time should be used to develop radical ideas. Their development and cultivation requires lots of time because there are always many setbacks and failures. Engaging in radical development is a growth process for many people. They need to dedicate themselves to it and have the courage to ideate and propose unconventional ideas.” — Steel Inc.</p>
Effort	<p>“When I get in “the zone”, I constantly think about the idea, day and night. It is very rewarding but also quite wearing.” — Steel Inc.</p> <p>“Other R&D projects are worked on during the working hours. This was a project which everyone believed in and was ready to put in a lot of effort.” — Steel Inc.</p>
Persistence	<p>“The development process is an emotional rollercoaster. One day it feels like the sky is the limit and the next day you’re faced with ten reasons why it can’t be done. Either way, people need to stay excited and work hard to get where you want to go.” — Forestry Inc.</p> <p>“But I think it might also be that they haven't seen that yet. I mean, if you have seen a radical idea once, it's like, if you're out fishing, if you're throwing in your bait all the time and nothing happens, but if you have had one fish just taking a bit of the worm, then you can stand there for ten hours more, waiting for that big fish.” — Process Inc.</p>

Task strategies	<p>“Every day, we can be faced with new discoveries: ‘here’s an aspect we haven’t been able to see until now’. Then we need to re-evaluate everything we have done so far and think how to proceed.” — Forestry Inc.</p> <p>“I have lots of skilled engineers working for me. But in this new role, a key issue is to get the engineers to embrace the “discomfort zone” and think about the problems at a higher level. To look a little bit further and a little bit wider, acknowledge the multitude of available paths, and learn to deal with the constant uncertainty.” — Broadcasting Inc.</p>
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Table 3. Frequencies of codes per company (shares of total number of codes).

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	Total
Steel Inc.	4 (3%)	4 (3%)	8 (5%)	11 (8%)	4 (3%)	20 (14%)	7 (5%)	22 (15%)	46 (32%)	12 (8%)	8 (5%)	146 (100%)
Forestry Inc.	5 (4%)	30 (24%)	15 (12%)	5 (4%)	12 (9%)	14 (11%)	21 (17%)	4 (3%)	7 (6%)	10 (8%)	4 (3%)	127 (100%)
Process Inc.	2 (2%)	11 (10%)	13 (12%)	12 (11%)	10 (10%)	7 (7%)	4 (4%)	15 (14%)	21 (20%)	5 (5%)	5 (5%)	105 (100%)
Broadcasting Inc.	26 (16%)	15 (9%)	19 (12%)	16 (10%)	13 (8%)	8 (5%)	19 (12%)	3 (2%)	13 (8%)	31 (19%)	0 (0%)	163 (100%)
Total	37 (7%)	60 (11%)	55 (10%)	44 (8%)	39 (7%)	49 (9%)	51 (9%)	44 (8%)	87 (16%)	58 (11%)	17 (3%)	541 (100%)

Table 4. Summary of empirical support for the propositions.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11
Steel Inc.	S	s	S	S	s	s	S	S	s	Ss	Ss
Forestry Inc.	S	S	S	S	S	S	S	s	S	S	S
Process Inc.	S	s	S	s	S	s	S	S	s	s	S
Broadcasting Inc.	S	S	S	S	S	Ss	S	s	Ss	s	0

S = The proposition is supported directly.

s = The inverse proposition is supported by evidence.

0 = The proposition could not be observed.

Table 5. Representative quotations related to support for the propositions.

Proposition	Representative quotations
P1	<p data-bbox="390 383 1894 581">“Not everybody is suitably oriented for radical development. One of my employees has recently transferred elsewhere because she said that she prefers more incremental development — instead of looking further in the future. I think this was a good choice. If we find people who don’t adapt to the more abstract level of thinking and doing, we have to think of something else for them.” — Broadcasting Inc.</p> <p data-bbox="390 643 1894 727">“If we have an idea which is so novel that it requires great effort before any results are to be seen, we need to identify and involve the kind of people who have an entrepreneurial spirit and intrinsic motivation.” — Steel Inc.</p> <p data-bbox="390 789 1894 932">“For people working there, it’s not just about maintaining up-to-date expertise in a changing world. They need to tolerate constant changes in their role. At first, technical skills may be more important and, later on, commercial skills. The role may vary quite a bit.” — Forestry Inc.</p>
P2	<p data-bbox="390 995 1894 1138">“When we explore new domains, everything is of course very interesting and there would be enough work for a thousand researchers but we have to maintain the focus. We have defined these three strategic themes, which are like opportunity fields, and we have restricted ideation to them.” — Forestry Inc.</p> <p data-bbox="390 1200 1894 1284">“They do follow how big a share of our projects aims for new-to-the-market products but we are not given any specific goals. If the objective is to significantly renew our business, we should be given goals, such as, ‘We want this many</p>

	<p>novel products in this sector.’ But we don’t have those kind of goals. We have strict goals to generate revenue and profit but radical innovation hasn’t been acknowledged.” — Process Inc.</p> <p>“We need to be able to tell the business units about new things. They expect us to explain where the industry is going and what our technology strategy and development project portfolio are going to look like.” — Broadcasting Inc.</p>
P3	<p>“If there are projects which don’t fit the agenda of the business units but are considered to have potential, we can do a sort of arrangement — that is we don’t burden the business units with projects which they aren’t currently motivated towards but which everyone agrees that in five years could be really motivating. Instead, we do the groundwork in another unit and at some point integrate the project into the business.” — Forestry Inc.</p> <p>“We actually have a chronic problem in that we have so much to do with the challenges of the near future. And in reality these long-term projects have the lowest priority”, Process Inc.</p> <p>“There is of course a trade-off regarding where we should invest our time and resources. If one option is to improve an existing solution in order to get through the next two to three years, I think the future-oriented efforts would get less attention.” — Broadcasting Inc.</p>
P4	<p>“We can do very innovative work by relying on people’s expertise and enthusiasm. But it requires a manager who, when they find a person who gets really excited about something, realizes the potential and gives time and resources to try and do something.” — Broadcasting Inc.</p> <p>“It takes a lot. Management has to consist of people who can embrace my grandmother's idea that a day when you don't learn something new is a wasted day. I think that's the best summary I can say. If people are not curious, they will never</p>

	<p>be prepared to take any actions in that direction. You have to be curious, you have to be interested.” — Process Inc.</p> <p>“What we criticize in R&D is that it seems the higher in the hierarchy you go, the less you are interested in how to really make these things work. They should also be interested in the technical aspects, not just the commercial side, and be willing to learn what they don’t know. In this project, we had the problem that the management did not have faith in us even when the results were obvious. They think that managers shouldn’t get excited over this kind of stuff, that you lose your credibility.” — Steel Inc.</p>
P5	<p>“I strongly believe that you need to test the production technology and validate the concept by conducting pilots as early as possible. Especially if you have a new-to-the-world product, you can enter the market and iterate the product features based on market feedback and customer collaboration and, this way, ensure that you are developing the right product with the right specifications and functionalities.” — Forestry Inc.</p> <p>“The traditional way is to have a long planning phase. This kind of process based on experimentation is a novel approach for us. You get only so far with creating slide shows, concepts and business plans. In the end, seeing is believing and you have to see how the idea works in practice.” — Broadcasting Inc.</p> <p>“You need a process which is not so much about measuring efficiency, but about supporting the thing. And about learning. Because whatever is up there could fail. And maybe it should fail. Learn fast and learn early, so that is sometimes what it's all about. Make your mistakes early enough, so that you can then correct going forward.” — Process Inc.</p>

P6	<p>“If we took this seriously, we would have a real budget and a bigger project group. Now this is like a flower in a desert, the sun blazes down and it rains when it rains. And someone visits there once in a month to see if it’s still alive.” — Steel Inc.</p> <p>“For me it has been almost impossible to contribute to the project even though I wanted to because it has been so poorly resourced. Like many others I have mostly worked on this in my free time.” — Broadcasting Inc.</p> <p>“So I think we are much, much closer to improving the performance of existing machines than to finding new approaches. I don't think it's a secret that if we look at our budget, we will see that the majority is on the renovative side.” — Process Inc.</p>
P7	<p>“We have brainstorming sessions, that's OK, but if you brainstorm with the same people and if all of them come from the same universities and are trained in a certain way.... In order to be really creative, you also need discrepancy, you need different opinions, one guy who's saying “left” and the other saying “right”.” — Process Inc.</p> <p>“Today, we have everyone in the same organization. We don’t have business people in one unit and technical people in another. It makes much more sense to have one manager to lead the whole thing.” — Forestry Inc.</p> <p>“We found quite a good combination, we have sufficiently different kinds of people here. And differences generate discussions and little conflicts which then give birth to new ideas.” — Broadcasting Inc.</p>
P8	<p>“To my understanding our innovation process hinders radical things because you don't meet the first criterion. You don't even get through the first gate. It's very good for the incremental stuff but it does not support radical projects</p>

	<p>because questions about market potential and so on come too early when you cannot possibly answer them.” — Process Inc.</p> <p>“Usually it is so that, if you think processes, people are not very enthusiastic about them. Unless they feel that they are helpful, they are just unnecessary bureaucracy. Our idea has been to keep the processes as light as possible so that the bureaucracy is minimized and all of the time doesn’t go into documentation and such but to actually doing things.” — Forestry Inc.</p> <p>“A good rule of thumb is that the closer you are to a really radical innovation, the more difficult it is to do any business plans in the early stages. In incremental development, it is always much easier to calculate scenarios and draw up business plans, but when you go for really novel things, it gets difficult.” — Broadcasting Inc.</p>
P9	<p>“We have a culture with a long history, according to which you have to succeed 100 percent every time and mistakes aren’t allowed. To us, it is extremely important that when something goes wrong, you don’t punish those responsible but you learn from the failures. Because failing every now and then is a part of the deal.” — Broadcasting Inc.</p> <p>“The first thing is that we have to create this mind-set, culture, whatever term you want to use, that people are willing and daring and able to discuss their challenges or ideas openly.” — Process Inc.</p> <p>“I’m not saying that we don’t have technical competence, but I think innovativeness requires confidence and a certain kind of mind-set. Unfortunately, if the idea is radical, you have to fight tooth and nail for it.” — Steel Inc.</p>

P10	<p>“In the past, it was so that the technocrats told us where the company was going, but it doesn’t work like that anymore. We have to inform the others and sell our ideas to them. We have to earn their respect and get them to believe that we’ll really produce good forward-looking solutions.” — Broadcasting Inc.</p> <p>“They can’t become an island detached from everybody else because then there’s a risk that they do things that are not relevant. And others start to think that they probably have different benefits, working hours and management than the others. And that kind of thinking is a source of conflict” — Forestry Inc.</p> <p>“I think entrepreneurial employees have quite a good reputation. They don’t really have to be afraid of being seen as nutcases. Of course it’s always a challenge that we don’t belong to any unit. Perhaps the most difficult thing is to overcome the “not-invented-here” syndrome.” — Steel Inc.</p>
P11	<p>“Some don’t want to propose their ideas. In the past, they might have suggested a good idea which has been implemented but have felt that they haven’t got any rewards from that. Their names are not on any lists and they haven’t received any bonuses. I feel that some kind of reward system is very important. And it doesn’t have to be just money. Also positive publicity and acknowledging the person’s effort and expertise works.” — Steel Inc.</p> <p>“Usually we don’t give out rewards for ideas. But we have found that it is important to acknowledge the inventor and, for example, organize a workshop to discuss the idea. In the end, it’s very important to get feedback and the feeling that you make a difference.” — Forestry Inc.</p> <p>“We have a company award for innovativeness, which is handed out once a year. Usually they are for very clever solutions, service innovations or concrete product innovations.” — Process Inc.</p>

Table 6. Examples of managerial methods to motivate individuals for radical innovation development

Managerial action	Working mechanisms (related propositions)	Example	In use in companies
Organization level			
Structural separation of radical and incremental innovation activities.	Resolving goal conflicts helps focus efforts. Ensuring resources for radical innovation projects increases self-efficacy. (P3, P6)	Broadcasting Inc. established a new organizational unit which focuses on envisioning alternative futures and launching radical innovation projects.	Broadcasting Inc., Forestry Inc., Steel Inc.
Complementing monetary rewards with public acknowledgements .	Rewards influence personal goals by strengthening extrinsic motivation hence increasing the attractiveness of radical innovation development. (P11)	Steel Inc. covered the team behind a successful radical innovation in an internal magazine and promoted them in the media.	Process Inc., Steel Inc.
Emphasizing past success stories. Emphasizing the learning aspects of failures.	Reduces fear of negative outcomes and encourages risk-taking. (P9)	In Broadcasting Inc., radical innovation developers are coached to abandon their established risk-averse mindsets.	Broadcasting Inc., Forestry Inc.

Making radical innovation a strategic priority.	Increases purposefulness, meaningfulness and social gains from involvement in radical innovation development. (P10)	Innovations in new businesses and technologies is one of the key elements of Forestry Inc.'s corporate strategy.	Broadcasting Inc., Forestry Inc.
Project team level			
Assigning strategic goals to define a desired future vision.	Balancing with goal clarity and ambiguity increases self-efficacy and helps guide the development towards desirable directions. (P2)	Forestry Inc. decided on four key development areas which were supervised by the top management team and resourced well. This was a clear mandate for radical ideation and defined which ideas are considered to be out of scope.	Forestry Inc., Process Inc.
Iterative innovation processes.	Allows employees to succeed in reaching intermediate goals, which strengthens self-efficacy beliefs and helps maintain enthusiasm despite frequent failures. (P5)	Process Inc. has adopted iterative innovation processes both in software and hardware projects.	Broadcasting Inc., Forestry Inc., Process Inc.
Cross-functional project teams.	Diverse expertise and perspectives facilitates the search	In radical innovation projects, Forestry Inc. integrates technical and commercial	Broadcasting Inc., Forestry Inc., Process

	for suitable task strategies and increases self-efficacy. (P7)	staff under the same management.	Inc., Steel Inc.
Reducing the amount of bureaucracy in radical innovation projects.	Removing obstacles to radical innovation projects makes employees perceive to be better equipped to succeed in their tasks. (P8)	Forestry Inc. aims for light bureaucracy in radical innovation projects, visible, for example, in flexibility in documentation requirements.	Broadcasting Inc., Forestry Inc.
Transparency in radical innovation activities: open communication and presentation of interim results.	Reduces goal conflicts within the organization making it easier to direct development effort and resources. (P3)	The unit responsible for radical innovation in Broadcasting Inc. organizes a monthly internal event where it demonstrates its operations and results to the rest of the organization.	Broadcasting Inc., Forestry Inc.
Individual level			
Defining development tasks and workload according to each developer's skills and characteristics. Changing assignments	Encourages high effort but does not incapacitate the developers. (P1)	Broadcasting Inc. carefully selects radical innovation team members according to their personal characteristics and adjusts team compositions when needed.	Broadcasting Inc., Forestry Inc., Process Inc., Steel Inc.

according to the process phases.			
Giving central positions to managers with champion characteristics.	Increases developers' self-efficacy by removing barriers and giving encouragement. (P4)	Forestry Inc. has nominated 'innovation agents' in all functions to keep radical innovation on the agenda and facilitate knowledge exchange across the organization.	Broadcasting , Inc., Forestry Inc.

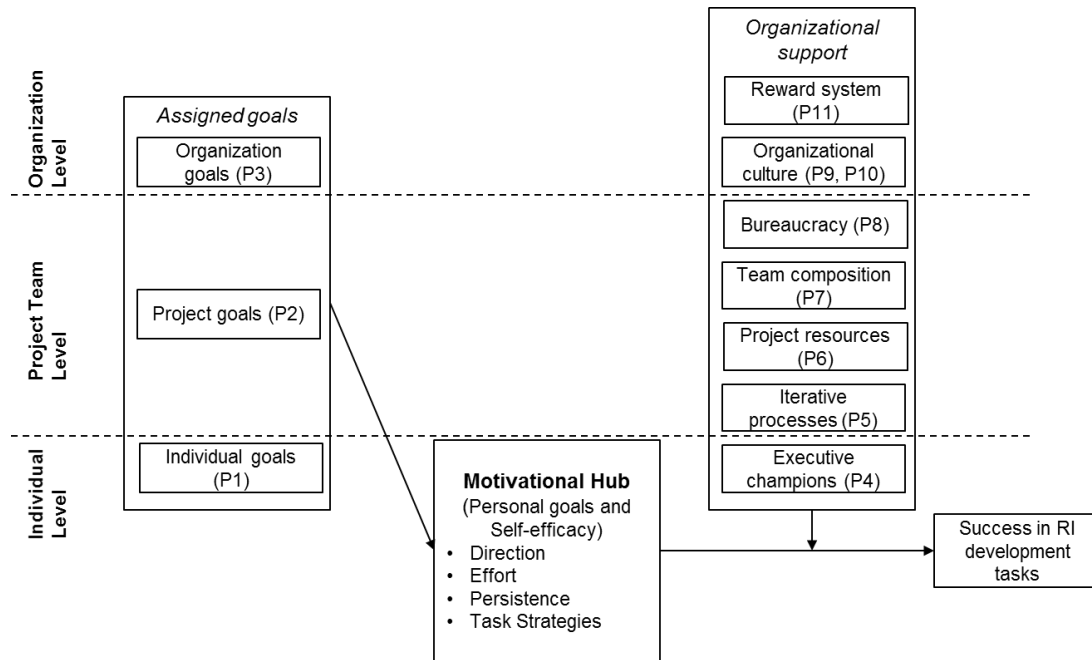


Figure 1. The research model