Chapter 1

Introduction

This chapter provides an overview of some academic debates within the innovation and decision-making literatures and defines the research topic of this dissertation. First, I discuss recent empirical developments in both fields and describe research directions that so far have received scarce attention. Based on this review, important insights may be drawn from combining both fields to reach a better conceptualization of decision making in innovation. In addition, this initial chapter describes the research aim and the research question that I set out to answer. Three empirical studies are introduced that examine and develop theory regarding innovation decision making, and an overview is provided of the contributions that these studies may offer to the existing literature. Finally, this chapter provides information on the research setting, data sources, and methodology of the studies in this dissertation, and concludes with an overview of the remaining chapters.
1.1 Setting the scene

Research and development (R&D) decision making plays an important role in a firm’s survival and development. Even more so, R&D contributes to society and to the economic growth of whole nations (Guellec & Van Pottelsberghe de la Potterie, 2001). By deciding how to develop new products and processes and in which technologies to invest, R&D professionals contribute to the firm’s strategic orientation, and in a wider sense, to the development of society. Hence, making the right decisions is key not only to the firm’s survival, but also to the broader economy. However, decision making in a technology-intensive environment is challenging.

Imagine the following situation:

You are the director of an R&D department in a multinational telecommunications company in which the business model has changed with the rise of the Internet. New players in the field provide services that use the telecommunication infrastructure without having participated in building it. To keep up with these changes, your company headquarters seeks to enter the IT market and has charged your department with building multimedia products, a new area for your department. However, budget cuts within the last years have forced you to dismiss several hundred engineers in the R&D department. Now, with fewer employees and a leaner budget than ever before, you must enter this new market and master the new related technological know-how. Somewhere, you come across the term “open innovation,” which refers to increasing collaborations with external partners to develop new products. Perhaps you could collaborate with other smart actors in your region, such as small and medium-sized enterprises, universities, and competitors to explore the new area. Ideally, this new collaborative innovation process would produce a new product with sufficient value to allow your department to grow again. This is exciting! Your gut tells you to explore the idea further, and you identify colleagues and others who are interested. Although employing new staff is out of the question and existing staff has little time available, you set up a small team of engineers and managers to work on the project. At this point, you decide not to share this project with the higher management because you are afraid that they might stop you in your tracks.

After some time, you establish a wide network with new contacts, and the project produces numerous prototypes. Additionally, some colleagues are extremely excited about the initiative. However, getting other firms on board to
finance the open innovation initiative has been more difficult than you expected, and the initiative has not generated enough money to stand on its own feet. As most products in the open innovation process do not move beyond the prototyping phase, establishing a successful product or innovation process seems far away. As the initiative continues, differences between your own strategies and those of other key managers in your department become apparent. Some managers believe that the proposed products are too far removed from the firm’s core activities. Opinions also differ regarding the technologies that the project should focus on and how much it should focus at all.

In summary, your initiative has shown some successes and some failures. How long do you hold on to this idea? Do the failures motivate you to try harder, or is it foolish to continue to reach the original goals? How would you approach this decision? For example, you could make a list of the pros and cons with an overview of the losses and gains, think about the alternatives for action, and identify possible consequences for either decision. Maybe you would not even have started the initiative since it emerged from a hunch rather than an assignment from your higher management, or would you?

This little thought experiment illustrates that innovation and R&D decisions can be messy and ambiguous. Existing academic literature explores how decisions are made: whether people make well-informed decisions, rely on their personal judgment, or whether they decide based on relationships and social context. In investigating this tension, I depart from the assumption that the complexity and unpredictability of technological innovation results in decisions that do not necessarily follow logically from analysis of the facts. Rather, R&D professionals’ attitudes, intuitions, and the politics between professionals influence decision making and innovation outcomes. Professional experiences, individual character, and a firm’s social context are factors in how someone would answer the questions posed in the scenario above. In this dissertation, I incorporate an individual decision-making perspective that borrows ideas from psychology and behavioral decision-making theory to contribute to R&D research and practice. This work includes recent trends in the R&D and innovation literature and a review of the literature on organizational and psychological theories of decision making. Based on this analysis, I present three studies that investigate decision making in an innovative and technology intensive context.
First, this chapter provides an overview of relevant literature on R&D organization, open innovation, and decision making to conceptualize innovation decision making in an R&D context. Next, the chapter includes the methodological approach of this dissertation and provides an overview of the following chapters.

1.2 Innovation literature

This section provides an overview of the most important theoretical concepts used in this dissertation. Innovation is defined (section 1.2.1) and open innovation (section 1.2.2), other theoretical approaches to collaborative innovation (section 1.2.3) and the motivation for using open innovation in this dissertation (section 1.2.4) are discussed.

1.2.1 Definition

Innovation can be described as “the generation, acceptance and implementation of new ideas, processes, products or services” (Thompson, 1965, p. 2). Another definition describes the innovation process as “the development and implementation of new ideas by people who over time engage in transactions with others within an institutional context” (Van de Ven, 1986, p. 591). While the first definition refers to the outcomes of innovation such as ideas, processes, products, or services, the second includes the role of the agent, specifying that individuals engage with one another in transactions throughout the innovation process. The role of the individual in innovation is at the core of this dissertation; therefore, I have replaced the term “transaction” with “interaction” to illustrate the non-pecuniary character of many occurrences during the development process. Individuals may interact with one another throughout the innovation process for a large variety of reasons other than business, such as to brainstorm new ideas, to share and seek knowledge regarding new technologies, and so on.

Van de Ven's (1986) definition also notes that transactions take place “within an institutional context.” As the R&D and innovation literatures indicate, this institutional context is constantly changing. Academics have identified different generations of R&D, which refer to different R&D stages that have enfolded from the early 20th century. First generation R&D, present until the 1950s, refers to an isolated R&D strategy that focuses on producing significant technological breakthroughs in a hierarchical organization without interacting with other departments in the firm. Second generation R&D describes the change towards project management organization. At this stage, the R&D department establishes first links to different departments in the firm and has an increased focus towards the market (Niosi, 1999; Nobelius, 2004; Rogers, 1996). In third generation R&D management is increasingly systematic as intra-
organizational ties are formalized and the focus shifts from projects to processes (Nobelius, 2004) and portfolios (Rogers, 1996). Fourth generation R&D is marked by cross-functional collaboration, implications for customers and users, and a focus on the total concept rather than the specific product (Nobelius, 2004; Rogers, 1996). Finally, in the fifth generation model, the network expands and the interaction of the R&D department with external actors increases. R&D is marked by collaboration and open innovation with suppliers, competitors, customers, and universities that interact across organizational boundaries (Nobelius, 2004; Rogers, 1996). At this stage, the single firm focus of R&D shifts towards a network perspective that evolves around knowledge. Currently, R&D is transforming from fourth to fifth generation, which implies a fundamental shift in the sources of technology and innovation that may originate from inside or outside the company.

Therefore, the definition of innovation used in this dissertation specifies that people’s interactions throughout the decision-making process may occur between individuals from the same organizational context or different contexts, such as companies, universities, research institutions, suppliers, or other actors. In summary, innovation is defined as the generation, acceptance, and implementation of new ideas, processes, products, or services by individuals who engage in interactions over time with other individuals both inside and outside the company.

In this dissertation I examine innovation at the intersection between R&D and new product development (NPD). My focus is on the development of products, processes, and services within the R&D department in the technology-intensive sector, and therefore, is more concerned with engineering than marketing or basic research.

1.2.2 Open innovation

Academics report important changes in how the innovation process is organized, which have resulted in greater collaboration and the exchange of knowledge and resources across boundary limits (Chesbrough, Vanhaverbeke, & West, 2006; Robertson & Verona, 2006). There is enormous interest in understanding how organizations can manage partnerships with external actors. In this context, academic literature from a variety of fields includes investigations of such questions as how a firm can profit by collaborating with users and clients in co-innovation projects (Bossink, 2002; Von Hippel, 1986, 2005), how to integrate patients’ experience in biomedical research (Broerse, Zweekhorst, Van Rensen, & De Haan, 2010; Caron-Flinterman, Broerse, & Bunders, 2005, 2007), how to involve stakeholders in science projects (Roelofsen, Boon, Kloet, & Broerse, 2011), the use of open source software (West & Gallagher, 2006),
ways to discover collaborative R&D ventures through informal contacts (Kreiner & Schultz, 1993), how to form successful alliances (George & Farris, 1999), and how to create network ties (Ahuja, 2000).

The notion of open innovation also has met wide interest among the scientific and professional community within the last decade. Introduced in 2003 and directed to the practical community (Chesbrough, 2003), open innovation has received attention from academic researchers who have built its academic and theoretical base (for example, Chesbrough, Vanhaverbeke, & West, 2006; Vanhaverbeke, 2006; Vanhaverbeke & Cloodt, 2006; West & Gallagher, 2006). During the last decade, the literature on open innovation has grown and evolved (Dahlander & Gann, 2010; Huizingh, 2011; West, Salter, Vanhaverbeke, & Chesbrough, 2014).

Open innovation is defined as “the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively” (Chesbrough, 2006, p.1). Figure 1.1a and Figure 1.1b illustrate the innovation funnel—symbolized by the horizontal lines—according to the closed innovation and open innovation models. Research projects move through the R&D funnel from basic and fundamental research toward development. The closed innovation model (Figure 1.1a) depicts the conventional way in which technological developments move through the R&D funnel in a firm. The open innovation model (Figure 1.1b) describes the new way of organizing R&D in which the boundaries of the R&D funnel—represented by dashed lines—become permeable.

In closed innovation, projects develop internally within the research section of the funnel and move in a linear process through the research funnel. Throughout this process, R&D
professionals may decide to stop projects for various reasons and continue with others. Terminated projects are parked “on the shelf,” and continued projects are introduced into the market through the firm’s manufacturing and sales channels (Chesbrough, 2006). The firm’s boundaries are impermeable, as the solid lines in Figure 1.1a indicate, and projects either move through the whole funnel or are cancelled along the way.

In open innovation, projects may enter the funnel at any point and may develop internally or from other firms outside the research funnel. As the firm’s boundaries are permeable, projects may exit the funnel at any time throughout the process. Projects that exit the funnel through the firm boundaries before the funnel ends approach new markets, and those that travel through the entire funnel approach the firm’s existing markets.

According to the concept of open innovation, such an open funnel is desirable, because technological firms are increasingly specialized. To develop products with a broader focus, firms must integrate specialized knowledge from various sources (Giannopoulou, Yström, Ollila, Fredberg, & Elmquist, 2010). The integration of knowledge and technology from outside parties—such as suppliers, clients, and other innovative institutions—is called inbound open innovation (Chesbrough, 2006). The permeable funnel also allows firms to use knowledge spillovers and technologies that they may decide not to continue because they do not address the firm’s target market. In this way, the firm can monetize ideas that might otherwise be forgotten on the shelf. Through licensing, spin-offs, or collaborations with other partners, firms may make profits from products that they decide not to bring to market themselves. This form of open innovation is called outbound open innovation (Chesbrough, 2006). Whether or not and to what degree firms use external knowledge sources may be dependent upon the economic climate, which may force firms to reduce costs in R&D and instead increase collaboration (Chesbrough, 2006). Other factors may be the availability of technologies, specific market dynamics (Schroll & Mild, 2011), the technological capability available in the firm, the firm’s network (Wang, Chen, Wang, Ning, & Vanhaverbeke, 2014), and the firm’s size (Fontana, Geuna, & Matt, 2006).

In addition to these environmental factors and company characteristics influencing open innovation and its success, managers may differ in their individual perceptions of future possibilities, even when they face the same situation (Laursen & Salter, 2006). Based on their past experiences, managers can have different expectations regarding their likely failure or success (Levinthal & March, 1993). Tidd, Bessant, and Pavitt (2005) showed that employees involved in alliances believed that collaboration made development more expensive and
complicated. According to Laursen and Salter (2006, p.146), a firm’s lack of openness “to the external environment may reflect an organizational myopia, indicating that managers may overemphasize internal sources and underemphasize external sources”. Lack of openness also may be ascribed to R&D professionals’ attitudes. For example, the “not-invented-here” attitude (Katz & Allen, 1982) describes people’s tendency to reject ideas and technologies that come from outside the firm, and such an attitude can be expected to play a role in the firm’s approach to open innovation (Lichtenthaler, 2011). Professionals also may show different levels of trust (De Man & Roijakkers, 2009). Therefore, implementing open innovation may require adaptation of new management styles and systems (Gassmann, 2006) and changes in attitudes (Lichtenthaler, 2011) and culture (Schroll & Mild, 2011).

An additional barrier to the implementation of open innovation is considerable time needed to complete some collaborations and development projects. This lack of immediacy complicates the clarity between cause and effect of decisions because managers do not receive direct feedback regarding their open innovation decisions (Chatenier, Verstegen, Biemans, Mulder, & Omta, 2009). Research also indicates that openness is not always positive, but also may have negative effects on firm performance (Faems, Van Looy, & Debackere, 2005, Laursen & Salter, 2006). Thus, managers face an ambiguous situation in which the decision to adopt collaborative strategies may be made without reliable information and experience, and therefore be dependent on the individual manager.

In this dissertation, I examine the transition from closed to open innovation and the barriers to a firm’s solid boundaries becoming permeable and the role of the R&D professional in this transformational process. I investigate the extent to which open innovation implementation depends on the R&D professionals who manage and conduct innovation. This investigation does not explicitly differ between inbound and outbound open innovation. Open innovation as described in this dissertation may have permeable or semipermeable firm boundaries. The aim is to gain insight into the adaptation of any degree of openness rather than distinguish between different degrees.

1.2.3 Other approaches to collaborative innovation

Within organization theory, various approaches have attempted to explain how firms cooperate with each other. While open innovation represents a fairly new approach to understanding collaborative innovation, there has been a long tradition of research on inter-firm collaboration and networks (e.g. Hakansson, 1982; Grandori & Soda, 1995). This perspective considers the embedding of firms in a wider network, and the interaction between firms within
that network (Hakansson, 1982). It sees economic outcomes and competition to be dependent upon relationships and interdependencies between companies (Burt, 2009; Hakansson, 1995). Such research has provided findings on how firms select their alliance partners. For example, Gulati (1995) finds that firms cooperate with each other as a result of the social context of previous alliances. He finds that the strategic interdependence between partners, meaning whether one partner possesses resources that the other lacks, influences whether or not firms form an alliance.

Network theory has also been used to explain innovative performance. For example, Burt (2009) introduced the concept of ‘structural holes’ into the literature, which refers to the disparity between the network clusters of two different partners in terms of the non-redundancy of their information. Forming relationships with firms that provide access to new clusters of contacts may provide useful access to new kinds of information, and would therefore be expected to have a positive effect on innovative performance. Coleman (1988) emphasizes the advantages of closure, or in other words highly connected networks, as it may facilitate the exchange of knowledge, and therefore advance innovation. The consequence of structural holes may be a lack in common routines and trust, and can therefore lead to a decline in innovative performance (Ahuja, 2000). The best way to describe the relationship between innovative performance and discrepancy between partners is probably to use an inverted U-shape: innovative performance increases when the cognitive distance—the difference of technological knowledge between partners—increases, and at a certain point decreases when both partners become too distant (Nooteboom, Vanhaverbeke, Duysters, Gilsing & Van den Oord, 2007).

Based on this literature, two factors may have an impact on collaborative behavior and innovative performance: network characteristics, such as the nature of ties, presence of structural holes, and a firm’s location within the network; and the cognitive distance between the alliance partners (Ahuja, 2000; Burt, 2009; Pullen, Weerd-Nederhof, Groen & Fisscher, 2012). Such network studies are oriented towards knowledge between different partners and information that lies outside the firm’s boundaries (Gulati, 1999). Hence, network research occurs at the level of analysis of the network, and regards innovative behavior as being determined by the dynamics within these networks (Hakansson, 1982).
1.2.4 Motivation for the use of open innovation in this dissertation

The paradigm of open innovation has been criticized for not drawing upon earlier bodies of research concerning collaboration, mergers and acquisitions, and networks; thereby creating a false dichotomy between the open and closed models of innovation (Trott & Hartmann, 2009). Critics argue that openness is not necessarily a recent trend, but rather a well-established fact. According to this view, open innovation does not offer sufficient new ideas to replace other well-established concepts (Groen & Linton, 2010; Trott & Hartmann, 2009), and represents a fad rather than a theoretical framework.

In spite of these critiques, this thesis supports the view that open innovation has important advantages for investigating fifth generation R&D decision-making. Most importantly, it is open to multiple levels of analysis, and thereby offers a better opportunity for the purpose of this research, which studies the individual manager. In order to understand how organizational structures change, and how larger companies actually open up to more and different external partners than before, this dissertation aims to understand how an R&D professional decides whether or not to collaborate. Hence, the level of analysis is the individual and his or her project environment within a single firm, while the level of analysis of the innovation of the network is the firm’s position within a network of organizations and its multilateral relationships (for example, the dyad and triad levels). This thesis investigates whether or not individuals take an active role in engaging with their network, and thereby change their organizational structure. It studies the antecedents of collaborative innovation from a perspective that regards individual decision makers as having the volition and discretion to influence their organizational structures, rather than being driven by the relational dynamics within the network. Since open innovation describes a fundamental change that occurs in a firm’s innovation funnel that requires new internal structures, norms, values and management systems (Van de Vrande & De Man, 2011), the individual level of analysis of open innovation may provide interesting insights that would otherwise remain hidden if approached from a traditional network perspective. Open innovation also draws attention to new actors and activities that have not been traditionally investigated, such as crowd sourcing and innovation intermediaries, and stresses the importance of the business model for commercializing knowledge spillovers early in the process (Van de Vrande & De Man, 2011). Open innovation, therefore, offers a good framework for our purpose of studying the behavioral foundation of decision making in the organization of R&D today.
Additionally, since it is rooted in practical problems rather than theoretical niches, open innovation also provides a framework that offers the possibility to integrate different existing areas of research. The choice made in this thesis to focus on the open innovation framework as a point of departure, rather than other theories such as the network theory, also resulted from issues raised by the interview partners of exploratory interviews in the early stages of the research project. When asked about recent developments within R&D, R&D professionals raised the issues of open innovation and the struggle to build new processes that would successfully include external actors in the innovation funnel. Hence, the choice for the centrality of open innovation in this thesis is also based on practice-driven motivations.

Without question, I could have approached collaborative innovation from a different angle, but this would have resulted in a slightly different research focus looking at networks that are already in place and focusing on different levels of analysis (for example, dyads, triads and multilateral relationships). This thesis, however, focuses on the antecedents of collaborative innovation, and the decision process of R&D professionals within the firm that cannot be explained by network theory.

1.3 Decision making

Decision making has been studied in multiple fields, such as economics, mathematics, and psychology (Kahneman & Tversky, 1984). While psychological researchers have focused on the cognitive aspects of individual decision making in a laboratory setting, organizational researchers are often more concerned with decision making as it unfolds in the field (Mintzberg, Raisinghani, & Théorêt, 1976). This dissertation, which examines decision making in technology-intensive firms, can be located in the second group. However, I seek to build a bridge between both groups by utilizing theories from social psychology to understand innovation decision making.

Section 1.3.1 provides an overview of the current debate in the literature of organizational decision making and proposes greater integration between two identified perspectives. Section 1.3.2 presents insights from the field of psychology to revive the debate on organizational decision making and deepen understanding of its behavioral foundations. The section provides a short overview of a decision maker’s cognitive processing and introduces the idea that decision makers may differ in how they reach decisions. Section 1.3.3 presents three theoretical lenses I use in this dissertation to understand the micro perspective of innovation, and specifically open innovation decision making. These three lenses—decision-making styles, regulatory focus theory, and the theory of planned behavior—were chosen because they have
been successfully applied in social and organizational psychology and have been related to innovative behavior. No previous research has applied them to study the implementation of open innovation. Finally, Section 1.3.4 provides arguments for the necessity of developing a micro perspective on decision making within the innovation literature. A literature scan of four major innovation journals showed that, during the last 10 years, interest has increased in understanding the micro processes of innovation decision making. The section identifies the need to include theories from psychology that may offer novel insights.

1.3.1 Reviving the debate on organizational decision-making processes

Nobel Prize winning economist and psychologist Herbert Simon, who wrote his doctoral dissertation on human decision making in organizations more than 60 years ago, said:

It is . . . the process of choice which prefaces all action . . . All behavior involves conscious or unconscious selection of particular actions out of all those which are physically possible to the actor and to those persons over whom he exercises influence and authority. (1997, p. 1–3)

Decisions may imply conflict between the interests of different decision makers and between goals of the individual and the organization, and may require communication between different actors (Gavetti, Levinthal, & Ocasio, 2007). During the last few decades, the organizational debate has moved away from a focus on decision making, and according to some authors, disregards the role of human choice and cognition to concentrate instead on concepts such as learning, routines, change, and adaptation (Gavetti et al., 2007). In reaction to this development, researchers have called for a revival of the debate regarding organizational decision making (Hauser, Tellis, & Griffin, 2006; McNally & Schmidt, 2011) and for understanding the psychology of decision making (Gavetti et al., 2007).

Intrinsically, the strategic decision-making literature is concerned with decisions that are unstructured, complex, and novel (Eisenhardt & Zbaracki, 1992; Mintzberg et al., 1976; Schwenk, 1984), and broadly distinguishes two basic perspectives: the synoptic and the incremental. The synoptic decision perspective describes decision making as a comprehensive and analytical process. Strategy making is based on following distinguished steps through a systematic process to reach an ideal (Fredrickson, 1983). For example, decision making might consist of three steps: “(1) the listing of all the alternative strategies; (2) the determination of all the consequences that follow upon each of these strategies; (3) the comparative evaluation of these sets of consequences” (Simon, 1997, p. 77). However, other researchers have contended
that such a conceptualization may not describe reality and have advocated instead for an incremental perspective that takes into account other dynamics, such as power and politics (Fredrickson & Mitchell, 1984; Nutt, 1993). Within this perspective, decisions are made in social and institutional contexts and in interaction with other individuals and within power positions (Halpern & Stern, 1998). Langley, Mintzberg, Pitcher, Posada, and Saint-Macary (1995, p. 261) stated, “Rather than proceeding merely as the linear unfolding of sequences of decomposed stages, . . . decision making processes are driven by the emotion, imagination, and memories of the decision makers and are punctuated by sudden crystallizations of thought.” Therefore, decisions are likely to include power, emotion, and intuition.

In synoptic decision making, decision quality is judged by how well a decision reaches its desired goal. In contrast, in incremental decision making, solutions are considered successful when the decision makers achieve agreement after weighing different alternatives (Fredrickson, 1984). In this understanding, decisions are judged in terms of their outcomes and how well they fulfill the decision makers’ interests (Fredrickson, 1984).

Academics have debated which decision-making process yields the better results for strategy making and innovativeness. On one hand, researchers suggest that people do not act rationally and therefore exclude important alternatives that might contribute to finding innovative solutions. Driven by fear of change and a desire to maintain the status quo, individuals sabotage the innovative process. According to this view, clear rational structures, tools, and processes must be built to compensate for the single decision maker’s deficiencies. On the other hand, some researchers claim that the failure to use rationality may motivate individuals to draw upon play and faith, which may elicit truly innovative solutions (March, 2006). The theoretical understanding of decision making as an economic rational-choice paradigm, or a behavioral bounded-rational paradigm, lies at the core of the empirical investigation of the effectiveness of rationality versus other approaches (Grandori, 2010). While the first deals with well-defined problems and the choice of known alternatives following an optimizing strategy, the latter deals with the search and discovery of different alternatives, using shortcuts to reduce complexity (Grandori, 2010). Hence, the latter perspective stresses the vital importance of the individual to the decision-making process: the actions of decision makers may have a significant impact on problem formulation, the development of alternatives, and the course of the decision making.

A combination of decision-making approaches may be necessary in order to reach a better conceptualization of the decision-making process, and to help practitioners make more
successful decisions; therefore, some researchers have concluded that both approaches should be viewed in conjunction (Brews & Hunt, 1999; Dean & Sharfman, 1993b, 1996; Elbanna & Child, 2007). According to this view, the same decision maker may use different types of decision processes, either alternately or in combination, throughout the decision-making process (Grandori, 1984, 2001). In an empirical study, Hart and Banbury (1994) find that organizations that make use of multiple-strategy processes outperform organizations that are less adept at combining different strategies. Authors in this field have formulated different types of decision models that may be combined at every level of organizational decision making (Grandori, 1984, 2010; Hart, 1992).

One theory that formulates distinct decision-making approaches for different levels of uncertainty is called ‘effectuation’ (Sarasvathy, 2001). Deriving from the entrepreneurship literature, effectuation identifies a theoretical dichotomy between an effectuation logic, in which the decision maker departs from the alternatives at hand to define possible goals and strategies, and a causal logic, in which the decision maker defines goals and strategies beforehand and strives to attain the necessary means to achieve them (Sarasvathy, 2001). While effectuation theory was formulated to explain the cognitive processes and behaviors of entrepreneurs at the individual level, it has also been applied to the R&D context (Brettel, Mauer, Engelen, & Küpper, 2012), suggesting that effectuation is more likely to be successful in highly innovative contexts and that causation is favorable in projects with low levels of innovation (Brettel et al., 2012).

Therefore, different decision-making approaches should be applied in situations where information is ambiguous rather than those applied in well-structured situations, and decision makers may possibly apply different approaches to solve distinct parts of the same decision problem. A study of the combination of different perspectives on decision-making may offer an insight into how the decision-making process unfolds, and help us to understand the complexity of decision-making behavior. Nevertheless, in-depth descriptions of how different decision-making processes interact are scarce (Hauser et al., 2006).

The present study aims to gain an insight into the interaction between synoptic and incremental approaches to the decision-making process (Dean & Sharfman, 1993a, 1996; Elbanna & Child, 2007; Kester, Griffin, Hultink, & Lauche, 2011; Ilori & Irefin, 1997). The concepts used in this thesis derive from strategic decision-making literature (e.g. Eisenhardt, 1989b; Grandori, 1986) rather than from entrepreneurship literature (Sarasvathy, 2001); this is because the primary aim of this thesis is to understand the decision-making of R&D
professionals in large organizations rather than entrepreneurs in start-ups. The concepts are, therefore, more easily transferrable to this context. Consequently, this dissertation follows other researchers (e.g. Elbanna & Child, 2007) by exploring the extent to which the decision-making process integrates rationality, representing the synoptic perspective, and intuition and political behavior, representing the incremental perspective. However, to reach a fuller understanding of how the decision-making process unfolds over time, this thesis addresses the disparity by studying a combination of these process characteristics.

When establishing a micro-perspective on organizational decision making, it may be important to understand how individual differences have an impact on the decision-making process. The next section, therefore, provides an overview of the psychological literature on decision-making, and focuses on the role of the individual decision maker.

1.3.2 Characteristics of the decision maker

Decision making can be understood by exploring three elements: decision features, situational factors, and individual differences (Einhorn, 1970; Hunt, Krzystofiak, Meindl, & Yousry, 1989). The innovation literature has focused substantially on decision features and situational factors, but has widely disregarded the role of individual differences. This section provides an overview from the field of psychology regarding individual differences that may affect decision making.

Researchers in psychology and business seem widely to agree that people by nature are not rational decision makers. Individuals bring their own experience, affect, and insight into the decision-making process (Langley et al., 1995). As described previously, some research has suggested that individuals create an artificial certainty in which they disregard important alternatives and act based on habit instead of choosing an inspirational or innovative solution (Nutt, 1993). However, psychological research can offer further insight into the information processing common to all human decision making as well as the role of individual difference in tendencies, habits, and characteristics (Scott & Bruce, 1995; Thunholm, 2004).

Researchers in psychology have sought general rules for information processing and human cognition that may provide insight into the basis of human decision making (De Visser, 2013). This topic also has attracted great interest among the general public, as the success of the bestselling book Thinking, Fast and Slow (Kahneman, 2011) indicates. In the book, Kahneman disentangles the cognitive process to provide better insight into people’s thinking.
Dual process theory describes two basic cognitive processes: One happens quickly and unconsciously and the other more slowly, implying conscious reflection (Chaiken & Trope, 1999; Epstein, 1994; Kahneman, 2003; Sloman, 1996; Stanovich & West, 2000). Stanovich and West (2000) referred to these processes as system 1 and 2: System 1 is based on associative memory, intuition, and automated processes, while system 2 is based on deliberate thought that aims to produce a coherent perspective on surroundings. As in the organizational decision-making literature, the individual decision-making literature distinguishes between two perspectives, one intuitive and one rational, but both coexist.

The ability to make effective decisions is important in people’s lives. For example, research shows that competent decision makers are better able to deal with real life problems and prevent negative experiences (Bruine de Bruin, Parker, & Fischhoff, 2007; Peterson, Parker, & Ribbers, 2002). Individual differences in approaching decisions also relate to happiness, optimism, self-esteem, life satisfaction, depression, and perfectionism (Bruine de Bruin et al., 2007). Research suggests that people also differ in their cognitive processing preferences (Allinson & Hayes, 1996; Nutt, 1986; Witkin, Moore, Goodenough, & Cox, 1977). These differences in cognitive styles, defined as “individual differences in how (people) perceive, think, solve problems, learn, relate to others” (Witkin et al., 1977, p.15), may relate to individual innovative behavior (Sadler-Smith & Badger, 1998), individual and team exploration, and exploitation behavior (De Visser, 2013). Related research has introduced the concept of decision-making styles, which are described in the next section.

In addition to having cognitive processing preferences that influence decision making, people also differ in their more general traits or personality characteristics. Personality characteristics can be conceptualized in several ways, such as introversion and extraversion (Jung, 1923) or the “big five” traits (Digman, 1990; Goldberg, 1990): openness, conscientiousness, extraversion, agreeableness, and neuroticism. Personality traits are relatively stable, which means that a relationship between personality and decision making would lead to relatively stable predictions of behavior. However, personality traits are unlikely to show direct effects on work-related behaviors (Lanaj, Chang, & Johnson, 2012). Rather, they have been found to influence behavior through processes that are closer to the actual behavior and related to people’s motivation to engage in that behavior (Lanaj, Chang, & Johnson, 2012). One theory that explains people’s differences in motivational inclinations is regulatory focus theory. As a more direct predictor of human behavior, this theory is used to understand interpersonal differences between decision makers in their innovation decision making (Lanaj, Chang, & Johnson, 2012). Regulatory focus theory is described in more detail below.
In addition to differences in cognitive or decision-making styles, personality and motivation, decision makers may differ in a third dimension: their individual attitudes (Eagly & Chaiken, 1993), which may be positive or negative towards an issue. Attitudes, which Eagley and Chaiken (1993, p. 1) define as “a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor,” have been shown to be good predictors of decision making. To understand why people hold certain attitudes, researchers have developed and tested the theory of planned behavior (Ajzen, 1985, 1991), which has been applied to a large variety of behaviors and may shed light on how people’s attitudes influence innovative behavior. The next section includes more detail regarding this theory.

1.3.3 Psychological decision-making concepts used in this dissertation

As described in the previous section, cognitive processing may be rational or intuitive, and people may differ in three dimensions: cognitive style, personality and motivational characteristics, and attitudes. To investigate each of these dimensions, I have chosen three theoretical lenses: decision-making styles, regulatory focus, and theory of planned behavior, respectively. This section provides a brief overview of each lens, and a more profound discussion follows in Chapters 2, 3 and 4.

First, differences in cognitive style are explored through the closely related concept of decision-making style, which can be defined as a “learned habitual response pattern exhibited by an individual when confronted with a decision situation” (Scott & Bruce, 1995, p. 820). According to Thunholm (2004), decision-making style may be more than a habit because of its close relationship to cognitive style. For Thunholm (2004), decision-making style is:

the response pattern exhibited by an individual in a decision-making situation. This response pattern is determined by the decision-making situation, the decision-making task and by the individual decision maker. Individual differences between decision makers include differences in habits but also differences in basic cognitive abilities such as information processing, self-evaluation and self-regulation, which have a consistent impact on the response pattern across different decision-making tasks and situations. (p. 941)

Therefore, individuals may differ in their decision making depending on their habits and cognitive abilities, and the decision situations they confront. Scott and Bruce (1995) distinguish between four decision-making styles: Rational, intuitive, dependent, and avoidant, and noted that most individuals use a combination of two styles. Theory on decision-making styles has
been applied in literature on career development and vocational behavior (Scott & Bruce, 1995) and on behavioral decision making (e.g. Bruine de Bruin et al., 2007; Gambetti, Fabbri, Bensi, & Tonetti, 2008; Hodgkinson & Sadler-Smith, 2003; Thunholm, 2004), but it has received scarce attention in literature on innovation and R&D.

Empirical research for this dissertation especially focused on three decision-making styles—the rational, the intuitive, and the political—to investigate whether decision-making style impacted R&D managers’ decisions to engage in collaborative innovation projects. Rational and intuitive decision-making styles were chosen because they represent central concepts discussed in the psychological and organizational decision-making literature. In the psychological literature, these dimensions may be referred to as system 1 and 2 processing, and in organizational literature, they represent the synoptic and the incremental perspectives. The political decision-making style was selected because of the predominant role political processes play in the organizational decision-making literature. Therefore, investigating political decision making on an individual level may contribute to the ongoing debate regarding the incremental and synoptic perspective. The political dimension also represents the incremental perspective.

Second, I used regulatory focus theory to investigate whether interpersonal differences have an impact on innovative decision making, and the decisions of R&D managers to engage in collaborative projects of innovation. Regulatory focus theory, which originated in the field of social psychology, distinguishes between two self-regulatory orientations: a promotion focus that is concerned with hopes and accomplishments; and a prevention focus that stresses responsibilities and obligations (Higgins, 1998, 2000). While an individual with a promotion orientation strives to achieve positive outcomes, an individual with a prevention orientation strives to avoid failure. Whether an individual adopts a promotion or a prevention orientation depends on his or her predominant regulatory focus, but it may also be induced depending on the situation. Hence, regulatory focus may refer to a dispositional tendency, or it may be motivated by organizational cues (Higgins, 1998). Depending on their regulatory orientation, people use different strategies to achieve their goals: promotion-oriented individuals favor eagerness strategies to ensure gains, while prevention-oriented individuals prefer applying vigilance to prevent mistakes. Following the regulatory fit argument, it is important that decision makers are able to use a strategy that suits their regulatory orientation (Higgins, 2002). This is because they will achieve better results, and more favorably evaluate the decision-making process and the results. Regulatory focus theory is, therefore, a model that allows for investigation and interpretation on multiple levels, and takes into account the institutional
context in which individuals act. It thereby offers an advantage over other decision-making theories, such as effectuation theory, that are located on the individual cognitive level.

Regulatory focus theory does not seek to describe differences in personality, but rather it describes distinct and self-regulatory ways of understanding motivational mechanisms. Personality describes more stable traits that may be seen as precedents of regulatory focus. For example, a promotion orientation is positively associated with extraversion and openness to experience, while a prevention orientation is related to conscientiousness (Lanaj, Chang & Johnson, 2012). While personality differences may not directly translate into work-related decision making, regulatory focus represents a dimension that has been found to more directly add additional value to explaining work outcomes, such as innovative performance (Lanaj et al., 2012).

Regulatory focus theory has been associated with a person’s tendency to engage in risky behavior, since promotion-oriented individuals tend to make risky choices in real-life situations, whereas prevention-oriented individuals are concerned with safety, and therefore tend to avoid risks (Hamstra, Bolderdijk, & Veldstra, 2010; Spanjol, Tam, Qualls & Bohlmann, 2011). Risk propensity has a long tradition of research in the entrepreneurship and economic literature (e.g. Carter & Jones-Evans, 2006), where it is studied either as a stable characteristic (e.g. Stewart & Roth, 2001), or as a tendency that may differ according to the context of the situation (e.g. Kahneman & Tversky, 1979). Regulatory focus theory may offer further insights into how to predict and manipulate risky behavior. For example, managers may provoke riskier behavior by priming their employees to be more promotion-oriented, or discourage risk-taking by triggering a prevention focus (e.g. Gino & Margolis, 2011). While regulatory focus has implications on people’s risk-taking, it may not be seen as one and the same since it explains a much wider array of behaviors in different contexts.

Understanding the role of regulatory focuses in collaborative innovation may therefore help to build multi-level models that take into account the organizational context, offer insight into the impact of individual differences on innovative and collaborative behavior, and offer possibilities to plan interventions by inducing adequate regulatory foci depending on the preferred outcomes. The theory has been applied to a large variety of topics and in an organizational context, to study entrepreneurship (Hmieleski & Baron, 2008), creativity (Friedman & Förster, 2001), and new product development teams (Spanjol et al., 2011). However, it has not been used to explain collaborative innovation, and therefore offers a fresh perspective.
Third, a concept borrowed from psychology to understand attitudinal differences between people is the theory of planned behavior (Ajzen, 1985, 1991). Based on the theory of reasoned action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), the theory of planned behavior can be used to understand human behavior in general, and offers a model that may present detailed insights into behavioral determinants (Ajzen, 2005). According to the theory of reasoned action, the most important determinant of behavior is the intention to conduct the behavior. The intention to conduct a specific behavior, builds on a person’s attitude towards the behavior—the positive or negative evaluation of the behavior—and the subjective norm, or whether the person perceives a social pressure to conduct the behavior. The theory of planned behavior proposes that individuals may not always be able to conduct a certain behavior and that the perceptions of behavioral control and the actual behavioral control determine individuals’ behavioral intentions and the behavior itself. In this dissertation, I explored how decision makers’ beliefs influenced their attitudes, and ultimately their engagement in open innovation, and how individual beliefs impacted the project level of an open innovation initiative.

I selected these three theoretical approaches because each has been tested and applied successfully in previous research and has been related to innovative behavior. However, no previous study has explored the impact of these three theories on open innovation. The next section provides an overview of existing literature on innovation decision making and shows the necessity of developing its behavioral basis.

1.3.4 The development of a micro perspective on innovation decision making

The previous two sections provided an overview of (1) the recurring debate in organizational decision making regarding the synoptic and incremental perspectives on the decision-making process, (2) theories from psychology to understand cognitive and other individual differences among decision makers, and (3) three theoretical lenses applied in this dissertation. These sections discussed decision making in an organizational context and the cognitive processes that may play roles in decision making in various contexts. In this section, I argue for the need to integrate existing knowledge about the decision-making process with the current innovation literature. I show that an understanding of the behavioral foundations, or micro level, of innovation decision making can be a beneficial contribution to the literature. To do so, I first discuss the various levels of analysis considered in the innovation literature and identify the individual level as an area in which to gain further insights. Next, I present the results of a literature scan of four important innovation journals on the topic of decision making. This review revealed a growing interest in the topic of innovation decision making, but detected
some areas that have received only scarce or no attention, such as the individual perspective on open innovation decision making.

Figure 1.2 provides an overview of the five most important levels of analysis in the study of innovation (Vanhaverbeke, 2012), from the micro to the macro level: (1) the individual level, (2) the team, project, and process level, (3) the firm and units of the firm level, (4) the networks and dyad level, and (5) the national innovation system (NIS) level. To ensure the readability, only five levels are depicted, but additional levels might more adequately represent reality. For example, the dyad level could be located one level below the network level, instead occupying the same category.

Figure 1.2
Levels of analysis in organizational research
Adapted from Hitt, Beamish, Jackson, & Mathieu (2007) and Vanhaverbeke (2012)

According to Hitt, Beamish, Jackson, and Mathieu (2007), an individual’s knowledge, skills, abilities, and other personal characteristics transcend all levels of analysis. Therefore, an understanding of the individual level may contribute to understanding organizations in general. Most handbooks of innovation mention the role of the individual as key to innovation management (Von Stamm, 2008; Tidd et al., 2005; Trott, 2008). Nevertheless, most handbooks dedicate only one chapter to the development of individual concepts, while focusing mostly on the processes and mechanisms of innovation, R&D, (new) product development, and technology management. However, interest in a micro perspective on innovation has grown recently within
the academic literature, and innovation literature has recognized the impact of the individual in the technological innovation process (Van de Ven, 1986).

Table 1.1
Overview of publications on decision making in four innovation journals

<table>
<thead>
<tr>
<th>Journal</th>
<th>Total</th>
<th>Level of analysis (#)</th>
<th>Topics of individual level studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal of Product Innovation Management</td>
<td>23</td>
<td>Individual (12)</td>
<td>Visual decision aid and go stop NPD decisions, experience and project exploitation, passion and NPD exploitation, manager disposition and new product portfolio management, transactive memory system theory and screening decisions, entrepreneurs, mental models and entry decisions, regulatory focus and NPD, persisting with underperforming projects, well-informed decision makers</td>
</tr>
<tr>
<td>Technovation</td>
<td>11</td>
<td>Individual (3)</td>
<td>Users’ reception of technology, competence, dysfunctional decisions</td>
</tr>
<tr>
<td>R&amp;D Management</td>
<td>8</td>
<td>Individual (4)</td>
<td>CEO characteristics and R&amp;D investment, risk taking, attitude and judgment, impact of inventor profiles on patents, HRM, competencies, effectuation</td>
</tr>
<tr>
<td>Research Policy</td>
<td>5</td>
<td>Individual (1)</td>
<td>Impact of scientists’ research trajectory on patents</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>Individual (20)</td>
<td></td>
</tr>
<tr>
<td>Total articles published 2004–2009</td>
<td>15</td>
<td>Individual (5)</td>
<td></td>
</tr>
<tr>
<td>Total articles published 2010–2014</td>
<td>32</td>
<td>Individual (15)</td>
<td></td>
</tr>
</tbody>
</table>

Note. Most articles look at two levels of analysis simultaneously; therefore, the numbers of articles in parenthesis add up to a larger amount than the total number of articles published on decision making.
Until recently, few studies on decision making in R&D and the innovation process could be found (Hauser et al., 2006). However, researchers have encouraged more research on the topic (Hauser et al., 2006; McNally & Schmidt, 2011), and consequently, the literature is growing. Table 1.1 shows an overview of the decision-making studies conducted in four of the most important innovation journals: Journal of Product Innovation Management (JPIM), Technovation, R&D Management, and Research Policy. The table categorizes the literature on basis of the number of articles published about decision making within the last 10 years, the levels of analysis in these articles, and the topics with an individual decision-making focus. Appendix A provides a list of all publications.

Since 2005, approximately 47 articles have been published on decision making in the four innovation journals. Within the last five years, the number of publications about innovation decision making has more than doubled in comparison to the period 2005–2009. Since 2011, the number of publications on the topic of innovation decision making has risen considerably, which may be partly ascribed to a special issue on new product development decision making published by JPIM in 2011 which included five papers on innovation decisions. The literature scan indicated that JPIM is the most important outlet for decision-making research, with 23 or half of all the articles on the topic in the reviewed journals.

Overall, the preferred level of analysis was the project, product, or process level, with 25 articles. The strong focus on this level was not surprising, because most of the articles on decision making were published in JPIM, a journal explicitly dedicated to enhancing product innovation. Of these 25 articles, 19 were published in JPIM. Popular topics of research were the screening and selection of NPD projects or the “go” or “no go” decision at the project or portfolio level. The review showed that the literature on the micro level, such as the individual and project perspectives, had grown considerably, more so than studies on the firm, networks, or national levels, which would indicate a growing need for a micro perspective on R&D and new product development. Most studies that focused on a micro perspective looked at the individual level and the project level of analysis simultaneously. As a result, although the main focus and outcome variable might have been a decision made at the project level, the individual characteristic, such as the R&D professional’s passion, was used as a predictor variable (for example, Klaukien, Shepherd, & Patzelt, 2013). Within the last years, interest in the individual level of analysis has grown. Research in this area has been concerned with competencies and disposition, as well as the mental process and the kind of information that managers use to make decisions.
Although some studies used novel approaches to understanding individual level processes in innovation and integrated theories that were new to the field of innovation (see Hammeci, Van Riel, & Sasovova, 2011; Spanjol et al., 2011), most studies primarily focused on project outcomes rather than a profound understanding of individual behavior. Hence, few studies used coherent frameworks from psychology or introduced theories that had not previously been discussed in the innovation literature. Rather, they used concepts such as risk taking or leadership style that have been frequently and well researched in the innovation literature.

In addition, existing decision-making literature takes an internal R&D perspective on innovation and focuses on project selection within the context of one firm context, widely disregarding open innovation. Only three studies in the literature scan integrated the external firm perspective into their studies. These studies looked at the decision whether to source technologies from outside or inside the firm (Boneso, Comacchio, & Pizzi, 2011; Montoya, Zárate, & Martín, 2007; Wang et al., 2014). Two of the three looked at factors in a firm that may influence the decision to use external or internal technology and explored the effects of this decision on firm outcomes. For example, Wang et al. (2014) found that firms with high internal technological capabilities were less open than those with wide external networks. The authors found that openness was positively related to sales growth and negatively related to innovativeness. On the other hand, Bonesso et al. (2011) proposed that sourcing decisions are made on a project-to-project basis and may depend on the knowledge that the project aims to produce. Hence, the more novel and diverse—or broad—the knowledge of the project, the more external technologies are sourced. These studies examined the antecedents of open innovation decision making and proposed firm and project factors as the most important determinants. While these studies offer interesting insights on understanding the open innovation phenomenon, the role of the individual decision maker—and his or her agency in making open innovation decisions—remains unexplored. So far, no studies have examined the topic of individual decision making in open innovation.

Based on the review of the existing innovation decision-making literature, three conclusions can be drawn: (1) interest is growing in innovation decision making and particularly the micro perspective on the topic; (2) the existing literature on individual innovation decision making mainly relies on well-established individual concepts, and only some studies use novel approaches to integrate theory from psychology; (3) open innovation decisions have been discussed scarcely and no study on open innovation decision making has looked at the role of the individual. To address these issues, this dissertation offers insights on the behavioral
foundations of (open) innovation decision making. The following section describes the research aim and this study’s contributions to existing literature.

1.4 Research aim

The previous sections offered an overview of current debates and research necessities in the innovation and decision-making literature. Based on the literature review, the aim of this research has two directions: The first direction, derived from the organizational strategic decision-making literature, is to understand the process that guides innovation decision making within technology-intensive settings. The second direction, derived from the psychological decision-making literature, aims to understand the R&D professional’s individual decision making and his or her influence on open innovation. This section provides the research question of this dissertation and explains how answering this question contributes to the existing literature.

1.4.1 Research question

The previous sections provided an overview of innovation and decision making and the current debates and unresolved issues. The literature review provided a general definition of the concept of innovation and identified open innovation as one major development within research and practice that brings its own set of challenges. The topic of decision making can be approached from different disciplines. Organizational and strategic decision-making literature concerns the decision-making process, and the psychological literature examines decision maker’s individual characteristics and actions. Despite growing interest in understanding decision making in the field of R&D and innovation, the field has not taken advantage of the wealth of knowledge from psychology concerning the individual and has scarcely dealt with open innovation decision making at all. Based on these insights, I formulated the following research question for this dissertation:

What are the behavioral foundations of (open) innovation decision making in R&D projects in technology intensive firms?

The topics and chapters in this dissertation are shown in Figures 1.3a and 1.3b. Figure 1.3a shows three influences on innovation behavior, and Figure 1.3b shows the dissertation topics. The first research area—innovation—is addressed in Chapter 2, and the second area—open innovation—in Chapters 3 and 4.
4.2 Contribution of this dissertation

This dissertation makes six major contributions to the strategic decision-making literature, the innovation literature in general, and the open innovation literature specifically, which are described below.

Contribution to the strategic decision-making literature

1. Some researchers in strategic management have called for a shift in focus from theories of learning and routines to reclaim ideas from behavioral decision making (Gavetti et al., 2007; Gavetti, Levinthal, & Rivkin, 2008), especially studies that incorporate new psychological insights into research in organizational decision making (Gavetti et al., 2007). This study of organizational decision making builds on the authorities in the field, such as Simon and March, and incorporates theories of decision-making style, regulatory focus, and planned behavior. As a result, these findings indicate that decision makers’ beliefs especially drive their decisions to engage in innovative behaviors.

2. Researchers have called for further insight into the interrelationship between the synoptic and the incremental perspectives on strategic decision making (Breus & Hunt, 1999) and so far have lacked empirical insights (Dane & Pratt, 2009). This study investigated the composition of the process leading to effective decision making, and findings indicate that the incremental perspective is used in early stages of an innovation process and the synoptic perspective in more mature stages. These first empirical insights into the sequencing of the decision-making process may contribute to designing more effective processes and encouraging useful behaviors within firms.
Contribution to the innovation literature

3. The topic of innovation decision making has received growing attention within the R&D and NPD literature as researchers have aimed to explore decision making on an individual and project level (McNally, Durmusoglu, Calantone, & Harmancioglu, 2009; McNally & Schmidt, 2011). Researchers have explored the role of facts and information in making effective innovation decisions (Atuahene-Gima & Li, 2004; Kester et al., 2011) and the role of intuition throughout the process of NPD (Eling, Griffin, & Langerak, 2014; Kester et al., 2011). In this dissertation, I examined rational, intuitive, and political decision-making processes to offer insights into the approach that may be superior in innovation results and how processes may be used in conjunction with each other. Findings indicate that intuitive and political processes are especially promotional to innovation and rationality may not impact innovativeness as strongly as earlier research has suggested.

4. Innovation literature is multidisciplinary and combines insights from such fields as economics, entrepreneurship, management, and technology, science, and engineering. Drawing from psychology, it has profited from concepts such as leadership (Elkins & Keller, 2003), creativity (Amabile, Conti, Coon, Lazenby, & Herron, 1996), teams, culture, and competence. This dissertation includes insights from psychology regarding the behavioral foundations of decision making. Findings indicate that the theories of decision-making styles and regulatory focus—when measured at the individual level—offer only limited insight into innovation behavior; however, the theory of planned behavior can be useful to reach new understandings regarding innovation decision making.

Contribution to the open innovation literature

5. Academics have suggested that open innovation requires an analysis on multiple levels (Gassmann, Enkel, & Chesbrough, 2010; Vanhaverbeke & Cloodt, 2006), yet only a few studies have focused on the individual level of analysis and insights into the role of the individual in open innovation are scarce. This level of analysis may be important for understanding open innovation because middle managers are especially responsible for implementing the practice (Floyd & Wooldridge, 1997). This dissertation helps to identify the behavioral foundations for open innovation implementation and explores open innovation decision making, thereby offering insights regarding individual decision orientation and the beliefs of R&D professionals. The study’s findings indicate that champions with positive beliefs regarding open innovation drive its implementation, while individuals with a rational decision-making style who focus on preventing negative outcomes hinder its implementation. Factors
other than the individual characteristics, such as availability of adequate competencies, partners, and resources also may facilitate or hinder open innovation.

6. The growing interest in open innovation calls for more rigorous quantitative studies (Dahlander & Gann, 2010) and case studies that provide new perspectives on the success or failure of open innovation (Van der Vrande, De Jong, Vanhaverbeke & De Rochemont, 2009). This dissertation meets these demands with a multi-methods approach that combines case study research with a survey. Through a case study showing mixed results of an open innovation implementation, this research contributes insights regarding the transition from closed to open innovation and complements earlier success stories, such as the case of P&G (Huston & Sakkab, 2006, 2007). This study also offers insights on the transition from fourth to fifth generation R&D in a context of limited budget and resources. Based on this case, this dissertation offers two operational models to be used in research and practice to assess decision-making processes and the open innovation mindset.

### 1.5 Research context and study methodology

This section provides information regarding the research context of the empirical studies and gives an overview of the methodology of the studies.

#### 1.5.1 Research context

This study used a multi-method approach to investigate innovation decision making, including a longitudinal case study and a survey in technology intensive firms in the Netherlands.

The case study was conducted in the R&D department of a multinational company operating in the information and (tele)communications technology industry (ICT). The firms’ business consisted in developing network equipment, software, and services for network and business operations. At the time of data collection, the company employed more than 100,000 in 180 branches worldwide, with about 24,000 employed in R&D. Approximately $3.5 billion were invested in R&D and the company filed approximately 33,000 patents. The case study was set in one specific R&D department with around 120 employees.

The company was selected for several reasons. First, the company was representative of the fast-paced R&D environment in which employees are challenged to adjust to rapid technological developments and to manage product failures and investments. For example, as the company expanded from telecommunications into the ICT sector, the R&D department
faced important decisions regarding how to implement this change and had to juggle reorganizations. Second, in reaction to these changes the R&D department began implementing open innovation. The success of this initiative was mixed. The open innovation literature includes few accounts of less than successful cases (Huizingh, 2011; Van de Vrande et al., 2009) because many firms share only their success stories.

In summary, a single empirical context for two case studies was chosen because of its revelatory nature. As previously discussed, R&D is currently transitioning from the fourth to the fifth generation model that is marked by higher interconnectedness. The company studied in this dissertation was located in the middle of this transition in a context of a severe decrease in budget and resources. Therefore, studying an open innovation initiative with mixed results offered an opportunity for research. For more information on the company and the specific data, see the next section and Chapters 2 and 4.

While the case study provided insight into one specific context, the quantitative study gathered insights from a variety of technology sectors. A survey was distributed through the Institute for Sustainable Process Technology (ISPT), the Dutch Product Development and Management Association (PDMA), and the research team’s professional network. The ISPT and PDMA were chosen because these institutions have a network of R&D professionals across a large variety of sectors. With approximately 250 members, the Dutch PDMA aims to exchange knowledge to improve the performance of innovation. The ISPT is a cooperation among industry, universities, and knowledge institutes that focuses on enhancing innovation in the process industry. Through these organizations and the researchers’ professional network, the survey was sent to innovation managers, product managers, and R&D managers in the private sector. Respondents came from the R&D departments of large, small, and medium-sized companies that develop new technologies in various sectors, such as pharmaceutics and chemistry, manufacturing and construction, food services, IT, and oil and gas. Chapter 3 provides more information on the data collection process and the characteristics of the respondents and their firms.
Table 1.2
Overview of collected data per chapter (ch.)

<table>
<thead>
<tr>
<th>Ch.</th>
<th>Company/Institute</th>
<th>Date of data collection</th>
<th>Research approach</th>
<th>Design</th>
<th>Level of analysis</th>
<th>Used data sources (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Magnus&lt;sup&gt;a&lt;/sup&gt;</td>
<td>February 2012 to December 2012</td>
<td>Qualitative: Case study analysis</td>
<td>Embedded case study (4 units)</td>
<td>Decision-making process; R&amp;D department</td>
<td>Interviews (24) Meetings (28) Documents (103) Diary</td>
</tr>
<tr>
<td>3</td>
<td>ISPT; PDMA (NL); Network</td>
<td>April 2013 to October 2013</td>
<td>Quantitative: Regression analysis</td>
<td>Embedded case study (17 units)</td>
<td>Individual; behavioral dimension; open innovation project process</td>
<td>Interviews (28) Meetings (6) Documents (2) Diary</td>
</tr>
</tbody>
</table>

<sup>a</sup>Name changed to ensure anonymity

1.5.2 Methodology

Because the aim of this research was to investigate the behavioral foundations of innovation and open innovation decision making, the empirical studies combined theories from psychology with theories from the innovation literature. Table 1.2 shows the company or organization providing data, collection periods, research approach and design, level of analysis, type and number of data sources (such as interviews or observations).

Traditionally, psychological research draws on quantitative methodology such as experiments and surveys and open innovation research predominantly uses qualitative methodology. For this dissertation, I have strived not only to utilize knowledge from both fields but also to combine each field’s typical methodology approach into a mixed-methods approach. With this mixed-methods approach, I could expand the scope, breadth, and range of the investigation by selecting the adequate methodology for various components of the research (Greene, Caracelli, & Graham, 1989). For example, a case study lends itself to answer how and why questions, while a survey asks who, what, and where questions and specifies the effects of one variable on another (Yin, 2009). Two case studies were conducted in the company described before (Chapters 2 and 4), and the survey resulted in one study (Chapter 3).

Data analysis in the two case studies (Chapters 2 and 4) followed a case study approach (Eisenhardt, 1989a; Yin, 2009). Both studies provide important insights into the innovation
decision-making processes that support or inhibit open innovation. During a nine-month period, I conducted 28 semi-structured and open interviews with managers and engineers. All interviews were face-to-face except for three that were held via video chat technology. Multiple data sources, which produce more robust and generalizable findings than a single data source (Jick, 1979; Yin, 2009), consisted of meetings, documentation, observations, and numerous informal conversations with managers and engineers during lunch or coffee breaks and the evening commute. I recorded the interviews and meetings and used an observation diary to collect the relevant content that could not be recorded by voice recorder and to write down my main thoughts, impressions, and interpretations. All recordings of interviews and meetings were transcribed and the data were analyzed using NVivo 10 software. To conduct the analysis, I collaborated with a research team, consulted existing literature, and followed rigorous procedures for case study research (e.g. Yin, 2009). I took an active role in the set up of the case studies, the data collection process, and the analysis of the data. I personally conducted all interviews, and was present on the research site for two to four days each week throughout the whole period of data collection, in order to attend meetings and to record my observations. During this time, I held several meetings with two senior researchers to discuss the process of data collection and to formulate possible interpretations. I transcribed some of the meetings and interviews myself, while others were transcribed by two research assistants. The data analysis occurred during frequent discussions with two senior researchers, for example, to establish a coding scheme. Chapters 2 and 4 provide in depth information on the respondents, data sources, and the data collection and analysis.

During literature analysis and interviews, it became apparent that the R&D or project manager’s decision orientation could have an important impact on project innovation and openness. For example, one manager in the case study said, “if people have to take decisions, then there is a link with the personality of the person who defines the goals. That person, the project manager, or product manager, plays an even more important role than the setting.”

Based on this insight into the decision-making process and the increasing interest in the individual perspective on innovation within the literature, I sought to broaden the study’s scope to include insights into the individual characteristics of the R&D and project manager. This topic called for a quantitative methodology, for two reasons: First, scales to measure individual characteristics are available and are good tools to assess the individual perspective. Second, applying a quantitative research method would make the findings more generalizable as patterns of characteristics across several industries could be identified, and researchers have called for more quantitative studies to improve generalizability (Dahlander & Gann, 2010).
Therefore, I developed a questionnaire to investigate the impact of decision orientation on project openness (Chapter 3), which consisted of scales and measurements that other researchers had previously tested. Ten experts from academia and practice provided feedback on the questionnaire or were involved in pretesting it to guarantee accurate wording and understandability. The data were collected during a seven-month period. The respondents were approached through the ISPT, PDMA, and the research team’s professional network. To increase the response rate, a cover letter on behalf of the corresponding institution or contact person was sent to the respondents prior to the questionnaire. I analyzed the data using the statistical software IBM SPSS Statistics version 21 using regression analysis. Chapter 3 provides a more detailed overview of data collection, the sample, and data analysis.

1.6 The next chapters

The next chapters examine different aspects of R&D decision making and the effect on innovative behavior in the technology-intensive sector. These different aspects jointly offer a differentiated view at the micro level on innovation decision making, which contributes to the existing innovation literature. In addition, R&D professionals may learn to design effective innovation decision-making processes that take into account individual attitudes and characteristics to enhance innovative and collaborative behavior. Reflecting the number of authors involved, Chapters 1 and 5 are written in the first-person singular, and Chapters 2, 3, and 4 are written in the first person-plural.

Chapter 2 investigates the innovation decision-making process, specifically, whether an ordering exists between rational, intuitive, and political decision-making processes, and how their interactions affect innovative outcomes. This examination of these different decision-making processes in conjunction extends the existing strategic decision making and innovation literature. The findings indicate that the innovation decision-making process begins with intuition, followed by politics, and concludes with rationality. Intuition and politics play an especially important role in innovation decision making and rationality does not influence the innovation process as strongly as the other processes. The practical implication is that R&D settings in which professionals are skilled in communicating about intuitions throughout the political process may outperform settings in which professionals communicate purely on rational terms.

Chapter 3 investigates how R&D managers’ decision orientation influences R&D project openness. Drawing upon theory from social psychology, this chapter examines (1) whether a rational, intuitive, or political decision-making style impacts collaboration, (2) whether the R&D
professional’s regulatory focus impacts collaboration, and (3) whether both variables interact. Results indicate that decision-making styles and regulatory focus taken separately do not significantly impact project openness; however, a rational decision making style negatively impacted collaboration in managers with a strong prevention focus. When rationality was low, managers with a high prevention orientation collaborated more than managers with a low prevention orientation. The findings indicate that although certain characteristics influence collaboration, individual influence is limited. The chapter provides possible explanations for this finding may serve as a starting point for future research.

Chapter 4 investigates how the R&D professional’s individual decision making influences the implementation of an open innovation process at the project level. This study applied the theory of planned behavior to offer insights into the reasons for conducting open innovation, which contributes to the existing literature. The results indicate that using theory of planned behavior in a qualitative research design may help to build theory regarding the individual foundations of open innovation. The findings also suggest that people with positive attitudes regarding open innovation most strongly influence the open innovation project process. Lastly, the chapter suggests several factors that may facilitate or inhibit open innovation.

Chapter 5 presents the conclusions of this dissertation. The findings indicate that innovation decision making is marked by the R&D professional’s intuition and political behavior, and suggests that the decision maker’s general dispositional decision orientation has only limited influence on implementing open innovation in R&D projects. However, the implementation of open innovation depends on the R&D professional’s belief system: Individuals with positive beliefs drive the implementation even under disadvantageous circumstances. Therefore, individuals who act proactively to engage in behavior in which they believe mark the innovation process. Chapter 5 also points out the theoretical and managerial implications of these findings and discusses limitations and avenues for further research.