LEADERSHIP AND INNOVATION

IN RESEARCH AND DEVELOPMENT TEAMS

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Leadership and Innovation in R&D Teams

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2013

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ISBN: 978-91-628-8734-6
Internet: http://hdl.handle.net/2077/33160

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ISSN: 1101-718X
ISRN: GU/PSYK/AVH--283—SE

Cover design: Magnus Grettve
Printed in Sweden by Ineko AB, 2013

Gothenburg, SWEDEN, 2013

Nothing endures but change

Heraclitus

Abstract

This thesis focuses on the members of industrial research and development (R&D) teams and their leaders. The field of individual innovation is fragmented and lacks research that coherently integrates psychological factors that explain why antecedent variables affect individual innovation. Leadership, the major issue in this thesis, has been shown conclusively to influence employee innovation, but research is especially needed on (1) the psychological factors that explain the relationship between leadership and individual innovation, and (2) the contextual factors that affect leaders' abilities to influence innovation in R&D teams. The aim of this thesis is therefore to identify and empirically test psychological and contextual factors that may explain how and when leaders influence innovation in R&D teams.

This thesis consists of four studies. Study I systematically reviews 30 years of research on leaders' influence on innovation in order to identify the factors that mediate or moderate the relationship. The sample consists of 30 empirical studies in which leadership is the independent variable and innovation is the dependent variable. Study II and Study III are correlational studies based on Study I. In these studies, leadership is conceptualized using leader–member exchange theory (LMX). Individual innovation is measured by innovation outcomes (e.g., new patents, products, scientific publications, and other publications) and by leaders' ratings of team members' innovative work behavior.

The main findings indicate that individual personal initiative—the propensity to take a proactive stance to one's work and to be persistent in overcoming challenges and setbacks—predicts individual innovation. A mediating effect is identified in which LMX is associated with innovation through the personal initiative of team members. Study II shows that organizational support—an organization's active encouragement of innovation through the provision of resources and empowerment—moderates the relationship between LMX and individual personal initiative and thus strengthens the relationship when organizational support is high. Study III shows that creative self-efficacy–the belief in one's ability to be creative—mediates the relationship between leadership and personal initiative. Moreover, Study III finds that the culturally bound value of conservation is negatively related to individual innovation. Highly conservative individuals value the status quo and are inclined to conform to established ways of doing things. Last, Study IV, which is an interview study, concludes that when R&D project leaders actively facilitate the development of new ideas and provide guidance and expertise, they may stimulate idea generation and increase the possibility of successfully completing innovation projects. Project leaders who limit team members' work autonomy and neglect basic project management hinder the generation and implementation of innovative ideas.

The thesis concludes that leaders in R&D influence the innovativeness of their teams and employees. Various contextual and psychological factors at the individual, team, and organizational levels may facilitate or hinder the efforts of leaders to influence innovation outcomes.

Keywords: LMX, leadership, innovation, creativity, personal initiative, creative self-efficacy, intrinsic motivation, mediator, moderator, R&D

Populärvetenskaplig svensk sammanfattning

Den här doktorsavhandlingen undersöker hur ledarskap påverkar innovationsförmågan i forsknings- och utvecklingsgrupper i svensk industri. Innovationsförmåga är förmågan att utifrån nya värdefulla idéer (kreativitet) realisera nya produkter, tjänster, patent, eller nya organisatoriska förändringar såsom processer och strukturer. En god innovationsförmåga är en nyckel till överlevnad för många svenska företag som är utsatta för en tilltagande internationell konkurrens. Ledarskap, ett centralt begrepp i denna avhandling, har under de senaste åren lyfts fram som en kritisk faktor för innovationsskapande. Det saknas emellertid specifik kunskap om psykologiska faktorer som förklarar hur ledare påverkar innovationsförmågan hos forsknings- och utvecklingsgrupper. Det saknas även kunskap om kontextuella faktorer, det vill säga faktorer som finns i den omkringliggande organisationen och som kan påverka ledares möjligheter att stimulera innovation.

Syftet med avhandlingen är att identifiera och empiriskt testa (1) psykologiska faktorer som förklarar sambandet mellan ledarskap och innovation i forsknings- och utvecklingsmiljöer, samt (2) kontextuella faktorer som stärker eller försvagar sambandet mellan ledarskap och innovation.

De huvudsakliga fynden som presenteras i avhandlingen är att ledare bör uppmuntra och stödja nya initiativ och att detta stöd bör vara förankrat i organisationen. Individer med hög initiativförmåga tar en proaktiv inställning till det egna arbetet, till exempel genom att lösa problem innan de blir för stora. De utnyttjar även uppkomna tillfällen för att driva igenom egna idéer. Avhandlingen visar att en god arbetsrelation mellan ledare och medarbetare är positivt relaterad till initiativförmåga, och att individer med hög initiativförmåga producerar fler innovationer.

Vidare kan organisationen i sig stödja innovation i större eller mindre utsträckning. Stödjande organisationer uppmuntrar innovation, till exempel genom att kommunicera att innovation är önskvärt och därigenom gynna en öppen dialog kring nya idéer. Stödet består även av i vilken grad organisationen tillhandahåller resurser öronmärkta för innovation såsom tid, pengar, information och tillgång till expertis. Stödjande organisationer ger också utökad frihet och mandat till utvecklingsgrupper. Avhandlingen visar att sambandet mellan ledarskap och personligt initiativtagande är starkare när graden av organisatoriskt stöd är starkt.

Avhandlingen är en sammanläggningsavhandling och består av fyra studier. Studie I syftade till att systematiskt gå igenom 30 års forskning för att granska de faktorer som visat sig mediera (förklara) eller moderera (påverka) sambandet mellan ledarskap och innovationsförmåga. Underlaget utgjorde 30 empiriska studier i form av experiment, intervjuer och enkätundersökningar. Studie II och III är enkätstudier som testade sambandet mellan ledarskap och individuell innovation i forsknings- och utvecklingsgrupper, samt ett antal medierande och modererande faktorer. I dessa två studier användes den amerikanska Leader–Member Exchange teorin (LMX) för att mäta ledarskap. LMX ser ledarskap som en arbetsrelation bestående av sociala utbyten mellan ledaren och dennes enskilda gruppmedlemmar. Denna arbetsrelation kan ha varierande kvalitet. En lågkvalitativ arbetsrelation utgår från det grundläggande arbetskontraktet, där gruppmedlemmens tid byts mot pengar. En högkvalitativ arbetsrelation innebär att ledare och medlemmar går bortom arbetskontraktet och utbyter ömsesidig tillit, respekt, uppskattning och arbetsinsatser gentemot gruppens mål. För att mäta individers innovation användes två metoder. Den första metoden var att projektledare ombads värdera sina medarbetares innovationsbeteenden. Exempel på dessa är i vilken utsträckning medarbetare söker upp nya tekniska tillämpningar, genererar och samlar stöd för nya idéer, samt planerar för idéernas implementering. Den andra metoden var att data över innovativa utfall samlades in. Deltagarna ombads ange hur många patent, produkter (eller produktförbättringar), vetenskapliga publikationer, samt andra typer av publikationer (exempelvis tekniska rapporter) de tagit fram under tiden de tjänstgjort under sin nuvarande ledare.

Studie II genomfördes i fem svenska industriföretag där 163 gruppmedlemmar från 43 forsknings- och utvecklingsgrupper deltog tillsammans med deras ledare och avdelningschefer. Resultaten visade att individers benägenhet att ta initiativ förklarade sambanden mellan LMX och innovativt beteende samt innovativa utfall. Graden av organisatoriskt stöd påverkade styrkan i relationen mellan LMX och personlig initiativförmåga. Detta samband var starkast då organisatoriskt stöd var högt. Vidare var LMX positivt relaterat till individers interna motivation, men individers grad av motivation var i sin tur inte relaterat till deras innovation.

Studie III genomfördes i ett svenskt industriföretag med forsknings- och utvecklingsgrupper från Sverige, Frankrike, USA och Indien. Totalt medverkade 266 gruppmedlemmar från 65 grupper, deras ledare och avdelningschefer. Även i denna studie förklarade individers benägenhet att ta initiativ sambandet mellan LMX och individuell innovation. Vidare förklarade individers kreativa självuppfattning sambandet mellan LMX och benägenhet att ta initiativ. Individer med hög kreativ själv-

uppfattning (creative self-efficacy) har en stark tro på sin egen förmåga att ta fram nya, värdefulla idéer. Ett tredje resultat från denna studie var att individers grad av traditionell läggning motverkade innovationer. Traditionell läggning (conservation) är en väsentlig aspekt av Schwartz värdeteori och varierar mellan länder. Individer med traditionell läggning är mer benägna att agera i enlighet med formella roller, normer, och för bevarandet av status quo. Individer med mindre grad av traditionell läggning är inriktade mot att söka förändring, personlig frihet och intellektuell utmaning. I Sverige har betydligt färre personer en traditionell läggning i jämförelse med andra länder.

Studie IV är en intervjustudie med syfte att identifiera specifika ledarbeteenden som antingen stimulerar eller hindrar innovation hos individer och projektgrupper i forsknings- och utvecklingsmiljöer. I denna deltog 72 personer från industriella utvecklingsgrupper i två organisationer. Dessa personer intervjuades om specifika händelser där deras projektledare antingen stimulerat eller hindrat deras förmåga att vara innovativa. Det mest frekvent nämnda ledarbeteendet som stimulerade medarbetares innovation var ledares aktiva stöd av nya idéer. Detta stöd skedde huvudsakligen genom diskussioner och utbyten på speciella möten och workshops som hade som syfte att ta fram idéer eller lösa specifika problem. Ledare som påverkade innovationsförmågan positivt skapade även en fri och öppen dialog där information och nya perspektiv kunde utbytas. Vidare använde de sin expertis och erfarenhet för att vägleda nya initiativ. Ledare som hindrade innovationsförmågan i sina projektgrupper begränsade gruppmedlemmarnas frihet, exempelvis genom att ge vad som upplevdes vara för detaljerade instruktioner. Att negligera sitt ledningsansvar var också något som hindrade innovationer. Stimulerande ledarbeteenden resulterade i bättre lösningar, fler idéer och ökad motivation hos medarbetarna. Hindrande ledarbeteenden resulterade i sämre lösningar, färre idéer, minskad samarbetseffektivitet samt upplevd frustration.

I avhandlingen dras två huvudsakliga slutsatser. För det första verkar ledare ha ett inflytande på innovationsförmågan hos sina gruppmedlemmar. Till exempel kan de uppmuntra diskussion och idégenerering samt ge gruppmedlemmar känslan av att kunna ge ett kreativt bidrag. En högkvalitativ arbetsrelation med ömsesidig respekt och tillit, där både ledare och medarbetare bidrar till att uppnå gemensamma målsättningar, underlättar innovationer. Speciellt viktigt är att ledaren uppmuntrar nya initiativ. För det andra belyser avhandlingen vikten av att från ledningshåll aktivt stödja innovationer. Ledningsgrupper bör uppmuntra innovationer i kommunikation och handling, ge tillräckligt med frihet till utvecklingsgrupper och tillhandahålla resurser i form av tid, utrustning, information och expertkunskap.

Preface

This dissertation is based on the following four studies which will be referred to by their Roman numerals:

I. Denti, L., & Hemlin, S. (2012). Leadership and innovation in organizations: A systematic review of factors that mediate or moderate the relationship. *International Journal of Innovation Management, 16,* 1-20. doi: 142/S1363919612400075.

II. Denti, L., & Hemlin, S. (2012). *Modeling the link between leader-member exchange and individual innovation in R&D.* Paper presented at the 72nd annual Academy of Management Conference, Boston, USA. *Submitted for publication.*

III. Denti, L., Hemlin, S., & Mumford, M. D. (2013). *Leadership and individual innovation: A cross-cultural study of mediating psychological mechanisms.* Paper presented at the 73rd annual Academy of Management Conference, Orlando, USA. *Submitted for publication.*

IV. Denti, L. (2013). *What do innovative leaders do? A critical incident study of innovation stimulating and hindering leader behaviors in R&D.* Unpublished manuscript. Department of Psychology, University of Gothenburg. Gothenburg, Sweden. *Submitted for publication.*

Acknowledgements

The last four years when researching this thesis have been the best of my life. During the journey I have encountered so many warm, intelligent and helpful people. This thesis is essentially a product of many people's efforts and contributions. There are so many to thank. I feel a deep gratitude to you all.

First and foremost, I would like to give my very warmest and special thanks to my supervisor, Professor Sven Hemlin. You are a true scholar, an academic maven and a role model; curious, knowledgeable, and charismatic. I also thank Professor Stefan Tengblad, leader of the research project, for valuable input and discussions. I am especially thankful for the high amount of autonomy I experienced under your supervision. I also would like to thank my co-supervisor Professor Jan Johansson-Hanse for your vast methodological knowledge and sharp analytical sense.

Thank you Professor Mike Mumford for taking me under your wings during my stay at the University of Oklahoma in the fall of 2011. To my colleagues at CASR, thank you for welcoming me warmly and making me feel comfortable. I know it must have been odd dealing with a dapper, socialist, nihilist, Swede. I have made good friends and I hope to visit y'all someday when you are scattered about the world.

To my partners at the companies where the research was conducted, thank you for your collaboration. I thank AB Volvo for being the main partner company of this research project. A special thanks to Jonas Salén, Björn Flood, Peter Janevik, Johan Stenson, Nitin Patel, Martin Moberg, Ingrid Engström, Christer Ovrén, Marita Grundström, Jonas Thorngren, and Karin André. Without your patience and efforts, this thesis would not exist.

I have also many colleagues in Sweden to thank. As a fresh doctoral student I took my first stumbling steps at the Gothenburg Research Institute. I would like to thank all the good people there for welcoming me. A fresh doctoral student should also be challenged. A special thanks to Professor Dennis Töllborg and Karl Ydén for keeping me on my toes.

At the department of psychology, I would like to thank my colleagues who have always been there to help and support me. I have had many interesting conversations with you guys. Your knowledge into the human psyche is truly inspiring.

Thank you VINNOVA (The Swedish Governmental Agency for Innovation Systems) for funding the project.

Thank you AB Netsurvey and Mårten Westberg for excellent collaboration with study II.

Thank you Lisa Olsson, my “academic big sister”, for your support and good advice.

Thank you Carl-Christian Trönnberg for your advice and interesting conversations.

Thank you Isak Barbopoulos for your help with surveying participants in study III.

Thank you Nakima Ackerhans-Schreiber for your help with interviewing participants in study IV.

Thank you Magnus Jansson for reviewing the thematic categories in study IV.

Thank you Marcia Lynn-Halvorssen for your language editing and valuable questions.

Thank you Magnus Grettve for your splendid design of the cover of my thesis.

Last, but definitely not least, I thank my family for always supporting me: my parents, and my brother and sister. Thank you my dear friends for all your help. Writing a doctoral thesis requires some solid work. Thank you Anna for your deep love and understanding.

A sunny day in June
LEIF DENTI

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Introduction

Under pressure from international competition, with the demand for more complex and differentiated products and services, developing innovation capability has become a key goal of organizations. Shorter product life cycles, with frequent replacements and improvements, add to the pressure for innovation as production processes are shortened to meet deadlines (Tidd & Bessant, 2009). More and more researchers are studying the factors that promote innovation and its antecedent, creativity. Such factors have been identified at the level of the organization (see Damanpour & Aravind, 2012), the team (see Hülsheger, Anderson, & Salgado, 2009), and the individual employee (see Hammond, Neff, Farr, Schwall, & Zhao, 2011). However, the research on innovation among individuals is fragmented. There is little integration in the research of the psychological and contextual factors that explain why antecedent variables affect innovation at the individual level (Hammond et al., 2011; Shalley, Zhou, & Oldham, 2004; Yuan & Woodman, 2010).

This thesis focuses on individuals' innovative activities in research and development (R&D) teams in organizations. The thesis takes an interactionist perspective on individual innovation. In this perspective, both psychological factors (such as an individual's intrinsic motivation) and contextual factors (such as the degree of innovation support in an organization) influence innovative outcomes (Hemlin, Allwood, & Martin, 2004; 2008; Woodman, Sawyer, & Griffin, 1993). Leadership,

the major topic of this thesis, has been shown conclusively to influence employees' innovation work (Rosing, Frese, & Bausch, 2011). However, research is especially needed on leadership in R&D (Elkins & Keller, 2003) and on the psychological factors that explain the relationship between leadership and innovation (Byrne, Mumford, Barrett, & Vessey, 2009; Mumford, Scott, Gaddis, & Strange, 2002; Shalley & Gilson, 2004).

This thesis proposes and integrates several factors that help explain how leaders influence innovation in R&D teams. The thesis investigates *how* leadership relates to innovation, examining the psychological factors that mediate the relationship between leadership and individual innovation. The thesis also investigates *when* leadership is related to innovation in its examination of the contextual factors that facilitate or hinder leaders' efforts to promote innovation. Such moderators strengthen or weaken the relationship between leadership and innovation.

A closer look at innovation

What is innovation?

At its core, innovation is a form of change (Tidd & Bessant, 2009). This change can refer to an organization's offerings such as goods or services (often called product innovation), or the way these offerings are created and delivered (often called process innovation). Innovation also occurs in the introduction of change to the organizational structure and its routines, policies, and methods. The changes resulting from innovation can have different degrees of novelty. Incremental innovations typically involve small changes (e.g., improvements) to an organization's offerings (or processes) that build on existing knowledge and capabilities. In contrast, radical innovations are fundamental changes to an organization's offerings that often prod the organization to take a new technological trajectory (Benner & Tushman, 2003).

Tidd and Bessant (2009) described four phases of a general innovation process. First, organizations must scan their environments to identify opportunities for innovation. For example, these opportunities may be new or changed customer needs, new technologies that stem from research activities, or pressures to conform to new legislation. This first phase, while vital, is often neglected by large organizations that would rather spend their resources on developing existing technology and catering to existing customers. As Christensen pointed out in his aptly named book, *The Innovator's Dilemma* (1997), organizations that focus solely on refining their current offerings (through incremental innovation) may find themselves at a dead end when

markets change or new markets emerge with very different needs and expectations. In those cases, smaller organizations that focus solely on offerings that cater to new markets may best the old competitors (Isaksen & Tidd, 2006).

The second and third phases of the innovation process involve selection of the options that are most likely to produce a competitive edge and to the resourcing of those options. Here, resourcing refers to the acquisition of knowledge resources through R&D efforts, to their purchase, or to their collaborative development with others (often called "open innovation"; see Chesbrough, 2003).

The fourth phase is the implementation of the innovation, which often begins with an idea that develops through different stages toward a tangible outcome. As discussed above, outcomes can be a new goods or services (for sale to customers) or new processes or methods for the organization.

Innovation and the fate of organizations

Innovation is assumed to be an integral factor that contributes to organizational results such as long-term growth and profit (see Schumpeter, 1934). Many firms that are regarded as highly innovative are also market leaders. Examples include Apple, Google, Proctor & Gamble, The 3M Company, and Bosch (Isaksen & Tidd, 2006).

One should keep in mind that innovation is not easy. The process of developing innovations is inherently uncertain and involves considerable risk. For instance, ideas fail, new technologies emerge, and markets change (Tidd & Bessant, 2009). Furthermore, innovation projects experience delays because of their novelty, complexity, and unpredictability (Reiter-Palmon & Ilies, 2004). Ideas are the raw material for innovation in organizations. Initial ideas, however, rarely lead to tangible outcomes that create value for organizations.

For example, Stevens and Burley (1997), in their literature survey of new product development in many different markets, reached a striking conclusion. They found that of 300 ideas for new offerings (e.g., goods or services) proposed to management, only about 125 of them actually resulted in new projects. Of these 125 projects, nine developed into larger projects, four resulted in major development efforts, and two resulted in new products. Of the new products launched, only one was profitable. They also found that approximately 90 to 95 percent of all U.S. patents lack any market relevance, and only 1 percent are profitable. Other estimates indicate that approximately 30 to 95 percent of the ideas for new offerings are unsuccessful (Tidd, Bessant, & Pavitt, 2001).

Given these odds, Getz and Robinson (2003, p. 132) suggest "companies might well be better off putting their money in the lottery!" However, companies rarely have the option of not innovating, especially in today's turbulent and fast-paced business

environment. Christensen (1997) and others (e.g., Tidd & Bessant, 2009) remind us that unless companies renew their offerings on a continual basis, their chances for survival are severely reduced. There are numerous examples of firms that failed to innovate in time. IBM received plenty of warning in the 1990s that technology had shifted from large mainframe computers into more decentralized networked computing. However, IBM reacted too late to this shift in technology and nearly missed the opportunity as a result. Another example is Polaroid Company that failed to recognize the developing digital imaging technology, and ultimately went into bankruptcy (Isaksen & Tidd, 2006). Hasselblad, which failed similarly, was ultimately acquired by two venture capital firms.

According to Tidd and Bessant (2009), innovation, which results in a number of strategic advantages, allows organizations to stay ahead of their competition. For example, the complexity of an offering (e.g., microchips that competitors have difficulties copying) and the possibilities for legal protection (e.g., for new drugs) increase these advantages. Another advantage that innovation can provide relates to the more efficient processes that can shorten production time. For example, Japanese car manufacturers, by fine-tuning their various processes, were able to offer better quality, flexibility, and choice while maintaining the same sales price for their cars. Finally, innovation creates strategic advantages related to timing, such as first-mover advantages, which allow a company to be the first in a new market.

Company profits reveal clearly that innovation matters. For example, the median profit margin for the 25 top innovative firms in the world[1] in 1995-2005 was 3.4 percent. The median profit margin for firms listed in the S&P Global Index in the same time period was 0.4 percent (Hauptly, 2008).

The elusive concepts of innovation and creativity

The concepts of innovation and creativity are highly intertwined and are often used interchangeably in the literature (Basadur, 2004; Csikszentmihalyi, 1999). This is partly because innovation and creativity have been defined similarly. OECD (2005, p. 46) defined innovation as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations," while Woodman et al. (1993, p. 293) defined creativity as "the creation of a valuable, useful new product, service, idea, procedure or process." The two definitions are similar because both relate to outcomes. Moreover, the concepts of innovation and creativity are intertwined because creativity precedes innovation in a multi-stage

[1] Per *Business Week*.

process with the goal of new outcomes. Creativity is required at various stages of the process of turning ideas into outcomes, but it is only part of the innovation process. In this view, creativity is often defined as idea gene-ration, or ideation. For instance, according to Amabile et al. (1996, p. 1155), creativity is "the production of novel and useful ideas." Innovation is the subsequent realization and implementation of ideas into outcomes (Anderson, De Dreu, & Nijstad, 2004; Mumford & Gustafson, 1988; Shalley & Gilson, 2004).

Thus, creativity can be thought of as a necessary but insufficient condition for the creation of novel and original outcomes. Creativity must be present in order to achieve these outcomes, but creativity by itself is not enough. Rather, creative ideas must be realized and implemented. Another aspect is that innovation, as an implementation-focused process, aims to benefit the organization, although this is not necessarily the goal of creativity (Anderson et al., 2004).

This thesis follows the OECD's (2005) definition of innovation. It views creativity as the generation of novel and useful ideas (Amabile et al., 1996). Innovation is the effort to turn those ideas into realities.

Measuring innovation

Innovation has traditionally been conceptualized and measured in the technology-based domains such as manufacturing (Martin, 2012). In these domains, attention focuses on new products and patents, and, to a lesser extent, on R&D funding and the number of R&D researchers (Archibugi & Pianta, 1996). Other measures of innovation are the numbers of invention disclosures and research reports (e.g., Scott & Bruce, 1994), the number and effectiveness of implemented innovations (e.g., Rank, Nelson, Allen, & Xu, 2009), and the number of scientific publications (e.g., Keller, 2012). Figures such as annual R&D expenditure as a percentage of gross revenue (e.g., Jung, Wu, & Chow, 2008) and the ratio of new product sales to total sales (e.g., Gumusluoğlu & Ilsev, 2009) have also been used to measure innovation. See Table 1 for an overview of these innovation measures.

Dark innovation. However, there is a danger in conceptualizing and measuring innovation using only broad measures such as patents and products (Martin, 2012). Many activities that could be characterized as innovative are missed if such measures are used (although some researchers, such as Archibugi and Pianta (1996), argue that a large share of firms' inventions are patented). Martin (2012) labels these activities as "dark innovation" because they are overlooked by the searchlight of "conventional" innovation measures. Some dark innovation examples are activities (1) that are incremental accomplishments too small to be correctly measured using typical innovation indicators, (2) that involve little formal R&D, and (3) that are rarely

patented. A challenge for the future conceptualization and measurement of innovation is how such dark innovations should be identified and measured.

Innovative work behavior. This thesis confronts the dark innovation challenge in its attempt to measure and validate one crucial aspect of dark innovation, namely the specific behaviors of R&D team members. An implicit assumption of this method for measuring innovation is that a higher frequency of a specific type of behavior promotes innovative outcomes in organizations.

A number of conceptualizations and scales have been suggested as ways to measure those behaviors (e.g., De Jong, 2008; Janssen, 2000; Krause, 2004; Scott & Bruce, 1994). For example, De Jong (2008) and De Jong & Den Hartog (2010) described four types of innovative work behaviors that they theoretically identified and empirically validated: i) opportunity exploration, ii) idea generation, iii) championing, that is, rallying support for one's ideas, and iv) implementation. Behavioral scales can be used in the context of the individual (e.g., Atwater & Carmeli, 2009), the team (e.g., Hurley & Hult, 1998), the supervisor or leader (e.g., Scott & Bruce, 1994), peer reports (e.g., Amabile, Schatzel, Moneta, & Kramer, 2004), and expert or external assessments (e.g., Jung et al., 2008; Sosik, Avolio, & Kahai, 1997). Furthermore, innovative work behavior scales have been positively related to innovation measures such as invention disclosures (Scott & Bruce, 1994) and the number and effectiveness of implemented innovations (Rank et al., 2009).

Innovative work behavior may be a promising construct for measuring dark innovations in organizations. The behavioral measure is statistically related to the more conventional innovation measures (e.g., products and patents) and additionally may cover aspects of organizational innovation related to more informal and incremental activities. Yet considerable challenges remain before we can conclusively accept behavioral data as proxies for innovation. First, behavioral reports depend on human judgments, and are thus more open to biases than measures of tangible innovation outcomes. Second, the collection of independent (i.e., leadership assessments) and dependent variables (i.e., self-rated innovation scales) from the same individuals invites statistical and methodological biases such as the common method bias. This bias refers to the situation when the covariance between variables is "attributable to the measurement method rather than to the constructs the measures represent" (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003, p. 879). As a consequence, the bias may inflate relationships between variables. Third, it is still a challenge to show conclusively that a high prevalence of innovative work behaviors at organizations is related to innovation outcomes.

Theoretically, since both types of innovation measures account for the same phenomenon, we should expect that the two measures would be related. For instance,

innovative work behavior most likely precedes tangible outcomes of innovation such as new products or product improvements. Furthermore, it is important to consider measurement levels (individual, team, or organization) when evaluating correlations between subjective measures and quantitative measures. For instance, assessments of individual innovative behavior should yield the highest correlations with outcome measures at the individual level. We should expect lower correlations if assessments of individual innovative behavior are correlated with outcome measures at the team level.

Table 1 and 2 provide an overview of commonly used innovation measures, both outcome measures (Table 1) and subjective innovation measures (Table 2). Corroborating correlations with other measures of innovation are shown in the columns “convergent validity”.

TABLE 1

Measures of innovation outcomes in innovation research at the individual, team, and organizational levels

Measure	Example study	Convergent validity
Individual level		
Number of invention disclosures	Scott & Bruce (1994)	Significant correlation with leader-rated individual innovation behavior (r = .33**)
Number and effectiveness of implemented innovations (leader rated)	Rank et al. (2009)	Significant correlation with leader-rated individual innovation behavior (r = .44**)
Number of patents, last 5 years	Keller (2012)	Significant correlation with number of publications (r = .35**)
Number of publications, last 5 years (both external and internal to the company)	Keller (2012)	Significant correlation with number of patents (r = .35**)
Team level		
Number of process innovations	West, Borril, Dawson, Brodbeck, Shapiro, & Haward (2003)	Other measures were not collected
Organization level		
Number of patents	Jung et al. (2008)	Significant correlation with expert ratings of 50 organizations (r = .50[a])
Number of patent citations	Makri & Scandura (2010)	No correlation with number of patents
Ratio of annual R&D spending to annual sales	Jung et al. (2008)	No correlation with patents or expert ratings, but similar pattern of correlations with independent variables
Ratio of sales of new products to total sales	Czarnitzki & Kraft (2004)	Other measures were not collected
1. Ratio of sales of new products to total sales, 2. ratio of sales of new products to R&D expenditures	Gumusluoğlu & Ilsev (2009)	Other measures were not collected
Number of 1. product/market innovations (i.e., new products and new markets entered) and 2. organizational innovations (e.g., new planning/control systems) adopted by an organization over a two-year period	Elenkov & Manev (2009)	The sub-dimensions of the product/market innovations and organizational innovations loaded on separate factors; they correlated significantly (r = .42**)
Number of 1. new products, 2. new markets entered, 3. total R&D spending, 4. employees in R&D	García-Morales, Matias-Reche, & Hurtado-Torres, 2008	Significant correlation with CEO subjective ratings of organizational innovation (r = .88**)

[a] p-value not reported.

* Correlation is significant at the 0.05 level (two-tailed)

** Correlation is significant at the 0.01 level (two-tailed)

TABLE 2

Subjective rating scales in innovation research at the individual, team, and organizational levels

Measure	Example study	Convergent validity
Individual level		
Innovative work behavior (leader-rated)	Scott & Bruce (1994)	Significant correlation with number of invention disclosures (r = .33**)
	De Jong & Den Hartog (2010)	Significant correlation with employee-rated innovation scale (r = .35**)
Innovative output (leader-rated)	Axtell, Holman, Unsworth, Wall, & Waterson (2000)	Significant correlations with employees' self-ratings on the same measure (Sub dimension 'suggestions': r = .062**; sub dimension 'implementations': r = .42*)
Team level		
Team innovativeness (self-rated)	Hurley & Hult (1998)	No correlation with number of ideas adopted by the organization.
	Burpitt & Bigoness (1997)	Other measures were not collected
	Somech (2006)	Other measures were not collected
Organizational level		
Exploratory/exploitative innovation of business unit (leader-rated)	Jansen, Van Den Bosch, & Volberda (2006)	Exploitative innovation was significantly correlated with measures of financial performance (r = .18*)
Organizational innovation (leader-rated)	Chen, Tjosvold, & Liu (2006)	Other measures were not collected
Organizational innovation (CEO-rated)	García-Morales et al. (2008)	Significant correlation (r = .88**) with quantitative measures (Number of 1. new products, 2. new markets entered, 3. total R&D spending, 4. employees in R&D)
Innovation as an entrepreneurial activity (CEO-rated)	Ling, Simsek, Lubatkin, & Veiga (2008)	Significant correlation with the sales growth of an organization (r = .27**)
Innovation as an entrepreneurial activity (CEO-rated)	Zahra (1996)	Significant correlations with firms 1. R&D spending as a percentage of sales, 2. No. of new products, 3. Revenue from new businesses (r not disclosed)

[a] p-value not reported.

* Correlation is significant at the 0.05 level (two-tailed)

** Correlation is significant at the 0.01 level (two-tailed)

Determinants of innovation

More than three decades of innovation research (1980–2013) present a fairly comprehensive picture of the antecedent factors that facilitate organizationally based innovation at the individual, team, and organizational levels (Anderson et al., 2004). However, the processes that result in innovation are complex because they occur at various and nested levels of human organizing. In addition, the commercial side of innovation demands more precise information about organizational innovativeness (Kanter, 1996; Paulus & Yang, 2000; Shalley & Perry-Smith, 2000; Sternberg, 1999; Williams & Young, 1999). This thesis acknowledges that many authors (e.g., Carlsson, 1997; Edqvist, 1997), particularly in the area of economics, view innovations as mainly the result of inter-organizational processes. This thesis does not examine this field of innovation research—i.e., innovation systems—because the focus is intra-organizational factors and processes.

This thesis takes an interactionist perspective on human organizing in that it acknowledges that innovative outcomes are the results of psychological and contextual factors (Ford, 1996; Woodman et al., 1993). The theoretical framework for this thesis is Creative Knowledge Environments (CKE) that Hemlin, Allwood, and Martin (2004; 2008) developed. They defined Creative Knowledge Environments as follows:

> …those environments, contexts and surroundings, the characteristics of which are such that they exert a positive influence on human beings engaged in creative work aiming to produce new knowledge or innovations, whether they work individually or in teams, within a single organization or in collaboration with others. (Hemlin et al., 2004, p.1)

CKE operate at several levels. Individuals are on work teams (at the micro level) within an organization or an organizational department (at the meso level). The organization/department is in a sector (university, industry), in a region, and in a nation (the macro level). At the macro level, market characteristics, laws, and regulations as well as regional, national, and cultural characteristics have influence. These levels can be described as mutually influential. For example, individuals, who are often members of teams, are influenced by factors such as team climate and leadership. In turn, teams, which are in departments or areas in the organization, are influenced by the organizational culture, resource availability, and various structural factors. This thesis focuses primarily on the micro level by investigating the relationship between team leadership and innovation.

CKE is similar to other noteworthy conceptualizations of creativity and innovation in organizations—Woodman et al.'s (1993) early interactionist theory of organizational creativity, and Ford's (1996) multi-level theory of creative action in social domains. Several reviews and meta-analyses on individual innovation are central to this thesis. In a recent review of innovation research, Anderson et al. (2004) identified several key factors that facilitate innovation at three levels: the individual, team, and organizational levels. Other literature reviews and meta-analyses have described various factors related to individual level innovation (Hammond et al., 2011), leadership as a predictor of innovation (Mumford et al., 2002; Rosing et al., 2011), team and organizational climate (Hülsheger et al., 2009; Hunter, Bedell, & Mumford, 2007), and organizational factors that influence innovation (Damanpour, 1991; Damanpour & Aravind, 2012). Table 3 synthesizes and condenses this literature with reference to Anderson et al. (2004) and Hemlin et al. (2008).

TABLE 3
Determinants of innovation at the individual, team, and organizational levels

Characteristic	Factor	Studies (empirical/meta-analytic)
Individual level		
Personality	Openness to experience, conscientiousness (N), autonomy, proactivity, locus of control, need for achievement	Barron & Harrington (1981); George & Zhou (2001); Keller (2012); Seibert, Kraimer, & Crant (2001)
Motivation	Intrinsic motivation, extrinsic motivation (N), self-efficacy, creative self-efficacy	Frese, Teng, & Wijnen (1999); Hammond et al. (2011); Prabhu, Sutton, & Sauser (2008); Tierney & Farmer (2011)
Cognitive ability and style	Knowledge and expertise, divergent thinking in combination with convergent thinking	Basadur, Graen, & Scandura (1986); Feist & Gorman (1998)
Task characteristics	Complexity, autonomy, challenge, stimulation, pressure (curvilinear)	Amabile et al. (1996); Hammond et al. (2011); Hunter et al. (2007)
Team level		
Structure	Job relevant diversity, background diversity (N), cohesion (curvilinear), size (N), goal inter-dependence	Hülsheger et al. (2009); Keller (2001); West & Anderson (1996)
Climate	Internal and external communication, openness, emotional safety, interpersonal relationships, participation, idea support, risk-taking, task orientation, conflict (N)	Amabile et al. (1996); Anderson & West (1998); Bain, Mann, & Pirola-Merlo (2001); Ekvall (1996); Hunter et al. (2007); Tierney, Farmer, & Graen (1999)
Leadership/leader traits	Participation, support, vision, goal setting, expertise, problem solving skills	Hülsheger et al. (2009); Mumford et al. (2002); Pearce & Ensley (2004); Tierney et al. (1999); Rosing et al. (2011)
Organizational level		
Structure	Specialization, functional differentiation, internal/external communication, formalization (N), centralization (N)	Damanpour (1991); Damanpour & Aravind (2012); Ekvall (1996)
Culture	Espoused/enacted support for innovation, experimentation, risk-taking, openness, trust, empowerment	Amabile et al. (1996); Ekvall (1996); Ekvall & Ryhammar (1999); Mann (2005); West & Anderson (1996)
Resources	Time, money, facilities, information, knowledge and expertise	Amabile et al. (1996); Damanpour (1991); Mann (2005)

Adapted from Anderson et al. (2004, p. 150) and Hemlin et al. (2008, p. 201).
Note: Factors thought to have a negative or curvilinear relationship with innovation are marked "(N)" and "(curvilinear)" respectively.

Determinants of innovation at the organizational level

Organizational structure. Burns and Stalker (1961), in their seminal work, described the difference between mechanistic and organic organizational structures. Mechanistic organizations typically rely on a high degree of formalization (using rules and procedures) and centralization (concentration of decision-making at upper management levels). Furthermore, mechanistic organizations tend to have a lower degree of complexity (differentiation of functions) compared to organic organizations. Organic organizations, on the other hand, have more areas of expertise and thus a broader knowledge base (specialization), as well as a greater tendency for employees to engage in cross-functional collaboration. Organic organizations also tend to engage in more internal and external communication. Internal communication within the organization spreads knowledge and ideas. External communication outside the organization promotes scanning the environment for opportunities, forming cooperative alliances with other organizations, and absorbing knowledge (also known as absorptive capacity). Managers at organic organizations, who are typically more favorably inclined toward change, are more likely to challenge the status quo (Burns & Stalker, 1961; Damanpour, 1991).

Damanpour (1991) tested the relationships between innovation and organizational characteristics (formalization, centralization, specialization, internal and external communication, and attitudes toward change) in a meta-analysis. Damanpour and Aravind (2012) re-tested these characteristics using a sample of studies published between 1991 and 2009. These two meta-analyses resulted in a similar pattern of correlations between the organizational characteristics and innovation, which suggests robustness of the relationships. Four characteristics that demonstrated good effect sizes in both meta-analyses were the following: specialization, complexity, external communication, and the degree of available technical knowledge resources. In addition, three characteristics that had positive effects in the 1991 meta-analysis also had positive correlations in a majority of the characteristics in the 2012 sample: professionalism (the degree of education and experience of organizational members), internal communication, and managerial attitude towards change. In summary, innovation appear to occur more naturally in decentralized, organic, and flexible contexts than in mechanistic and rigid organizational contexts (Jung et al., 2008; Kanter, 1996; Mumford et al., 2002; Thompson, 1965).

Organizational culture. The culture of an organization, specifically its degree of organizational support, also influences innovation (Amabile et al., 1996; Anderson & West, 1998; Hemlin et al., 2008; Pirola-Merlo, Bain, & Mann, 2005; Woodman et al., 1993). A number of studies have shown that support for innovation is positively

related to team innovation (e.g., Agrell & Gustafson, 1994; Anderson & West, 1998; Hülsheger et al., 2009; Pirola-Merlo, 2000). When teams and individuals are supported, they feel they can test new ideas and methods aimed at achieving their goals or completing their tasks (Pirola-Merlo et al., 2005).

Pirola-Merlo (2000) suggested dividing organizational support into three forms. The first form is organizational encouragement of innovation, that is, the extent to which individuals perceive various types of support such as idea encouragement, trust, emotional safety, and acceptance of risk-taking. The second form is access to needed resources such as time, materials, expertise, and information. The third form is empowerment, that is, the extent to which individuals feel autonomous as they undertake tasks. Such organizational support may lead to actual advances in innovation (Bain et al., 2001; Ekvall & Ryhammar, 1999).

In a questionnaire study among hospital management groups, West and Anderson (1996) found that organizational support for innovation was the strongest predictive factor of innovation, (i.e., the implementation of organizational changes). In particular, autonomy, or the freedom to pursue ideas, has consistently been linked to innovation (e.g., Ekvall, 1996; Hunter et al., 2007). Granting autonomy, which is a signal of trust, can empower teams and individuals who, as a result, experience a sense of ownership and control (Amabile, 1998; Mann, 2005; Pirola-Merlo, 2000).

Resources. From an organizational perspective, innovation is often resource-intensive (Damanpour & Aravind, 2012; Mumford et al., 2002; Woodman et al., 1993). These resources may be the money, time, and facilities for new projects that develop research ideas (Pirola-Merlo, 2000) or, increasingly important, the access to relevant information and knowledge (Tidd & Bessant, 2009).

Determinants of innovation at the team level

Team composition. Primarily, there are two types of diversity in teams: job-relevant diversity and background diversity. Job-relevant diversity refers to employees' different competences and functions, education, tenure, skills, and knowledge. Background diversity mainly refers to employees' age, gender, and ethnicity. The literature proposes that job-relevant diversity encourages team innovation because of the different perspectives and approaches that stimulate the communication of diverse information (e.g., Paulus & Yang, 2000; Reiter-Palmon, de Vreede, & de Vreede, 2013; West & Anderson, 1996). Hülsheger et al.'s (2009) meta-analysis related job-relevant diversity positively to team innovation but related background diversity negatively to team innovation. They explained that diverse backgrounds might impede communication, thereby increasing the risk of conflict and misunderstanding. In a longitudinal study of four manufacturers, Keller (2001) found that job-relevant

diversity indirectly influenced the performance of 93 cross-functional R&D teams as far as their product technical quality and scheduling.

Team size. Some scholars have suggested that team size (i.e., the number of team members) is positively related to innovation. More team members increase the likelihood that the team has sufficient competences (e.g., Stewart, 2006). Hülsheger et al. (2009) also found this positive relationship in their meta-analysis. However, at the individual level, they found a slightly negative relationship between team size and innovation. These findings suggest that team size is important when a team works on a complex innovation task that requires many and various competences, but a larger team size may encourage social loafing and free riding.

Team climate. Several factors pertaining to team climate have been linked to innovation. Team climate is the psychological atmosphere in the team and its organizational environment (Hemlin et al., 2008). Team creativity is facilitated when team member relationships (including the relationships with their supervisors) are positive and supportive. In this climate, ideas are encouraged, and risk-taking is approved (Hunter et al., 2007), members work together and communicate closely (Hülsheger et al., 2009), conflict is low (Ekvall, 1996), and joy is present (Hemlin, 2009).

An important team climate factor is the nature of its information exchange (Mumford et al., 2002). Internal communication refers to the information-sharing interactions within the team. External communication refers to the information-sharing interactions outside the team. These interactions are thought to increase the likelihood of new knowledge and perspectives entering the team (Perry-Smith & Shalley, 2003). It is especially important how a team uses these communication channels in innovation ventures where objectives are complex and ambiguous (Keller, 2001; Reiter-Palmon & Ilies, 2004). Hülsheger et al. (2009) related both internal and external communication positively to team innovation.

Task orientation. When team members agree that task outcomes should be as excellent as possible, the team has a high degree of task orientation. In such teams, members think about which processes and strategies can achieve their objectives. Typically, various ideas to improve the quality of decisions about processes and strategies are explored (Hemlin, 2008; Hülsheger et al., 2009). Often task orientation is a sub-construct in various team climate scales. An example is the Team Climate Inventory (TCI) that Anderson and West (1998) related to team innovation in R&D (see also Pirola-Merlo et al., 2005). A closely linked concept is goal interdependence, which is the extent to which team members share the same goals. In the meta-analysis by Hülsheger et al. (2009), goal interdependence was positively related to team innovation.

Vision. A team's vision is a clear expression of the purpose and importance of its goals (West & Anderson, 1996). A vision helps team members channel their efforts into solving problems and completing tasks. Hülsheger et al. (2009) found that a leader's support of the team vision through good communication and task-oriented focus was one of the strongest predictors of team innovation. Other studies have also established relationships between leader support for team vision and team innovation (e.g., Pieterse, van Knippenberg, Schippers, & Stam, 2010).

Determinants of innovation at the individual level

Personality. In a multi-faceted review of artists' and scientists' personalities, Feist and Gorman (1998) described the creative personality. Individuals with such personalities, they claim, are open, flexible, and self-confident. Such individuals also have high self-efficacy and a strong need for autonomy. Self-efficacy refers to people's perception of their effectiveness in a specific area. Autonomy refers to people's freedom to pursue their goals and to develop their ideas. Moreover, innovative behavior has been associated with other personality traits: high proactivity (Seibert et al., 2001), high achievement orientation (Barron & Harrington, 1981), openness to experience (Hammond et al., 2011), and internal locus of control (Keller, 2012). Individuals with an internal locus of control think they control their future, whereas individuals with an external locus of control think the future is outside their control (Judge, Locke, & Durham, 1997). Finally, George and Zhou (2001) showed that the personality trait conscientiousness is negatively related to creativity in the workplace.

Cognitive ability and style. Much of the work in R&D requires knowledge and expertise (Amabile et al., 1996; Hemlin, 2009; Woodman et al., 1993). However, expertise alone does not necessarily lead to innovative excellence. Feist and Gorman (1998) claimed that the way in which creative people approach a problem determines the outcome. Highly productive scientists have an open and explorative mindset at the beginning of the process. This mindset becomes considerably more incisive, focused, critical, and evaluative toward the end of the process. Divergent thinking, i.e., the ability to combine knowledge elements from diverse sources, is best combined with convergent thinking, that is, the ability to focus on and select the best solution to a specific problem, to produce creative and innovative outcomes (Woodman et al., 1993). In a longitudinal study of 644 scientists in the R&D departments of five organizations, the degree to which participants engaged in divergent thinking predicted the amount of patents and publications they produced (Keller, 2012).

Intrinsic motivation. Some scholars claim that the personality traits that favor creative outcomes depend on a key mediator: individual intrinsic motivation (Amabile, 1983; Mumford et al., 2002). According to Amabile (1983; 1998) intrinsic motivation

is a motivational state resulting from a reaction to the intrinsic challenge of a task (i.e., the work itself), rather than to extrinsic factors such as rewards. This motivational state is arguably one of the most important individual factors related to creativity (Amabile, 1983; Woodman et al., 1993). For example, Prabhu et al. (2008) found that intrinsic motivation mediated the personality traits of openness to experience and self-efficacy to individual creativity.

Creative self-efficacy. In their development of Bandura's (1977) theory of self-efficacy, Tierney and Farmer (2002) defined creative self-efficacy as the self-belief in one's abilities to be creative. A number of studies have related creative self-efficacy to individual creativity (e.g., Gong, Huang, & Fahr, 2009; Tierney & Farmer, 2011) and to team creativity (Shin & Zhou, 2007; Somech, 2006; Sosik et al., 1997). High levels of self-efficacy may increase intrinsic motivation (Ford, 1996) and mobilize individuals' cognitive resources in pursuit of their ideas (Thomas & Velthouse, 1990).

Task characteristics. Various scholars have suggested that task characteristics influence employees' creativity and innovative behavior. Hammond et al. (2011) related task characteristics, such as job complexity, work autonomy, and expectations of creativity, to individual innovation. Krause (2004) showed that when project leaders allow team members to use their own discretion, idea generation and idea implementation increase. Creativity in tackling challenging and complex tasks is enhanced when people are allowed more freedom because of their intrinsic motivation (Amabile, 1988; Oldham & Cummings, 1996). Moreover, such tasks spur employees to focus their attention, try new alternatives, and find creative solutions (Shalley & Gilson, 2004).

Summarizing determinants of innovation

Organizations that want to maximize their employee's innovation capabilities should first assess their organizational structure. Overly formalized and bureaucratic organizational structures seem to impede innovation. In contrast, organizational structures in which decision-making and influence over processes are decentralized and in which project teams have considerable autonomy seem to facilitate innovation (Damanpour & Aravind, 2012; Jung et al., 2008; Thompson, 1965). Upper management should encourage, expect, and reward creative ideas (Mumford & Gustafsson, 1988), promote open and critical discussion without fear of negative reprisals, and accept that failure is sometimes inevitable (Mann, 2005; Pirola-Merlo, 2000). Project teams should have a diversity of competences (Reiter-Palmon & Illies, 2004) as well as people with creative personalities and proactive traits (Feist & Gorman, 1998; Seibert et al., 2001). Team members should be assigned tasks that are challenging and stimulating (Amabile, 1998; Oldham & Cummings, 1996; Shalley &

Gilson, 2004), and shared (Anderson & West, 1998). Last, team members should be presented with a clearly stated vision (Pieterse et al., 2010).

However, a fundamental question must be asked: Who is responsible for implementing these recommendations and creating environments that encourage individual innovation? It is evident that ultimately this responsibility rests with the conductors of the symphony called organizational innovation — the leaders.

The role of leaders in R&D

Innovation *management* typically focuses on sustaining and nurturing innovation through managing the processes, strategies, structures, and external linkages related to innovation (Tidd et al., 2001). This thesis takes a narrower scope in that it deals with the role of R&D team leaders where most innovative activities of the organization take place. Despite the vast body of innovation and creativity research, relatively little attention has been paid to the relationship between innovation and leadership (Byrne et al., 2009), especially in R&D environments (Elkins & Keller, 2003). For example, in their meta-analysis, Hiller, DeChurch, Murase, and Doty (2011) do not discuss innovation as an outcome of leadership. In their summary of 1161 empirical studies, the aim was determine "whether, when, and how leadership affects outcomes" (p. 1137).

The reason may be that in complex systems such as organizations, the influence of leaders on innovation is only one of several influences (Kaiser, Hogan, & Craig, 2008). For example, because progress in innovation work is often non-linear, significant space exists for unpredictable dynamics (Marion & Uhl-Bien, 2001). In some instances, this unpredictability is the result of external forces and chance (Kaiser et al., 2008). In this perspective, innovation is a complex process that cannot be adequately and systematically managed (Tidd & Bessant, 2009). Another reason may be the "romantic conception of the creative act" (Mumford et al., 2002, p. 706). According to this notion, individuals conceive of creative ideas that their supervisor obstructs

rather than facilitates. However, conclusions from research into intra-organizational innovation point in the opposite direction. Leaders are increasingly considered essential for the facilitation of innovation. They can create the necessary conditions that allow innovation and creativity to flourish (Kaiser et al., 2008; Mumford et al., 2002; Shalley & Gilson, 2004).

As a general framework, this thesis conceptualizes the leadership role as integral to organizational innovation. Leaders have a dual role in managing innovation among individuals and teams. First, leaders can create the favorable environments and the multiple opportunities that lead to innovation (Shalley & Gilson, 2004). For example, they can help create and support a positive team climate (Anderson & West, 1998), facilitate problem-solving and team reflection (Puccio, Mance, & Murdock, 2010; Somech, 2006; Tierney et al., 1999), and assemble diverse teams (Keller, 2001). Moreover, leaders can increase individual intrinsic motivation (Deci & Ryan, 1987) and establish and maintain high quality work relationships with team members (Scott & Bruce, 1994). In this role, leaders promote innovation as a bottom-up process. They are the facilitators who create the conditions that allow team members to produce innovative outcomes.

Second, leaders embody the organization's desire to be innovative. For example, they manage and allocate resources such as time, facilities, money, and knowledge (Drazin, Glynn, & Kazanjian, 1999), set individual and team goals (Shalley & Gilson, 2004), coordinate expectations about innovation outcomes (Yuan & Woodman, 2010), monitor progress (Mumford & Connelly, 1991), oversee the reward system (Mumford & Gustafson, 1988), and grant autonomy to individuals and teams (Hemlin, 2006; Hülsheger et al., 2009). In this role, leaders promote innovation as a top-down process. They are the managers who coordinate the organization's innovation strategies and goals.

Theories of leadership

How does the literature define leadership? The concept is multifaceted with no single definition, but a reasonable and influential definition states that leadership is a process whereby one individual exerts influence over a group (Yukl, 2002). Leadership in organizations is typically studied at the individual level, for example, in research or project teams where there is a formal leader and various team members. This thesis focuses on the formal leaders of such teams.

Authors, researchers, and practitioners have long theorized about leadership. Human trait theories have focused on the characteristics of successful leaders. One popular theory was (and is) the so-called great man theory that maintains that outstanding leaders are simply born to be great. Other leadership theories—

contingency theories—focus on situational characteristics rather than personal characteristics. According to these theories, successful leaders adapt to their circumstances.

Today, much of the contemporary leadership literature on innovation refers to the transformational/transactional theory of leadership (Bass, 1985). Transformational leadership is a style theory of leadership (Oke, Munshi, & Walumba, 2009) in which *transformational* leaders exert influence by "broadening and elevating followers' goals and providing them with confidence to perform beyond the expectations specified in the implicit or explicit exchange agreement" (Dvir, Eden, Avolio, & Shamir, 2002, p. 735). In contrast, *transactional* leaders exert influence by means of the contractual exchange of rewards and corrective actions (Avolio, Bass, & Jung, 1999). Researchers have related transformational leadership to innovation in the study of individuals and teams (e.g., Eisenbeiss, van Knippenberg, & Boerner, 2008; Jung, 2001; Rank et al., 2009) and of organizations (e.g., Aragón-Correra, García-Morales, & Cordón-Pozo, 2007; Gumusluoğlu & Ilsev, 2009; Jansen, Vera, & Crossan, 2009).

There are other studies that link leadership to innovation. Some studies have operationalized leadership as leader behaviors that are positively related to individual and team innovation, for example, behaviors that aim at clarifying problem construction and improving self-efficacy (Redmond, Mumford, & Teach, 1993), stimulating open discussion and debate (Somech, 2006), and providing support and encouragement (Krause, 2004; Rosing et al., 2011).

Leadership consists of three elements: the leader, the team (or group) members, and the leader–member work relationship (Graen & Uhl-Bien, 1995). While much research on the leader's role in innovation has focused on leadership style and behavior, the perspective of this thesis is that leadership is a relational concept. This means the focus is on the leader-employee relationship rather than on the leader in isolation. Thus, leadership is viewed more inclusively in this thesis because it addresses those who are led (i.e., employees or team members) as well as those who lead.

This thesis conceptualizes the leader-member work relationship using leader-member exchange (LMX) theory (Graen & Cashman, 1975; Graen & Uhl-Bien, 1995). In this theory, the work relationship is the primary means leaders use to exert their influence. LMX may be especially important to investigate in R&D settings because of its team member focus. Without team members' ideas and efforts, there are no innovative achievements. In R&D settings, in particular, leaders may have to take greater recognition of these ideas and efforts than they would in less knowledge-intensive settings (Olsson, 2012). As Feist and Gorman (1998) discussed, engineers and scientists (who are often employed in R&D settings) require a high degree of autonomy. They have their own visions and ideas, and can manage their own tasks

(Hemlin, 2006). Thus, leadership in which followers have an active role in negotiating the leader-follower work relationship may be especially pertinent in R&D settings.

A closer look at LMX theory

LMX theory, theoretically rooted in role theory and social exchange theory, differs from other leadership theories because it focuses on the unique work relationship between supervisor and employee or, as in this thesis, between team leader and team member (see Gerstner & Day, 1997). LMX theory views leadership as a tacit agreement about what is expected from each participant in the leader–member dyad. Low quality LMX relationships are based primarily on the employment contract where the leader-follower interaction is formal and impersonal. In high quality LMX relationships, team members and leaders exert themselves beyond the formal terms and conditions of their work contracts. Their interactions are based on mutual trust, respect, liking, and influence (Greguras & Ford, 2006).

In the development of work relationships, leaders and team members gradually enter into reciprocal exchanges of greater value (Graen & Cashman, 1975). LMX relationships establish quickly—in about two to four weeks—and appear to be stable thereafter (Liden, Wayne, & Stilwell, 1993; Nahrgang, Morgeson, & Illies, 2009). In the early stages of the relationship, a leader assesses the motivation, behavior, and performance of a team member in order to determine how much discretion, autonomy, and influence in decision-making to allow that team member (Graen & Cashman, 1975; Scott & Bruce, 1994).

Gerstner and Day (1997) demonstrated that the quality of LMX is predictive of outcomes at the individual, team, and organizational levels. For example, researchers have studied the following outcomes: work performance (Burton, Sablynski, & Sekiguchi, 2008; Wang, Law, Hackett, Wang, & Chen, 2005), organizational commitment behavior (Burton et al., 2008; Sherony & Green, 2002), employee job satisfaction and well-being (Hooper & Martin, 2008), and creative performance (Olsson, Hemlin, & Pousette, 2012).

Researchers have also suggested that the quality of the LMX relationship relates to individual innovation. The heightened sense of advocacy and trust in high quality LMX relationships influences team member creativity (Mumford & Gustafson, 1988), partly because leaders are likely to evaluate ideas more favorably (Zhou & Woodman, 2003). Leaders in high quality LMX relationships may also increase team members' freedom in the implementation of creative ideas (Hemlin et al., 2008; Liden & Maslyn, 1998). Yuan and Woodman (2010) found that higher performance expectations and increased team member recognition in the organization might also stimulate innovation. However, empirical studies of LMX and of individual

innovation are few (e.g., Basu & Green, 1997; Scott & Bruce, 1994; Yuan & Woodman, 2010). Given the few studies, more research is needed. Olsson (2012, p. 62) argued, "scholars of leadership research should incorporate leaders, followers, and relational as well as contextual variables in order for the field to advance." This thesis is intended to help fill this gap in the leadership research.

How R&D leaders influence individual innovation

Innovation, from an individual perspective, has both cognitive and motivational aspects (Ford, 1996; Woodman et al., 1993). For instance, to generate ideas, individuals need to reorganize and combine knowledge, which is a cognitive process (Soriano de Alencar, 2012). Innovative work is also typically riddled with setbacks and problems (Reiter-Palmon & Ilies, 2004). People's intrinsic motivation will partly determine how much effort they invest in trying to overcome these difficulties (Puccio & Cabra, 2012). Leaders can influence both these cognitive and motivational aspects (Mumford et al., 2002; Rosing et al., 2011).

Creative problem-solving. The problems of innovative work are exceptional because they are often new to the person who encounters them, ill-defined because they are ambiguous and difficult to understand, and complex because they may have several different solutions (Mumford, Peterson, & Robledo, 2013; Reiter-Palmon & Ilies, 2004). The problem-solver must therefore begin by structuring (or making sense of) a problem and by identifying the goals, conflicts, procedures, restrictions, and data required to understand and solve it (Mumford, Mobley, Uhlman, Reiter-Palmon, & Doares, 1991). In some cases, problem construction is a relatively straightforward and quick process, after which the problem-solver can collect data and generate ideas. In other cases, however, the problems are so difficult that successful problem construction is essential for finding innovative solutions. Several studies have shown that when people spend more time constructing a problem, they generate better and more original solutions (e.g. Redmond et al., 1993). Leaders can assist in this process by offering their expertise. In fact, leaders' expertise (i.e., their domain-related knowledge and experience) is a strong predictor of innovation in R&D (Mumford et al., 2002).

Support. Although leader support is not a clearly defined concept (Rosing et al., 2011), it is thought that leaders who recognize the team members' good work, support them emotionally, involve them in important decisions, and monitor their progress fairly are instrumental in promoting innovative work. Less supportive leaders give employees ambiguous task assignments, fail to resolve important problems, and fail to monitor progress adequately (Amabile et al., 2004). Leaders typically support those team members with whom they have high quality work relationships (Liden & Maslyn, 1998). Leader support may also be important when the workload is high.

Janssen (2000) demonstrated that job demands were positively related to team members' innovative work behaviors only when team members perceived that leaders fairly rewarded their work. Janssen took a social exchange perspective on fairness that maintains that, much like LMX theory, exchanges consist of interpersonal trust and mutual obligation.

Guidance and intellectual development. Using their technical expertise, leaders can guide team members in selecting those ideas that are most likely to meet an objective or solve a problem. Leaders can help their team members construct and understand a problem (Mumford, Connelly, & Gaddis, 2003). Leaders with high expertise may also contribute knowledge and ideas useful in solving novel problems (Hemlin & Olsson, 2011). Furthermore, R&D leaders may stimulate their team members' intellectual development in a way that leads to an accumulation of knowledge and expertise (Bass, 1999; Rosing et al., 2011).

Other leadership behaviors. Other leader behaviors and leadership styles are less frequently examined in relation to innovation (Rosing et al., 2011). Krause, Gebert, and Kearney (2007) found that participative leadership is related to innovation at the individual level. Somech (2006) reached the same conclusion at the team level. Participative leaders share decision-making with their team members. Other studies have found that leaders should not monitor the innovative work by their employees too closely. George and Zhou (2001) showed that close monitoring was negatively related with employee creativity. Oldham and Cummings (1996) found that non-controlling leadership was positively related to industrial workers' individual creativity as assessed by supervisors (but not with patents, which are more related to innovation).

Summary of the empirical studies

General aim of this thesis

Research on innovation in R&D is fragmented because researchers have not yet agreed on the factors that influence innovation, or on how these factors interact (Hemlin et al., 2008). Thus, several scholars call for more inquiry (e.g., Anderson et al., 2004; Avolio, 2007; Graen & Uhl-Bien, 1995; Hackman & Wageman, 2007; Hammond et al., 2011; Hemlin et al., 2008; Hunter et al., 2007; Mumford et al., 2002; Shalley & Gilson, 2004). In particular, we know little about the contextual factors that influence leaders' abilities to promote innovation in organizations (Rosing et al., 2011) or about the psychological mechanisms that mediate leadership to individual innovation (Byrne et al., 2009).

This thesis responds to that call with its investigation into the factors that mediate and moderate the relationship between leadership and innovation.

Theoretical framework and central constructs

The theoretical framework Creative Knowledge Environments (CKE) posits that individuals who conduct creative work (such as in R&D) are nested in several different organizational levels of influence (Hemlin et al., 2008). This thesis contributes to the CKE framework and to the general body of knowledge of leadership and individual innovation in two ways, labeled here as (1) and (2).

(1) This thesis proposes and tests three psychological constructs (personal initiative, intrinsic motivation, and creative self-efficacy) as mediating variables because of their potential to advance our understanding of how leadership relates to individual innovation. The three constructs are facets of a general motivational construct.

Personal initiative is conceptually similar to intrinsic motivation. However, whereas intrinsic motivation is a psychological state (Amabile, 1983), personal initiative is a behavioral construct. Personal initiative is "a behavior syndrome resulting in an individual's taking an active and self-starting approach to work and going beyond what is formally required in a given job" (Frese, Fay, Hilburger, Leng, & Tag, 1997, p. 140). In this thesis, intrinsic motivation and personal initiative are proposed and tested as predictors of individual innovation in conjunction with leadership. None of the theoretical frameworks by Ford (1996), Woodman et al. (1993), or Hemlin et al. (2004; 2008) proposes the concept of personal initiative as a predictor of individual innovativeness.

There are, however, good reasons to complement these three theoretical frameworks with personal initiative. In innovation, the emphasis is on the implementation of ideas. Personal initiative is a particularly relevant concept in a R&D context because of its behavioral- and action-oriented focus (Rank, Pase, & Frese, 2004). Individuals with high personal initiative are proactive and set goals beyond the terms of their formal work contracts. For example, the concept has been related to individual creativity (Binnewies, Ohly, & Sonnentag, 2007) and to problem-solving (Daniels, Wimalasiri, Cheyne, & Story, 2011). This thesis proposes that personal initiative mediates the relationship between LMX and individual innovation. For example, the increased trust and mutual contribution associated with high quality LMX relationships may encourage team members to take the initiative at work when they think leaders listen to their ideas and support their innovation efforts.

Creative self-efficacy differs from the two other constructs in that it is self-belief in one's ability to produce creative outcomes (Tierney & Farmer, 2002). It is proposed in this thesis that creative self-efficacy mediates the relationship between leadership and personal initiative. It is likely that high quality LMX relationships increase team members' creative self-efficacy because of increased leader support, positive feedback on ideas, provision of useful resources (Chong & Ma, 2010; Tierney & Farmer, 2002), and expectations of creativity (Yuan & Woodman, 2010). Individuals with strong creative self-efficacy should be inclined to take the initiative in promoting and realizing their ideas (Tierney & Farmer, 2011).

(2) This thesis proposes and tests the influence of moderating variables in the relationship between leadership and the psychological constructs of intrinsic motivation and personal initiative. Several researchers have called for more study in

this area as leaders are influenced by organizational factors (Byrne et al., 2009; Mumford et al., 2002; Shalley & Gilson, 2004). The construct of organizational support is especially relevant in the R&D setting since meta-analyses have shown that support is one of the strongest factors that predict individual innovation (Hülsheger et al., 2009; Hunter et al., 2007). Bain et al. (2001), who studied R&D teams, confirm these findings.

This thesis follows Mann's (2005) description of organizational support. According to Mann, organizational support has the following characteristics: (A) Organizational encouragement of innovation, which encompasses both the espoused value of innovation (i.e., the stated value of innovation) and the enacted value (i.e., the actual support for innovation); (B) Resource availability, which includes access to facilities, materials, time, expert knowledge, and useful information; and (C) Empowerment, which refers to employee autonomy (i.e., the freedom to pursue unique ideas and insights independently) and supervisory encouragement.

This thesis proposes that the presence or absence of organizational support affects the ability of the leader to manage and promote innovation among team members. According to LMX theory, leaders and members continually engage in exchanges aimed at achieving better work relationships (Liden & Maslyn, 1998). When leaders are in an environment in which innovation is encouraged (i.e., an environment in which sufficient resources are available and work group autonomy is permitted), the likelihood that they will provide such resources and grant such autonomy increases (Graen, Cashman, Ginsburgh, & Schiemann, 1977).

How mediating and moderating variables work

It is important to differentiate between mediation and moderation. Both mediating and moderating variables are "third variables" that explain some aspect of the relationship between an independent variable, or the *predictor*, and a dependent variable, or the *criterion*. In this thesis, the predictor variable is leadership, and the criterion variable is innovation.

Baron and Kenny (1986, p. 1176) defined a mediating variable as a variable that "accounts for the relation between the predictor and the criterion." Thus, a mediating variable explains the mechanisms in the relationship between two other variables. They defined a moderating variable as "a qualitative (e.g., sex, race, class) or quantitative (e.g., level of reward) variable that affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or criterion variable" (p. 1174). Thus, a moderating variable explains the contingencies or circumstances when a relationship between two other variables is either strong or weak.

Overview and specific aims of the four studies

Study I is a review of the leadership and innovation literature. This study identifies and analyzes the factors that researchers claim mediate or moderate the relationship between leadership and innovation. Study I also identifies the non-conclusive factors and proposes new factors. Details of all four studies, with their findings, follow this overview of Studies II, III, and IV.

Study II empirically tests a model in which LMX is hypothesized as positively related to individual innovation. Specifically, this study integrates and tests several streams of research on how mediating and moderating factors affect leaders' influence on individual innovative work behavior as well as on innovation outcomes. The study hypothesizes that the relationship between LMX and team members' innovation is mediated by their intrinsic motivation and personal initiative. The study also hypothesizes that organizational support moderates the relationship between LMX and team members' intrinsic motivation and personal initiative. The model was tested at five Swedish companies known for their innovation.

Study III is a cross-cultural study that tests a model in innovative Swedish, French, U.S., and Indian industrial R&D teams. The study hypothesizes that LMX is positively related to individual innovation and is mediated by individuals' personal initiative. The study also hypothesizes that creative self-efficacy mediates LMX relative to personal initiative. Additionally, the study hypothesizes that the culturally bound personal value of conservation is negatively related to innovation.

Study IV is an interview study that uses the Critical Incident Technique (Flanagan, 1954) to identify leader behaviors that either facilitate or impede individual innovation and to identify the consequences of these behaviors. The study was conducted at the R&D departments of two innovative Swedish industrial companies. See Table 4 for an overview of the four studies.

TABLE 4

Overview of the four studies in the thesis

Study	Method	Sample	Predictor variables	Mediator/moderator variables	Criterion variables	Data collection period
I	Literature review	30 empirical articles	-	-	-	2009-2012
II	Survey. R&D departments at five Swedish industrial organizations	166 team members, 43 team leaders, 10 department managers	-LMX	-Intrinsic motivation *(mediator)* -Personal initiative *(mediator)* -Organizational support *(moderator)*	-Innovative work behavior -Innovation outcomes	2010
III	Survey. Four sites (Sweden, France, the USA, India) of R&D departments at an industrial organization	269 team members, 60 team leaders, 22 department managers	-LMX -Conservation	-Creative self-efficacy *(mediator)* -Personal initiative *(mediator)*	-Innovative work behavior -Innovation outcomes	2011-2012
IV	Interviews: Critical Incident Technique. R&D departments at two Swedish industrial organizations	72 team members and leaders	-	-	-	2012

Study I

Study I reviews the last 30 years of the research literature that describes the factors that moderate or mediate the relationship between team leadership and team or individual innovation.

Materials and methods. Online databases were used to search for empirical articles with the keywords leadership, innovation, and/or creativity. As a result of the article search, 99 peer-reviewed articles satisfied the following two criteria: i) empirically based; and ii) leadership treated as a predictor variable and innovation as a criterion variable.

The articles also had to meet several quality criteria (e.g., published in a journal with a journal impact factor[2] >1.0). In addition, we searched the Google Scholar database for influential articles that were frequently cited but were published in journals with a lower journal impact factor. The articles were coded according to the following categories: i) study sample, ii) level of analysis, iii) type of criterion variable[3] (i.e., creativity or innovation) and how it was measured (i.e., by subjective or objective measures), iv) predictor variables (i.e., how leadership was measured), v) mediating and moderating variables, and vi) results. The final sample consisted of 30 articles.

Results. At the individual level, leaders may stimulate their employees' creative self-efficacy (i.e., their perception of their creative ability) that results in innovative behavior (Gong et al., 2009; Redmond et al., 1993). Creative self-efficacy therefore mediates the relationship between leadership and individual innovation. Moreover, Study I identifies two factors that moderate this relationship. The first factor is organization-based self-esteem (OBSE), defined as an individual's self-perceived value as an organizational member (Pierce, Gardner, Cummings, & Dunham, 1989). Employees with low OBSE doubt their ideas or efforts benefit the organization. OBSE moderates the relationship between leadership and individual innovativeness because the relationship is stronger for employees with low OBSE (Rank et al., 2009).

The second factor is the individual's self-presentation orientation that also moderates the relationship between leadership and individual innovation. This concept refers to the extent to which an individual engages in certain behaviors, such as impression management, in order to meet the social context expectations in the organization (Gangestad & Snyder, 2000). High self-monitors (i.e., individuals with a high self-presentation orientation) tend to control and alter their behavior so as to present an image congruent with others' expectations. Low self-monitors do not engage in such image construction (Day, Schleicher, Unckless, & Hiller, 2002). Rank et al. (2009) found that self-presentation moderates the relationship between transformational leadership and individual innovativeness, and that the relationship is stronger for employees with a low self-presentation orientation. These authors concluded that low self-monitors perform best when they work for an organization that agrees with their beliefs and when they can do things their own way. Such individuals also perform best under transformational leaders who take into account their individual strengths and needs.

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[2] The journal impact factor (IF) of a journal reflects the average number of times each article in the journal has been cited in the preceding two years. Thus, when a journal has an IF of 1 or more, each article in the journal has, on average, been cited one or more times in the preceding two years (Garfield, 2006).

[3] The literature search and coding procedure were used in another article on factors that mediate and moderate the relationship between leadership and creativity (Denti & Hemlin, 2013). Study I includes only those articles coded with innovation as the dependent variable.

At the team level, leaders who introduce norms that promote debate, open communication, and divergent thinking may stimulate team innovativeness. Somech (2006) conceptualized the communicative process by which team members collectively reflect on the team's goals, strategies, and processes as "team reflection". She found that leaders facilitate team reflection, which in turn influences team innovation. Thus, team reflection is a mediator. Furthermore, Somech found that team heterogeneity moderates leaders' efforts when innovation is the goal. When team heterogeneity is low, a more direct style of leadership is needed to stimulate discussion and divergent thinking. A more participative leadership style is beneficial when team heterogeneity is high. Moreover, task characteristics may be a moderating factor. Oldham and Cummings (1996) showed that when task complexity is high and supervision is non-controlling and supportive, more patents are produced than in dissimilar situations.

At the organizational level, the relationship between leadership and innovation is strongest in organizations with supportive cultures that encourage innovation in their communications and, most importantly, provide sufficient resources and autonomy to teams that have innovation goals (Howell & Avolio, 1993; Jung et al., 2008). Moreover, organizations that are structurally decentralized, in which formalization is low, may provide a more favorable environment for innovation because of the increased autonomy and the inter-functional and inter-departmental collaboration (Jung et al., 2008; Miller, Dröge, & Toulouse, 1988). In such environments, it is more likely that employees can depart from established practices without negative consequences (Dougherty & Hardy, 1996).

Furthermore, Study I identifies two factors where the findings were too ambiguous to draw conclusions as to whether they are mediators or moderators in the relationship between leadership and innovation. Those two factors are psychological empowerment at the individual level and team climate at the team level.

New moderating and mediating factors. Study I proposes several new moderators and mediators between leadership and innovation. At the individual level, the individual's number of external work contacts and degree of personal initiative may mediate the relationship between leadership and innovation. At the team level, the team developmental stage may moderate the relationship. The research suggests that teams respond to leaders' influence differently at each developmental stage (Wheelan, 2005).

Conclusions. Study I concludes that leaders influence the innovation capabilities of their teams and their members. Organizations that want to lay a foundation for innovation should implement an innovation policy that rewards creative contributions and encourages risk-taking and innovation. In this way, organizations can create an environment that stimulates individuals' willingness to undertake creative endeavors

(Hemlin et al., 2008; Mumford & Gustafson, 1988). Teams engaged in innovation work should be granted sufficient autonomy for creative problem- solving and should be assembled with team member heterogeneity in mind. Finally, leaders should promote team norms that emphasize open discussion, emotional safety, mutual respect, and joy through stimulating team reflection and shared decision-making.

Study II

Study II models the relationship between leadership, conceptualized as the leader–member exchange theory (LMX), and team member innovation. The study addresses several factors that moderate and mediate this relationship.

Hypotheses. We hypothesized, first, that LMX is positively related to innovation, and, second, that team members' intrinsic motivation and personal initiative both mediate this relationship. Amabile (1983) and others propose that intrinsic motivation is an antecedent to employee creativity and intrinsic motivation has been shown to mediate the relationship between leadership and creativity (e.g., Shin & Zhou, 2003). Personal initiative may mediate the relationship between leadership and individual innovation because leaders in high quality LMX relationships are assumed to sanction and encourage initiative at work, for example by granting freedom and discretion (Frohman, 1999; Rank et al., 2004). According to Frese et al. (1997), individuals with high personal initiative are proactive and persistent in overcoming challenges and setbacks. This behavioral orientation may be especially valuable in R&D contexts where unpredictable and novel problems often arise and where progress is seldom linear (Marion & Uhl-Bien, 2001).

Third, we hypothesized that organizational support for innovation positively predicts team members' intrinsic motivation and personal initiative, and that organizational support interacts with LMX, strengthening the LMX relationships with intrinsic motivation and personal initiative, when organizational support is high.

Materials and method. We surveyed 43 R&D-intensive teams at five innovative Swedish industrial companies. The sample consisted of 166 team members (chiefly, scientists and engineers), 43 leaders, and 10 department managers. In each team, five team members completed a survey about their work relationships with their team leader, their degree of intrinsic motivation and personal initiative, and their perception of organizational support for innovation.

We used two strategies to measure innovation. First, we created an index of innovation outcomes by averaging the total number of i) patent applications, ii) new products, iii) scientific publications, and iv) other publications (e.g., white papers and in-house reports). It was required that a team member had contributed to these outcomes since joining the team under its current leader. We asked team members to

report their individual scores on the indicators. Each team leader and each department manager reported the total scores for the team as a whole.

Next, we used a rating scale developed by Scott and Bruce (1994) to measure team members' innovative work behaviors. We asked team leaders to rate their team members. Using the same scale, we asked department managers to rate the teams under their supervision. The two innovation measures indicated significant medium to high inter-rater correlations. This strengthened the convergent validity of the measures.

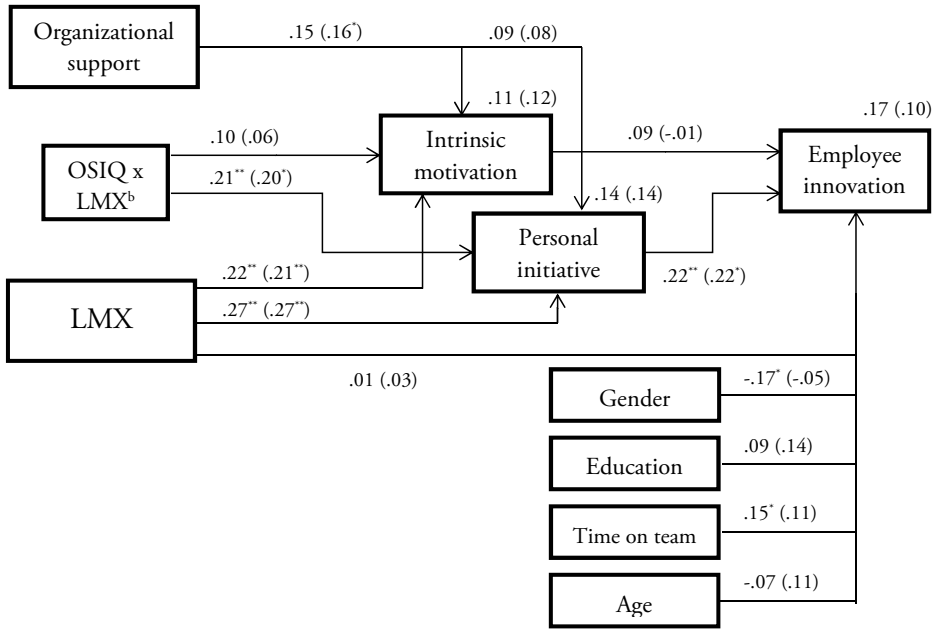
In testing our hypothesized model, we used the index of innovation outcomes provided by team members as well as the team leaders' ratings of innovative work behaviors (our level of inquiry was the individual level). The control variables were the participants' education level, time as a team member, gender, and age. We used path analysis to analyze the results. In path analysis, a researcher specifies a single model that permits the simultaneous analysis of an entire set of hypotheses.

Results. Figure 1 presents the results of Study II. Using both measures of innovation, personal initiative was positively related to individual innovation, while, contrary to our hypotheses, LMX and intrinsic motivation were not directly related to team member innovation. LMX positively predicted intrinsic motivation and personal initiative.

In assessing the hypothesized mediation effects, personal initiative mediated the relationship between LMX and team member innovation, but the mediator effect was not evident for intrinsic motivation, contrary to the hypothesis. LMX was therefore indirectly related to team member innovation, mediated by personal initiative.

There was a moderator effect when the relationship between LMX and personal initiative was stronger when organizational support for innovation is higher. Contrary to our hypothesis, this moderation effect was not evident for organizational support and intrinsic motivation (i.e., the relationship between LMX and intrinsic motivation was not moderated by organizational support for innovation).

FIGURE 1[a]
Results for the hypothesized paths between leadership, and innovation outcomes mediated by intrinsic motivation and initiative and moderated by organizational support



[a] Two sets of parameter estimates are presented. The first set (Model 1) uses employee innovation outcomes as the dependent variable. The second set (Model 2) is in parentheses and uses team leaders' ratings of innovative work behavior as the dependent variable. Standardized beta coefficients are given for the structural paths. All exogenous variables were allowed to correlate. R^2 is presented for the endogenous variables.

[b] This is the interaction term of organizational support (OSIQ) and LMX.

* $p < .05$

** $p < .01$

Conclusions. The main conclusion of Study II is that the team members play the lead roles in producing innovation outcomes in the five Swedish industrial companies. However, the team leaders may also play a crucial role. Through a high quality work relationship, leaders may stimulate team members to take greater initiative. Study II also concludes that organizations should support innovation by promoting pro-innovation policies and by providing their teams with sufficient autonomy and resources. This support may make it easier for leaders to create opportunities for team members to be proactive and take the initiative at work.

Study III

Study III is similar to Study II in that it models the relationship between leader-member exchange and team member innovation. The study addresses two factors that mediate the relationship in an organization that has a presence in four countries: Sweden, France, the USA, and India.

Hypotheses. We hypothesized that LMX is positively related to team member innovation. As in Study II, we hypothesized that team members' personal initiative mediates this relationship. We also hypothesized that team members' creative self-efficacy mediates the relationship between LMX and their personal initiative. Researchers have associated creative self-efficacy with leaders' supportive behaviors (e.g., Chong & Ma, 2010; Tierney & Farmer, 2002). According to LMX theory, such behaviors exist in high quality LMX relationships (Basu & Green, 1997; Liden & Maslyn, 1998). Thus, when the quality of the LMX relationship is higher, employees' creative self-efficacy should strengthen. Yet creative self-efficacy is primarily a self-belief in one's capabilities for producing creative outcomes. In order to turn these beliefs into tangible outcomes, these beliefs much be acted upon. Thus, creative self-efficacy is likely to be positively related to personal initiative, which is a related concept but one that is more clearly oriented toward action.

In responding to the call from many scholars (e.g., Anderson et al., 2004; Rank et al., 2004; Shalley et al., 2004) we investigated the construct of conservation, a personal value orientation that we argue is a relevant construct in the change processes needed for innovation in a cross-cultural setting (Shin & Zhou, 2003). We hypothesized that individuals' level of conservation is negatively related to innovation. Conservation is one of two overarching value dimensions in Schwartz's (1992) value theory. This theory, which posits ten fundamental human values, states that conservation as a value mainly consists of three combined elements: tradition, conformity, and security. Individuals with high conservation are inclined to act in accordance with their assigned roles, to conform to established ways of doing things, and to maintain the status quo. Individuals with low conservation are more inclined to seek freedom and to require

personal work autonomy. These inclinations are proposed to have associations with individuals' innovative outcomes and behaviors (Anderson et al., 2004).

Materials and method. The survey sample in Study III consisted of 269 team members in 60 R&D teams from an innovative organization in the automotive industry. The teams were situated in four countries: Sweden (n = 55), the USA (n = 76), France (n = 38) and India (n = 100). The team leaders (n = 60) and their section managers (n = 22) also completed the survey. Team members responded to measures of LMX, creative self-efficacy, personal initiative, and conservation. To ascertain construct validity and cross-cultural equivalence, these measures were subject to confirmatory factor analyses (CFA).

As in Study II, we used two strategies to measure team member innovation. First, we constructed an index of measures of innovation outcomes by averaging the numbers of (1) new patent applications, 2) scientific publications, 3) new product improvements (i.e. new components), and 4) other publications (e.g., technical reports, white papers) that team members had worked on or authored since joining the team under their current leader. Team leaders and department managers also reported on these measures for each team they supervised. Moreover, team leaders rated their team members on a rating scale that measured innovative work behavior (see Scott & Bruce, 1994). Using the same scale, the department managers rated the teams under their supervision. The two innovation measures provided by these three viewpoints yielded medium to high inter-rater correlations, indicating good convergent validity.

In further analyses, we used the index of innovation outcomes provided by team members, and team leaders' ratings of innovative work behaviors (our level of inquiry was at the individual level). Moreover, we used the following control variables: job complexity, affectivity, time as a team member, education level, and age. We used path analysis to test the hypothesized relationships.

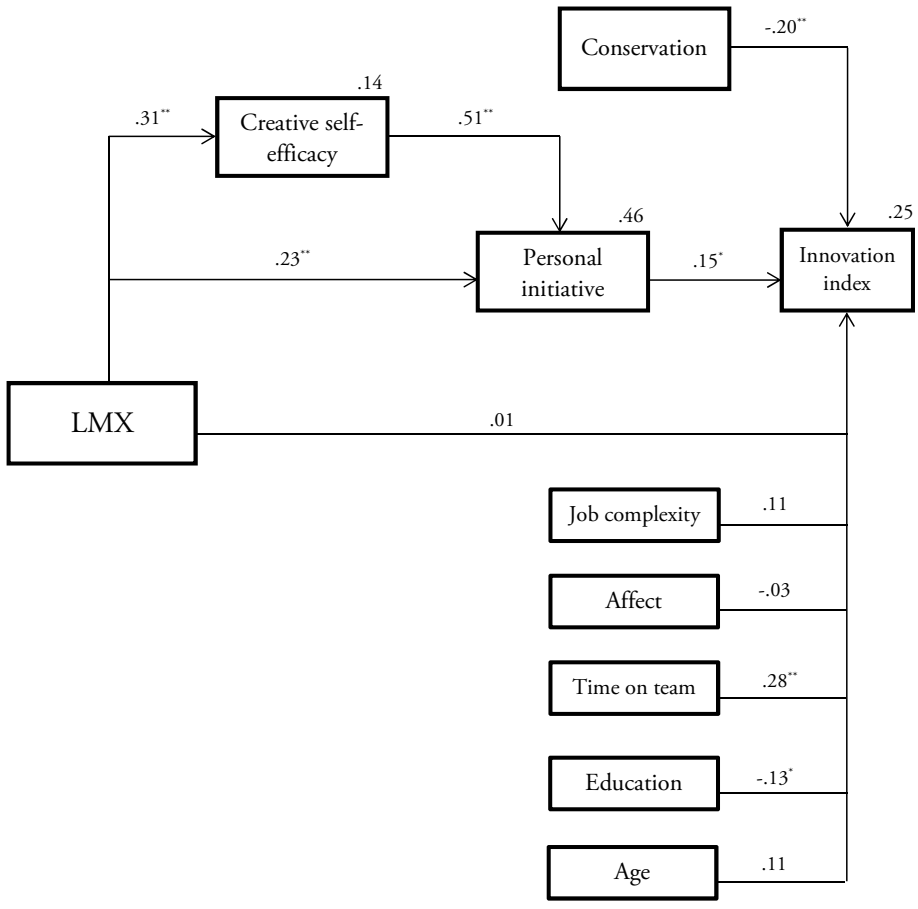
We tested our hypotheses using two models where the criterion variable was either the innovation index or the team leaders' ratings of innovative work behavior. As an additional test for model validity, we compared our hypothesized model with nine alternative plausible models. In these models we specified theoretically viable combinations of antecedent, mediating, and proximal variables in relationship to the innovation variable. None of the alternative models provided a better fit to the data than the hypothesized model.

Results. Figure 2 presents the parameter estimates for the hypothesized model when team members' innovation index is the criterion variable. Figure 3 presents the path estimates for the hypothesized model when leaders' ratings of team member innovative work behavior is the criterion variable. LMX was directly and positively related to team members' innovative work behavior but not to their innovation

outcomes. However, we found that personal initiative mediated LMX to these outcomes. Moreover, as hypothesized, creative self-efficacy mediated LMX to personal initiative. Finally, the culturally bound value of conservation was negatively related to individual innovation.

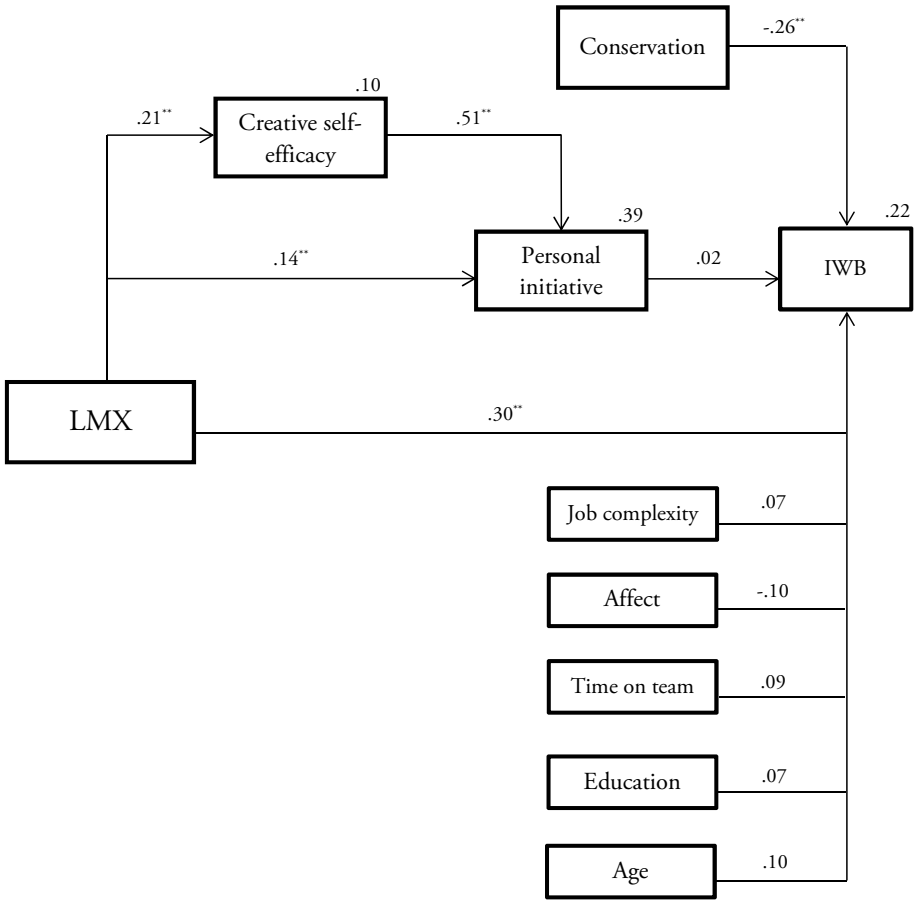
Conclusions. Study III concludes that high quality LMX may be conducive to team members' innovative work behaviors, but that it is plausible that innovative outcomes are more determined by individual factors than leaders' influence. The process of transforming new ideas into new technology and products is inherently unpredictable and complex (Kaiser et al., 2008; Mumford et al., 2002). The ability to be proactive and goal-oriented in overcoming obstacles and in making efforts that exceed the requirements of the formal work contracts may be crucial in these ventures. Initiatives aimed at innovation at all levels of an organization should be recognized and supported if organizations are to survive in the ever-increasing competition from global competitors.

FIGURE 2[a]
Results for the hypothesized paths between leadership, creative self-efficacy, personal initiative, conservation, and employee innovation outcomes (innovation index)



[a] Standardized beta coefficients are given for the structural paths. R^2 is given for the endogenous variables.
*. Significant at the 0.05 level (two-tailed).
**. Significant at the 0.01 level (two-tailed).

FIGURE 3[a]
Results for the hypothesized paths between leadership, creative self-efficacy, personal initiative, conservation, and employee innovative work behavior (IWB)



[a] Standardized beta coefficients are given for the structural paths. R^2 is given for the endogenous variables.
*. Significant at the 0.05 level (two-tailed).
**. Significant at the 0.01 level (two-tailed).

Study IV

Study IV identifies R&D project leader behaviors that either stimulate or hinder team members' abilities to produce innovative outcomes and the consequences of these behaviors.

Participants and procedures. The thesis author and an assistant interviewed 72 participants in the R&D departments of two innovative organizations in the automotive industry using the Critical Incident Technique (CIT) developed by Flanagan (1954). This interview method is preferable to other interview methods because it prompts participants to describe their experiences using specific, recent incidents as points of reference rather than generalized experiences or opinions (Butterfield, Borgen, Amundson, & Maglio, 2005; Flanagan, 1954).

We asked each participant to recall "a recent incident where your project leader did something that stimulated you or your team, increasing your ability for innovation." Innovative ability, which we defined using the OECD (2005) definition, was described to the participants as follows: "Ability for innovation means the ability to implement new ideas. Innovation differs from creativity in that creativity can be seen as generating new ideas, while innovation is the implementation of new ideas." When the participants said that they had recalled a recent incident we asked the following questions: i) Can you describe the situation? ii) What did the leader do that stimulated/hindered your ability for innovation? iii) What were the consequences?

We asked the participants to describe two instances in which their leader stimulated their innovative abilities and two instances in which their leader hindered their innovative abilities. Thus, each participant was prompted to describe as many as four incidents (two stimulating, two hindering). The 129 stimulating incidents and 102 hindering incidents were analyzed using thematic analysis (Braun & Clarke, 2006) where three categories were predefined: situation, leader behavior, and consequences.

Results. Most critical incidents occur during day-to-day management of projects. Project coordination, which is the largest category for both the stimulating and hindering situations, consists of assigning and directing tasks, calling meetings, outlining the project goals, managing resources and information, providing feedback, and making decisions. The critical incidents also occur in problem situations (for the team or for the team member), or when participants want to implement their ideas.

The most frequent leader behavior that stimulates team members' innovation is their active facilitation of new ideas. At idea-generating meetings and workshops, leaders encourage team members with feedback on new ideas. In this manner, leaders stimulated a free and open dialogue where information and perspectives can be easily exchanged. The leaders who hindered team members' innovation neglect new ideas. The most frequent leader behavior that hinders team members' innovation is the lack

of autonomy. Members' autonomy is restricted, for example, when leaders give them overly detailed instructions and too closely supervise their work.

Stimulating leader behaviors resulted in better solutions, more ideas, and increased team member motivation. Hindering leader behaviors resulted in poorer solutions, fewer ideas, member demotivation, and decreased teamwork efficiency.

Conclusions. Study IV concludes that R&D project leaders need good general project management skills (as conceptualized by Yukl, 2002). Such skills are hygienic factors with regard to innovation outcomes. For example, leaders' competent management of project information flow does not necessarily stimulate innovation, but if a leader lacks this skill, innovation suffers. To stimulate innovation, leaders can support team members' ideas, give them work autonomy, and offer their expertise.

Study IV also identifies various dilemmas in project management associated with the inherent uncertainty of the R&D work. Dealing with uncertainty and risks requires will and courage on the part of leaders (Dewett, 2007). Leaders require support for their scheduling and resource allocation decisions, especially in times when projects fail. Therefore, upper management should support experimentation and encourage risk-taking (see Hemlin, 2006).

Discussion

This thesis examines R&D team leaders' influence on team members' innovation. The thesis focuses on the *how* of this influence (i.e., the psychological mechanisms that mediate leadership and innovation) and on the *when* of this influence (i.e., the contextual factors that facilitate or hinder leaders' efforts to promote innovation in their teams).

The influence of leaders on team members' innovation

Based on the four studies, I conclude that leaders can positively influence team members' innovation. Study I, which reviews current research on team leaders' influence on innovation, reveals that leaders can exert such influence by stimulating discussion and reflection in teams, by counteracting narrow and conformist thinking, and by facilitating innovative ideas (Somech, 2006). Moreover, leaders can stimulate their team members' beliefs in their own creativity, which results in innovation outcomes (Gong et al., 2009; Redmond et al., 1993).

Study II and Study III show that the relationship between leadership, conceptualized as leader-member exchange (LMX) theory, and individual innovation is mediated by the creative self-efficacy and personal initiative of team members. Study IV shows that leaders stimulate team members' innovation by actively encouraging their new ideas and by providing them with autonomy and direction. These findings suggest that when leaders and team members work together in high quality work

relationships, leaders can provide more opportunities and more work independence for team members. Such relationships may encourage team members to take greater initiative as they work with innovative projects. At the same time, leaders should develop their project management skills. The lack of such skills hinders innovation in R&D projects.

Moderators of leaders' influence on team members' innovation

I conclude that certain factors at the individual, team, and organizational levels may either facilitate or hinder leaders' efforts to promote team members' innovation. Study I concludes that the leader-member relationship is strongest in more informal organizations that are decentralized because such organizations give teams and their members more freedom to work creatively (Jung et al., 2008; Kanter, 1996). Furthermore, leaders work best in situations that explicitly support innovation, such as when the organization encourages open discussion and risk-taking, grants sufficient autonomy to teams and their members, and provides them with adequate resources, such as facilities and materials, information, and expertise (e.g., Hunter et al., 2007; Mann, 2005).

The role of organizational support for innovation. Study II shows that organizational support moderates the relationship between LMX and team members' personal initiative. This relationship is stronger when organizational support is high. LMX theory states that leaders and team members engage in an ongoing process of mutual exchange in the interest of a higher quality work relationship (Liden & Maslyn, 1998). When organizational support is high, leaders can reward and encourage team members' initiatives because they have more options for meeting team members' demands. In contrast, leaders in less supportive organizational contexts may have little discretion as far as the support they can provide their team members. Thus, Study II suggests the degree of active innovation support provided by an organization indirectly affects innovation in the organization's teams. In such conditions, leaders can more easily support team members' innovation.

Study I identifies two moderating factors at the individual level. Leaders seem to have limited influence on individuals with a high propensity for self-monitoring. As these individuals are more concerned with fitting in than making changes, they may be disinclined to persist with their ideas and suggestions if they meet resistance (Rank et al., 2009). Moreover, individuals who perceive themselves as highly valued organizational members may be less inclined to respond to stimulation from leaders (Rank et al., 2009).

Findings like these pertaining to moderating variables at the individual level remind us that, while leadership may be important, innovation work in industrial development teams is chiefly carried out by skilled engineers and scientists.

The central role of individuals in innovation

The results of Study II and Study III suggest that LMX is indirectly related to innovative behavior and innovation outcomes through the personal initiative of team members involved in high-technology innovation. Feist and Gorman (1998) concluded that scientists are strongly driven and have a powerful need for achievement and independence. The scientists and engineers surveyed and interviewed in this thesis are likely to be highly and intrinsically motivated because of their education and the inherent complexity and challenge of their tasks (see Amabile, 1983). According to this view, leaders may have an indirect role in influencing innovation. Their influence may be a hygienic factor for these highly skilled individuals. As long as the leader-member work relationship is not detrimental, a reasonably satisfactory relationship will ensure that team members have sufficient work support. If this is true, it also means that a high quality LMX relationship will not necessarily lead to more and better innovation outcomes. This view is consistent with Tierney et al.'s (1999) research in which they found a difference between less innovative and more innovative employees. Leaders had little influence on the latter group.

Study III takes a cross-cultural view of individual characteristics. The value of conservation was negatively related to individual innovation as measured by innovation outcomes, as well as by innovative work behaviors. These results suggest that individuals who act in accordance with their social roles, accept prescribed norms and maintain stability are likely to be perceived as being less innovative and less involved in activities that lead to innovative outcomes. Rather, it can be argued that individuals who emphasize intellectual freedom, exercise personal discretion, and challenge the status quo exhibit the behaviors that result in innovations.

In conclusion, the transformation of new ideas into new technology and products is inherently unpredictable and complex (Kaiser et al., 2008; Mumford et al., 2002). The ability to be proactive and goal-oriented in overcoming obstacles and making efforts that exceed what is required (per formal work contracts) may be crucial in these ventures.

Dilemmas in leading innovative project work

Study IV concludes with four dilemmas that leaders of project work face. Projects usually must satisfy certain requirements from constituents (e.g., customers from

within or outside the firm) in order to be regarded as successful. Sometimes the requirements are so detailed that the project team has to work round some of them in order to satisfy the functional requirements of a product in a new way. The first dilemma is whether to meet these requirements or to think more radically. The second dilemma relates to the scheduling of projects. Testing new ideas takes time, especially if the ideas are novel. Given the unpredictability and non-linearity of R&D work, time schedules are often too rigid. Yet in order to produce innovative outcomes, new ideas require time for conceptions, testing and even failure. The third dilemma concerns the leader's decision-making vis-à-vis the often-changing requirements of constituents and technology. Some project leaders may react too quickly when they change goals and objectives of a project, while others may react too slowly. The fourth dilemma concerns the autonomy project leaders allow their teams. Allowing team members too much freedom risks losing control of projects. This is a problem for leaders who have the final responsibility for team projects towards constituents.

Implications for theory

The findings in this thesis contribute to the theoretical framework Creative Knowledge Environments (Hemlin et al., 2004; 2008) in several ways. First, the finding that personal initiative—not intrinsic motivation—predicts individual innovation gives us a better understanding of how motivational factors predict individual innovation. Personal initiative may be a pertinent construct in R&D because it focuses on implementation behaviors, whereas intrinsic motivation is a psychological state. As discussed previously, it is likely that R&D engineers and scientists have high intrinsic motivation. Moreover, personal initiative, combined with creative self-efficacy, mediates the relationship between LMX and individual innovation. The concept of personal initiative and the proposed mechanisms in this thesis should thus be incorporated into the theoretical frameworks that deal with the factors that promote innovation in organizations.

Second, the theoretical framework Creative Knowledge Environments posits that factors at the higher levels in an organization influence factors at the lower levels. This thesis shows that the organizational support, which moderates the relationship between leadership and team members' personal initiative, is such a factor. If organizational support is strong, the relationship between LMX and personal initiative strengthens. Thus, the presence of organizational support may affect the ability of leaders to promote innovation among their team members.

Third, further theoretical development should distinguish between innovative work behaviors and outcomes of innovation. Study III found that LMX was directly related to team members' innovative work behavior, while only indirectly related to

innovation outcomes such as the numbers of new products or product improvements, patent applications and publications (peer-reviewed or not). One explanation of this finding may be that innovative work behavior and indicators of innovation outcomes measure different aspects of innovative work. The first difference is that innovation measures focus on the tangible outcomes of this work, while assessments of innovative behavior measure the individual's propensity to generate, champion, and implement ideas. Innovative behavior is thus a broader measure of individual innovation, because innovation outcomes can include accomplishments that are not measured by commonly used measures such as patents (Martin, 2012). The second difference is that innovative work behavior likely precedes outcomes in a process where new ideas (e.g., related to technological challenges) are generated and championed, and where steps are taken to implement them (Basadur, 2004). This thesis has shown that innovative work behaviors and commonly used indicators of innovation are positively related. Innovative work behaviors may thus be a promising construct to measure dark innovation, that is, those aspects of innovation that are informal and incremental (Martin, 2012).

Additional conclusions and implications for organizations

The dilemma for project leaders between granting work autonomy and giving up project control is also found in the larger context of innovation management. Innovation in organizations is fraught with risks. Ideas and projects may fail, and advances seldom occur as intended (Getz & Robinson, 2003; Isaksen & Tidd, 2006; Mumford et al., 2002). To manage these risks, organizations may be tempted to increase control over their innovation projects, for example, by closely monitoring project process parameters, setting stringent time constraints, ending projects prematurely, or employing project "gates" (i.e., specific timeframes for progress stages). However, there is a paradox. When increased control limits teams' autonomy, teams tend to fall back on tried-and-tested ways of solving problems rather than testing new solutions. Yet innovation processes must be managed because of time limits and project specifications (Tidd & Bessant, 2009). The goal is to strike the right balance between tight control and *laissez-faire* control when managing innovation.

An innovation policy. Organizations can adopt an innovation policy that explicitly supports and encourages new initiatives. Risk-taking is inherent in innovation. Organizations that support and, more importantly, implement values such as experimentation create a hotbed for innovation (Mann, 2005; Mumford et al., 2002). An organizational culture that encourages innovation and individual creativity signals trust. In turn, this culture may influence people's willingness to undertake creative endeavors (Mumford & Gustafson, 1988; Shalley & Gilson, 2004). Hence,

increased autonomy and trust may inspire people who work in R&D to contribute more willingly to their organizations' innovation goals.

Implications for human resources managers. The findings in this thesis have practical implications for recruitment policies and team composition in R&D environments. R&D teams should have highly skilled and motivated members with different competences. Identifying and employing such people poses a recruitment challenge for human resource managers. R&D teams also require capable leaders who have domain-related expertise that they use in a participative and non-controlling manner. Such leaders are wise, adaptable, and sensitive to the cognitive and motivational needs of their team members.

Limitations of this thesis

The conclusions drawn in this thesis should be viewed in light of its limitations. The primary limitation concerns an effect that can be referred to as "the graveyard effect," which may have influenced the thesis as a whole. In Study I, several quality criteria reduced the number of articles in the first selection by two-thirds. The excluded articles went to a "graveyard." The findings and implications in this thesis may have been different if those studies remained in the sample. Indirectly, this selection process affected Study II and Study III that tested conclusions from Study I. In defense of the selection process, however, it can be argued that the use of fairly strict quality criteria strengthens the conclusions. Articles with higher impact factors and indexed in the ISI Web of Science (the selection criteria) have been through a more rigorous peer-review process (Aarssen, Tregenza, Budden, Lortie, Koricheva, & Leimu, 2008; Saha, Saint, & Christakis, 2003). This means that lower quality research has been screened out.

The second limitation of the thesis is that Study II and Study III used a cross-sectional design. This design limits the inferences drawn in this thesis regarding the direction of causality. As discussed in these studies, some hypothesized relationships may be reciprocal. For example, highly innovative individuals and project teams may demand certain behaviors from their leaders, such as granting autonomy and increased time for idea generation and problem-solving. Another relationship that may be reciprocal is the relationship between LMX and mediators such as creative self-efficacy and intrinsic motivation. Highly motivated individuals may positively influence the work relationship. On the other hand, the relationships hypothesized in Study II and Study III have a theoretical and empirical basis, which strengthens the causal plausibility of the model. For example, Deci and Ryan (1987) review causal evidence that links leaders' behaviors to employees' intrinsic motivation. Along similar lines, Tierney and Farmer (2011) show that leaders influence their employees' creative self-efficacy

over time. In Study III we checked for these potential problems when testing for alternative models. In these tests, the hypothesized model was the best representation of the data. Still, the path models proposed in Study II and Study III should be considered only an 'as if' model of causality (Kline, 2005).

Third, the theory of LMX was tested in relationship to innovation using only the individual team members' perspectives. As LMX is theoretically conceptualized as a dyadic phenomenon, ideally both sides should have a shared understanding of the nature of the relationship. However, Study II failed to show that leaders' and members' LMX ratings were correlated. This is a well-known problem in LMX theory (see Schriesheim, Castro, Zhou, & Yammarino, 2001).

Fourth, because of the nested nature of the data in this thesis (individuals nested in groups, departments, and countries), multi-level statistical methods could have been useful for the analyses. Future researchers should consider using multi-level structural equations modeling whenever individual, dyad or group level effects are hypothesized. These methods allow the researcher to specify mediating and moderating mechanisms, while at the same time consider the multi-leveled nature of organizations.

Fifth, the thesis does not discriminate between radical and incremental innovation. Radical innovation refers to the creation of new and valuable products, while incremental innovation concerns the improvement and refinement of existing products (Tidd & Bessant, 2009). In Study II and Study III, the innovation measures were composites of radical and incremental innovation. In Study IV, the participants were not asked to differentiate between the two types of innovation. The processes in each form of innovation likely differ, adding a layer of complexity to the conclusions of this thesis.

Recommendations for future research

This thesis introduces a promising construct—personal initiative—to the field of innovation research. However, more research is needed, especially longitudinal research, before we can infer that the relationships are causal. Research is also needed into the individual construct of intrinsic motivation, which was not related to team member innovation despite a sound theoretical basis and positive relationships with the related concept of individual creativity identified in other studies (e.g., Shin & Zhou, 2003). However, in innovation work, which concerns activities that go beyond idea generation, such as idea development, idea championing, securing resources, and taking steps to realize ideas (Tidd & Bessant, 2009), taking personal initiative, and working proactively may be more important than just being intrinsically motivated.

Furthermore, in Study III's sample (participants from four countries), unlike Study II's sample (Swedish participants), the leader–member work relationship was

directly related to team member innovative work behavior. LMX was indirectly related to team member innovation outcomes mediated through the personal initiative of team members in both Study II and Study III. These findings call for further research in five areas which are described next.

(1) More research is needed on the role of leaders in innovation ventures in high technology R&D contexts where scientists and engineers are highly autonomous (Feist & Gorman, 1998) and intrinsically motivated (Amabile, 1983). We need to integrate contextual and psychological factors that facilitate or hinder leaders' efforts to influence innovation processes and build on the interactionist frameworks proposed by Hemlin et al. (2004), Woodman et al. (1993), and Ford (1996).

(2) Although some work has been done (e.g., Czarnitzki & Kraft, 2004), we need more research that establishes cross-cultural generalizability of processes related to leaders' influence on innovation (Anderson et al., 2004; Shalley et al., 2004; Yuan & Woodman, 2010). This seems vital in an age where firms are increasingly global.

(3) Researchers could differentiate between measurements of innovation and clarify which variables predict each. As Study III shows, the two measures of innovation (leaders' subjective ratings of innovative work behavior, and quantitative measures of innovation outcomes) are associated differently with their predictors. For instance, this distinction could become a moderator in the relationships between predictors and innovation in future meta-analyses.

(4) Study III shows that people's degree of conservation is negatively related to their innovative work behavior and innovation outcomes. Although many individual factors have been scrutinized as predictors of individual innovation (e.g., personality, cognitive ability, motivation, and domain specific skills and expertise), the concept of individual values is missing in reviews and meta-analyses (e.g., Anderson et al., 2004; Hammond et al., 2011; Hülsheger et al., 2009). Thus, further research is needed on individual values that predict innovation. In addition, we need more research on the psychological mechanisms by which these values are related to individual innovation.

(5) Creative self-efficacy and personal initiative are two constructs that we found positively related to innovation as measured by objective measures. A future area of research is to identify the antecedents of these constructs. For example, an innovative team climate (Anderson & West, 1998) may influence individuals' perceptions about their creative abilities as well as their willingness to engage in long-term, goal-oriented behaviors aimed towards implementing ideas.

In short, we are only beginning to understand leaders' complex roles in organizational innovation. Integrative studies are needed that examine leaders, teams, and their members, and the contextual and psychological factors that determine individual innovation (Avolio, 2007; Graen & Ulh-Bien, 1995; Hackman & Wageman, 2007).

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