Contingent use of rational, intuitive and political decision-making in R&D

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Abstract

Purpose – The purpose of this paper is to gain insight into the contingent use of rational, intuitive and political decision-making in R&D.

Design/methodology/approach – This research is based on a study in an R&D department of a multinational high-tech firm in the Netherlands. The study consists of a case study design, focusing on four embedded cases, longitudinally studying each case.

Findings – The literature distinguishes three dimensions of innovation decision-making processes: rational, intuitive and political. By studying these interwoven dimensions over time, this study finds that the dominant use of each of these dimensions differs across the innovation process. There is an emphasis on intuitive decision-making in an early phase, followed by more emphasis on political decision-making, and moving to more emphasis on rational decision-making in a later phase of the R&D process. Furthermore, the predominant choice in a specific innovation phase for one of the three decision-making dimensions is influenced by the decision-making dimension that is dominantly employed in the preceding phase.

Research limitations/implications – This study contributes to the innovation decision-making literature by developing and applying a model that distinguishes rational, intuitive and political decision-making dimensions, the interactions among these dimensions in innovation decision-making in R&D, and the contingency of these dimensions upon the innovation phase. It calls for further research into the contingent nature of innovation decision-making processes.

Practical implications – For practitioners this study has two relevant insights. First it highlights the importance and usefulness of intuitive and political decision-making in addition to the prevailing emphasis on rational decision-making. Second, practitioners may be more alert to consciously changing their dominant decision-making approach across the phases of the innovation process. Third, companies may adjust their human resource policies to this study's findings.

Originality/value – The literature on rational, intuitive and political decision-making is quite extensive. However, research has hardly studied how these decision-making dimensions develop in conjunction, and over time. This paper reports on a first study to do so and finds that the dominant use of these dimensions is contingent upon the phase of the R&D process and on the decision-making dimensions used in earlier phases. The study suggests that using a contingency approach can help to further integrate the debate in research and practice.

Keywords Decision-making, Innovation, Intuition, Politics, Rationality, R&D

Paper type Research paper

1. Introduction

The literature shows that intuitive, political and rational decision-making all play a role in an R&D context. However, little is known about how these three decision-making dimensions relate to each other. In particular there is room to study how the dynamic interplay between

the three dimensions unfolds over time in an R&D project. Based on case study research, we find that in the early phase of an R&D project intuition is the most important decision-making dimension, whereas political decision-making is more widely used in the next phase. In a later phase of an R&D project rational decision-making becomes dominant. In addition to uncovering the relation between the three decision-making dimensions, our findings also question the dominant focus on rational decision-making in the literature.

Previous studies mainly focused on the role of either rationality, or intuition, or politics in decision-making. The rational process perspective investigates how issues can be divided into structured decision problems. It is based on the assumption that issues can and should be handled through analysis and thinking about alternative options, and their possible outcomes, before actually making a decision (e.g. Dean and Sharfman, 1993b). Intuitive decision-making also has received increasing attention from researchers and practitioners seeking to understand its possibilities and limitations (e.g. Dane and Pratt, 2007; Kahneman and Klein, 2009; Khatri and Ng, 2000). Intuitive decision-making includes the subconscious and unconscious processes that guide human behavior and decisions (Dane and Pratt, 2007, 2009). The political perspective looks at decision processes marked by power, negotiation and mutual influence. It concentrates on decision-making that is guided by the interplay between individual and group interests (Nutt, 1993).

Researchers have pointed out the advantages and disadvantages of the three decision-making dimensions, with most studies examining each of these decision dimensions separately. Researchers have indicated that decision-making in the various phases of the innovation process may be based on all three – rational, intuitive and political – and may include a combination of these dimensions of decision-making, sequential, as well as occurring in parallel (Brews and Hunt, 1999; Calabretta et al., 2017; Elbanna, 2006). From this perspective, the literature argues that innovation decision processes are dynamic, complex and nonlinear, and intertwine with each other in an interwoven process, over time (Langley et al., 1995; Kester et al., 2009; Lerner et al., 2018; Teisman, 2000). Yet, for years research in this area was non-existent, and to date it still is relatively scarce. Two recent studies focused on the interplay between intuitive and political decision-making (Brinkerink and Bammens, 2018; Elbanna et al., 2015), three studies focused on the interlinkages between rational and intuitive decision-making (Calabretta et al., 2017; Kester et al., 2009; Skrepnek and Sarnowski, 2007), and two research project studied rational, intuitive and political decision-making in conjunction (Behrens, 2016; Stanczyk et al., 2015).

One element that remains understudied, also in the above-mentioned research, is the dynamic aspect. Research has not addressed the question whether and how the use of these decision-making dimensions in innovation processes changes over time. This paper answers a call for further longitudinal research into how decision-making dimensions are interwoven (Dean and Sharfman, 1993a, 1996; Elbanna and Child, 2007; Ilori and Irefin, 1997; Kester et al., 2011; Stanczyk et al., 2015). Our research question is how the use of rational, intuitive and political decision-making dimensions develops over time, and whether and how this use is contingent upon the phase of the innovation process.

Given the above, the core motivation of this study is to develop and apply a model that differentiates between rational, intuitive and political decision-making dimensions; addresses the interactions among these dimensions; and identifies the contingent use of these decision-making dimensions, in innovation decision-making in R&D, over time. The study aims to add a new insight by searching for an answer to the question how R&D professionals make decisions – rationally, intuitively and politically – in the innovation processes in which they participate. It develops a process model that enables the study of rational, intuitive and political decision-making over time. By applying this model in four embedded units in a case study design, this study finds a pattern that indicates that

the dominant use of a certain decision-making dimension is contingent upon the phase of the innovation process.

This finding extends the literature by showing that the type of decision-making dimension used depends on contingencies like timing. Incorporating timing in research into decision-making may strengthen theory building in this area. More research into the question how the three decision-making dimensions may change, or morph into each other over time may uncover new insights. For practitioners our findings provide a guiding principle of how to interactively and dynamically involve intuitive, political and rational decision-making dimensions in their innovation decision-making. For example practitioners may start to value intuitive and political decision-making more, rather than using rational frameworks to guide decision-making, especially in the early phases of an innovation project.

First, this paper provides an overview of the empirical and theoretical research concerning the rational, intuitive and political dimensions of innovation decision-making and the interaction between the three dimensions. Second, it presents the methodology of this study, and third, the empirical findings. Finally, it discusses these findings, their contributions to the literature and the field, and provides recommendations for theory and practice.

2. Decision-making in the innovation process

This section reviews the literature regarding each of the three decision-making dimensions and discusses their application to the innovation process. It first summarizes the existing literature on rational, intuitive and political decision-making in the innovation process, then discusses the interaction between the three dimensions, and concludes with analyzing the gaps in the existing literature. The section ends with the research question we pose to close these gaps, and with a proposal for a process model that guides this search.

Three decision-making dimensions

We define a decision as the choice for an alternative, and the decision-making process as one or more choices for alternatives by one or more persons over time (e.g. Beach, 1993). Table I summarizes the definitions of the three decision-making dimensions – rational, intuitive and political decision-making – as presented and discussed in the literature. It also lists main indicators that are useful to observe whether a specific decision-making dimension is used in practice. Table I serves as the guiding framework for this research's empirical study. The definitions and indicators are used as the bases for the empirical study of decision-making in R&D. First, Table I is further explained in the subsequent text of this section.

Rational decision-making

The rational decision-making dimension has been studied extensively (e.g. Dean and Sharfman, 1993b; Fredrickson and Mitchell, 1984; Gavetti and Levinthal, 2000). Rational decision-making can be defined as a "decision process [that] involves the collection of information relevant to the decision and the reliance upon analysis of this information in making the choice" (Dean and Sharfman, 1993a, p. 1071). Researchers have reported positive effects of rationality on decision outcomes in general (Bourgeois and Eisenhardt, 1988; Fredrickson and Mitchell, 1984) and on decision outcomes in product and service innovation contexts (Atuahene-Gima and Li, 2004; Van Riel *et al.*, 2004). Indicators of the use of rational decision-making are the use of decision makers' cognition, knowledgeability and well-informedness (Ram and Ronggui, 2018; Tripsas and Gavetti, 2000; Van Riel *et al.*, 2004). Studies show that these relate to innovation success.

Decision-making dimension	Definition	Indicators
Rational decision-making	A "decision process [that] involves the collection of information relevant to the decision and the reliance upon analysis of this information in making the choice" (Dean and Sharfman, 1993a, p. 1071)	Decision makers using their cognition and knowledgeability (Ram and Ronggui, 2018; Tripsas and Gavetti, 2000; Van Riel *et al.*, 2004) Reliance upon collection and analysis of information (Dean and Sharfman, 1993a; McNally *et al.*, 2009) Calculation of the decisions and their outcomes (Child and Hsieh, 2014; Colman, 1995; McGrath, 1999; McMillan, 1992)
Intuitive decision-making	Choices for alternatives are driven by "affectively charged judgments that arise through rapid, non-conscious, and holistic associations" (Dane and Pratt, 2007, p. 40)	Decision makers using their feelings: hunches, gut feelings (Khatri and Ng, 2000; Sadler-Smith and Shefy, 2004), excitement and emotions (Agor, 1986; Seo and Barrett, 2007) Decision makers expressing and verbalizing their feelings (Eling *et al.*, 2014) Tolerance for increased emotionality (Eling *et al.*, 2014)
Political decision-making	"Decisions emerge from a process in which decision makers have different goals, forming alliances to achieve their goals in which the preferences of the most powerful prevail" (Elbanna and Child, 2007, p. 434)	Formation of alliances (Elbanna and Child, 2007) and negotiation between them (Nutt, 1993) Decisions made by and in favor of the goals of the most powerful (Elbanna and Child, 2007; Kester *et al.*, 2011; Thompson, 1965) Winning colleagues for decisions (Francioni *et al.*, 2015) Manipulating of information flow to influence decisions (Bourgeois and Eisenhardt, 1988)

Table I.
Definitions and indicators of the decision-making dimensions

McNally *et al.* (2009) and Dean and Sharfman (1993a) find that the reliance upon collection and analysis of information is another indicator of the use of rational decision-making. A third indicator is the importance decision makers attach to a thorough calculation of possible decisions' outcomes. By carefully evaluating possible outcomes of a variety of decision options, decision-makers aim to reduce uncertainty and choose for decisions that are favorable in terms of a risk-benefit analysis (Child and Hsieh, 2014; Colman, 1995; McGrath, 1999).

Two widely established research streams that concentrate on the rational aspects of decision-making in organizations are the mathematical game theoretical approach, and research based on real options theory. In mathematical game theory, innovation decisions are modeled and calculated by defining a limited set of actors, decision alternatives, environmental constraints and decision outcomes. By means of putting these elements into a comprehensive model, alternative routes for behavior, decisions and outcomes can be calculated (Colman, 1995; Jekunen, 2014; McMillan, 1992). In innovation settings where decision makers decide by following a real options strategy they also primarily act on rational grounds. Using this approach, decision makers evaluate possible outcomes of the options they encounter in reality, decide in which one to invest or not, review this decision after a given period, and decide to continue or to end the investment in a certain option. By means of a decision trajectory that is defined by investments and outcomes the decision-maker finds him/herself in an ongoing rational decision process (Child and Hsieh, 2014; Johal *et al.*, 2007; McGrath, 1999).

Although rationality has broad support in previous research literature, it has limits as a sole perspective for explaining innovation decision-making. For example, studies indicated that rationality does not improve product innovation projects and innovative product portfolio performance when (technological) uncertainty is high (Atuahene-Gima and Li, 2004; Kester *et al.*, 2011). Furthermore, a rational perspective ignores the role of emotion, imagination, memories and thought (Langley *et al.*, 1995, p. 261), and may offer an overly

simplified model of innovation decision-making. This is stressed by researchers in adjacent fields of research, who model the process of decision-making as less rational, as a more creative, improvisational and occasional process (Burke and Miller, 1999; Sayegh *et al.*, 2004; Shepherd *et al.*, 2015).

Intuitive decision-making
In this line of reasoning Baker *et al.* (2003) and Baker and Nelson (2005) substantiate that decision-making of entrepreneurs and innovators is often driven by the concept of bricolage – "making do with what is at hand" (Baker and Nelson, 2005, p. 329). Decisional bricolage concentrates on the assumption that innovation decisions can be made by looking around, discovering what is available and then making the best out of it. In the same line, Miner *et al.* (2001) and Moorman and Miner (1998) specifically stress the importance of improvisational capabilities in organizations that aim to learn, improve and innovate. Based on a review of emerging literature in this field, Lerner *et al.* (2018) argue that there is a growing call for more attention in research to the "impulse-driven behavioral logics" behind decision-making, which can complement past and future research that seeks for answers in "intendedly rational logics" of decision-making.

Therefore, intuition has been proposed as an alternative and complementary approach. Intuitive decision-making can be defined as "choices for alternatives that are driven by 'affectively charged judgments that arise through rapid, non-conscious, and holistic associations'" (Dane and Pratt, 2007, p. 40). In contrast to rational processes that can be managed actively and consciously, intuitive processes occur on the non-conscious and subconscious levels (e.g. Dane and Pratt, 2007; Khatri and Ng, 2000).

Indicators of the presence of intuitive decision-making are hunches and gut feelings (Khatri and Ng, 2000; Sadler-Smith and Shefy, 2004) or excitement and emotions (Agor, 1986; Seo and Barrett, 2007). In addition, an intuitive decision process allows different decision makers to express their gut feelings and the positive, neutral or negative emotions they feel with regard to certain decision options. In a purely intuitive decision-making process, reasoning for these feelings is absent and hence emotions are used to come to a decision, rather than rational decision-making. Research on intuition, which has revived within the last couple of years (Sadler-Smith and Shefy, 2004; Shepherd *et al.*, 2015), generally has suggested positive relationships between intuition and innovation outcomes in certain cases, such as in a product innovation context (Dayan and Elbanna, 2011), in the beginning phases of innovation projects (Eling *et al.*, 2014), and in innovation portfolio decision-making (Kester *et al.*, 2011). However, professionals' intuitive judgments may differ enormously, even when decision makers are exposed to exactly the same information (Cowlrick *et al.*, 2011). Their judgments may be contingent upon surrounding factors and the stage of the innovation process (Eling *et al.*, 2014).

Political decision-making
Next to rationality and intuition, political decision-making is concerned with social interaction during the decision process, and this also has been studied widely in the innovation decision-making literature. In political decision-making, "decisions emerge from a process in which decision makers have different goals, forming alliances to achieve their goals in which the preferences of the most powerful prevail" (Elbanna and Child, 2007, p. 434). Several researchers have reported negative effects for political behavior on organizational and decision outcomes (Dean and Sharfman, 1996; Eisenhardt *et al.*, 1997; Elbanna and Child, 2007; Elbanna *et al.*, 2015; Nutt, 1993). So far, few studies have looked at political behavior in an innovation context. While some researchers have expected negative effects of concentration of power on innovativeness (Thompson, 1965), Kester *et al.* (2011) suggested that political behavior may have positive effects on breakthrough product ideas if

managers act in the firm's best interests. These findings suggest a more differentiated perspective on political decision-making than proposed in previous literature.

Indicators of the presence of political decision making emanate, first, from the above-cited definition of Elbanna and Child (2007), in which the formation of alliances between individuals is mentioned. Others have added that negotiating between individuals is political behavior as well (Nutt, 1993). Next, various authors identified decision-making that favors the goals of the most powerful as an indicator for political decision-making (Elbanna and Child, 2007; Kester *et al.*, 2011; Thompson, 1965). A third indicator is trying to win colleagues over for decisions (Francioni *et al.*, 2015), and a final indicator mentioned in the literature is the manipulation of information flows to influence decisions (Bourgeois and Eisenhardt, 1988).

Interaction between decision-making dimensions

Although several researchers have pointed out the importance of looking at rationality, intuition and politics in conjunction (Dean and Sharfman, 1993a, 1996; Elbanna and Child, 2007; Kester *et al.*, 2011; Ilori and Irefin, 1997), very little insight is available regarding their interrelation and its effects on the innovation process over time. Dean and Sharfman (1993a) find that rationality and political behavior are independent dimensions that can occur simultaneously. Therefore, decisions may be both highly rational and highly political. The authors indicate that decision processes that are high in rationality and low in politics generate the most successful decisions (Dean and Sharfman, 1993b). More recently, Francioni *et al.* (2015) studied the occurrence of rational and political behavior in decision-making by employees of small- and medium-sized enterprises (SMEs) in developing new internationalization strategies. They found that most decision makers acted highly rational, but at the same time also invested in the political dimension by creating an atmosphere wherein their decisions were supported by colleagues. The interests and feelings of a dominant person or group in the organization can also increase the importance of intuition and politics. Based on the results of their study of 365 family-owned firms, Brinkerink and Bammens (2018) argue that most firm-owning families decide to relatively underinvest in R&D because they emotionally feel it is in the family's best interest. Oh and Barker (2018) argue on the basis of data from manufacturing firms that top executives tend to make R&D decisions that correspond with the R&D decisions made by firms they are socially tied to, for example, as an outside board member. Other research suggests that decisions using equal shares of intuition and rationality are more successful than decisions using other ratios (Blattberg and Hoch, 1990). Although combining decision-making dimensions simultaneously may lead to more accurate decision outcomes (Dane and Pratt, 2007), this approach can be challenging because of the way decision-making dimensions may influence each other in different phases of the innovation process. For example, Eling *et al.* (2014) find that rational decision-making cultures may counteract the effective use of intuition in innovation because the innovation process focuses only on those intuitions that can be easily justified. Although group members may verbalize their hunches and feelings in groups' decision-making, expressing these intuitions may be problematic when decisions are based on power or majority votes. Consequently, valuable intuitions can be lost or may have to compete with other, contradicting intuitions (Eling *et al.*, 2014). Thus, both rationality and politics may hinder intuition. In their study of innovation decision-making in high velocity environments, Bourgeois and Eisenhardt (1988) find that politics may "impede the flow of information" (p. 763). Hence, political behavior may hinder rationality when it precedes the rational assessment of a situation because decision makers cannot consider alternatives that are deliberately kept hidden.

Gaps in the literature

The rational, intuitive and political innovation decision-making dimensions may be active in sequence as well as in parallel, and they also may serve to stimulate and/or hinder each other.

This suggests that certain sequences or parallel use of distinctive decision-making dimensions over time may be more or less effective. However, researchers differ on the effectiveness of a certain ordering. Some researchers propose that managers should record intuition before the rational assessment of the decision problem (Shapiro and Spence, 1997), others suggest intuition should follow rational analysis (Agor, 1986), and still others say it should be applied both before and after rational analysis (Dane and Pratt, 2007). However, these different views have not yet been researched empirically. Other unexplored questions emanating from this debate are how innovation decision-making dimensions may be combined throughout the innovation process, and which sequences produce effective innovation decisions.

The existing strategic and innovation decision-making literature has predominantly studied rational decision-making and relatively lacks empirical data on the role and effectiveness of intuitive and political decision-making. Since innovation can be described as a social process (Swan *et al.*, 1999), the relative scarcity of empirical studies about the political and intuitive decision-making dimensions in innovative decision-making in firms calls for more research in this area.

Research question and process model
Through a longitudinal study of four decision-making units in an R&D department of a multinational high-tech firm in the information and (tele)communications sector in the Netherlands, this study therefore seeks to answer the question how R&D professionals make decisions – rationally, as well as intuitively, as well as politically – in the innovation processes in which they participate, during a considerable time frame. Discovering whether these three decision-making dimensions occur in parallel and/or in succession in a time frame, and which combinations lead to decision outcomes, can be of importance for a better understanding of the question whether and how the decision-making dimension is contingent upon the phases of the innovation process.

A conceptual process model functions as a starting framework to enable the empirical study of the rational, intuitive and political decision-making dimensions in R&D over time (see Figure 1). The model visualizes two major factors that are taken into account
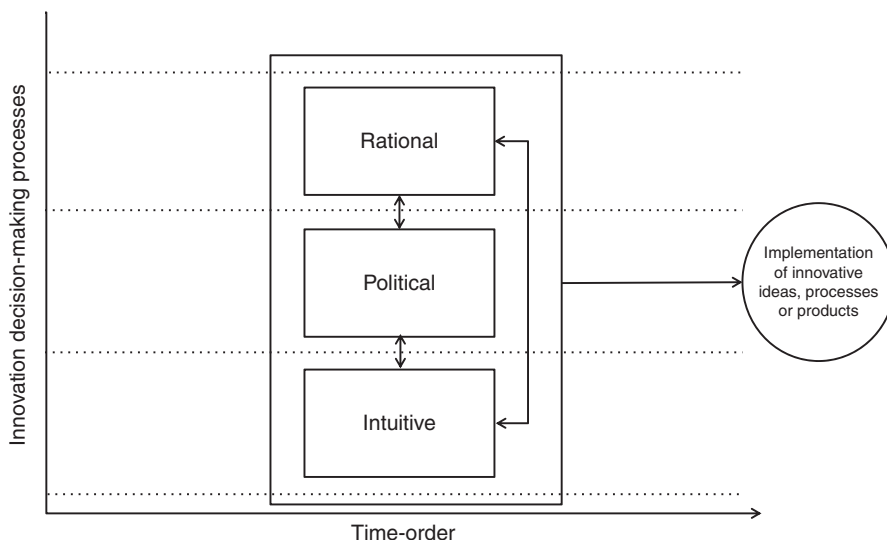
Figure 1.
Conceptual
process model

in this study. The first factor is "time-order" (*x*-axis). By studying time-order we can discover how innovation decision-making dimensions develop over time (Calabretta *et al.*, 2017; Elbanna, 2006; Kester *et al.*, 2009). The second factor of focus is the "innovation decision-making processes" (*y*-axis), which consists of interrelated rational, intuitive and political decision-making dimensions (Stanczyk *et al.*, 2015) in the R&D context. The conceptual process model enables the study of the time-order and interaction over time of rational, intuitive and political innovation decision-making.

3. Case study methodology and methods

To answer the research question, a qualitative study is conducted in an R&D department of a multinational high-tech firm in the Netherlands. A characteristic of this R&D setting is that it faces many decisions on which innovations to develop technically, and which markets to serve with these innovations commercially. The empirical study consists of a case study design, studying four embedded units in the same firm, following the rationale that case studies of innovation decision-making in these four units should provide longitudinal data (Yin, 2009). This design allows the study to track the development of the decision-making dimensions over several months, and to understand dynamics and changes across time. During data collection, a principal researcher immersed in the embedded case study units of the firm, and was present on site, at the firm. This made it possible to trace decision-making dimensions in real time, instead of having to rely on retrospective accounts, which could be biased by the respondents' knowledge regarding the decision outcomes (Langley *et al.*, 1995; Schwenk, 1995).

The firm

To ensure anonymity, the firm is referred to as "Magnus." As a technology-intensive, multinational company, Magnus has more than 100,000 employees of whom almost a quarter is employed in R&D. Headquartered in Europe, the firm has branches in 180 countries worldwide and is listed on the stock exchange. Traditionally, the firm has provided equipment and services within the telecommunication industry, and expanded into information and communications technology (ICT).

The study is conducted in the R&D department of Magnus' local branch in the Netherlands. At the time of data collection, the R&D department consisted of approximately 120 employees, most with a bachelor's degree or higher in a technical field, such as software engineering, electrical engineering or physics.

Embedded units

Table II summarizes the four decision-making units, providing the innovation issue for each unit, the organizational location in which the decision-making process took place, the type of decision and the key decision makers.

The four embedded units in the same organization are selected to be the subject of study because of the aspects they have in common. Their comparability enables a search for empirical patterns that occur in all four units and meet replication logic (Yin, 2009). All embedded units had in common that these dealt with a broad organizational innovation issue, like the reorientation of an open innovation venture, the organization of an innovation team, the formulation of an innovation strategy, and the organization of a new product development portfolio. In addition to this in all four units cross-functional and varying teams consisting of multiple in- and outgoing representatives of the group of 120 R&D professionals (technicians, product managers, sales people, marketing experts) were active. All teams were led by one to five key decision makers (directors, operational managers, innovation managers).

Embedded unit	Innovation issue	Organizational unit	Decision type	Key decision makers	Process followed
1	Reorienting the open innovation venture	Open innovation venture	Open innovation strategy	R&D director, open innovation manager	Real-time, retrospectively
2	Organizing the development process within an innovation team	Innovation team	Innovation team design	Manager, former manager, operational manager	Real-time, retrospectively
3	Formulating a common innovation strategy	Open innovation venture and innovation team and alpha portfolio	R&D strategy	R&D director, open innovation manager, innovation team operational manager, innovation team manager, strategic product manager	Real-time
4	New product development decisions	Alpha portfolio	New product development	Strategic product manager	Retrospectively

Table II.
Description of the four embedded decision-making cases studied

Data collection
In total, five researchers cooperated to conduct this case study project: a principal researcher, two senior researchers, and two junior researchers. Data sources include:

(1) 24 interviews with informants inside and outside the firm;

(2) observations of 28 meetings, such as weekly project meetings, monthly firm meetings and meetings of steering groups;

(3) an analysis of 103 secondary sources, such as company documents, processes, organizational charts, documented presentations and meeting notes; and

(4) approximately 40 days of on-site observation, resulting in 49 single-spaced annotations.

The principal researcher gathered all data and was present frequently on site throughout the whole research project. During the research period, which covered a period of ten months, the principal researcher consulted regularly with the two senior researchers to make sense of the available data, test and elaborate the fit of theories with the available information, and discuss the next steps for data collection. In addition, the principal researcher held feedback sessions with the firm's managers to test the interpretations and adjust the research approach when necessary. After the data were collected, two junior researchers transcribed most of the interviews and offered interpretations based on existing theory. Interviews and meetings were recorded and verbatim transcriptions were used for data analysis. A case study database was established using the software NVivo 10 and digital and analog analyses were conducted. The analysis was made at the level of the four embedded case study units of innovation decision-making in the same firm (Eisenhardt, 1989; Langley *et al.*, 1995). Research team consultation meetings with principal researcher and senior researchers were frequently organized to control for single researcher bias. Regular feedback meetings with the company were organized to control for internal validity of the analysis of data and the narratives derived from this. The organization of the interviews, observations, feedback meetings with the company and consultation sessions with senior researchers in the ten months of empirical study is visualized in Figure 2.
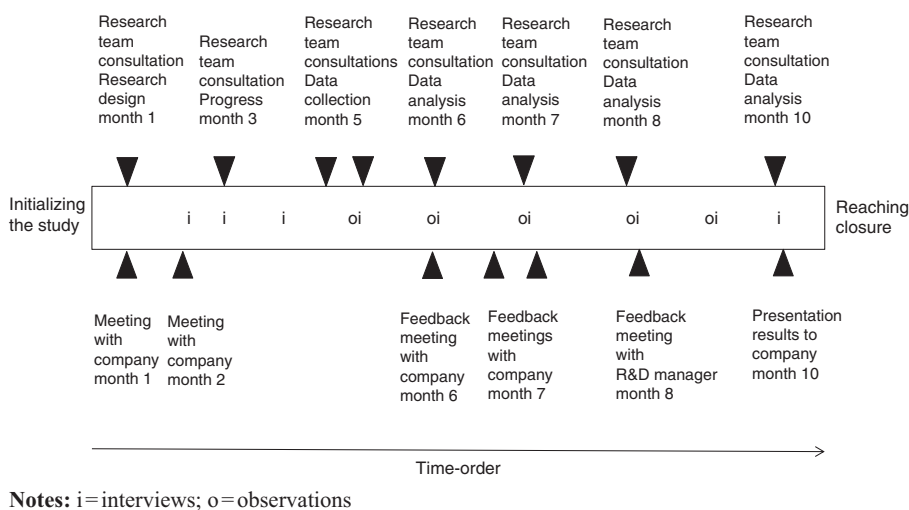
Figure 2.
Data collection
and analysis

Notes: i=interviews; o=observations

Data analysis
Data analysis consisted of three steps. First, a list of all issues (activities and events) concerning how innovation was conducted within the R&D site was compiled. This list was then organized according to main themes and developments across time. Second, the material (interviews and observations) of the four embedded units was coded following a previously designed scheme. This study sought to expand existing theory; therefore, the development of the concepts, categories and to some extent, the codes was based on theory, before data analysis, and did not emerge from the data. Consequently, this study's coding process was fundamentally different than the process of researchers who are building theory purely on the basis of empirical observations, without a theoretical basis (Charmaz, 2014; Glaser and Strauss, 2009). This study's coding scheme was based on the three theoretical concepts (rationality, intuition and politics) identified in the literature, as summarized in Figure 1 and described and explained in Section 2. Per concept, five categories were formed, also based on the literature regarding each concept, summarized in Table I and discussed in Section 2. The categories were operationalized by a set of first order codes that were developed in a first round of coding. These codes were based on both the theoretically defined concepts and categories, as well as on the empirical observations at the initial stages of the empirical study. The concepts, categories and codes are provided in Table III.

In order to build a model of innovation decision-making both within-case and cross-case analysis (Eisenhardt, 1989) is conducted in and between the four embedded decision-making units to identify generally recurring patterns (Yin, 2009) in the decision-making processes over time. Memo-writing and tabulation is used to develop the model and summarize the findings (Miles and Huberman, 1994).

4. The key narrative from the four embedded case studies
This section narrates the main findings on rational, intuitive and political decision-making and their interaction in the four embedded decision-making units of the studied firm. In this section, we first show how the three dimensions of decision-making are present in our data. Next we discuss how these dimensions relate to the phases in the decision-making process.

Foremost, and forming the basis for this narrative, Table IV presents key quotes from our interviews. They are categorized as being indicative of either intuitive, political or

Concept	Categories	Codes
Rational decision-making; a "decision process [that] involves the collection of information relevant to the decision and the reliance upon analysis of this information in making the choice" (Dean and Sharfman, 1993a, p. 1071)	Collect and analyze information (Dean and Sharfman, 1993a; McNally et al., 2009)	Collect information Ask members about input Be very rigorous about understanding information Pose questions about information Rephrase information Discuss information
	Define goals (McGrath, 1999; Van Riel et al., 2004)	Define goals for a certain action Analyze decision items in face of a certain goal (e.g. the fit with the strategy of the firm) Define priorities Evaluate a project in terms of the goals reached
	Use (analytic) tools (Child and Hsieh, 2014; Colman, 1995; McGrath, 1999; Van Riel et al., 2004)	Use calculations or programs to compare information Use project management tools and specifications
	Generate alternatives (McMillan, 1992; Tripsas and Gavetti, 2000). Think about consequences (McGrath, 1999; Ram and Ronggui, 2018)	Think about different ways of doing things Bring a new aspect into the discussion; question something established Think about consequences of actions
Intuitive decision-making; choices for alternatives are driven by "affectively charged judgments that arise through rapid, non-conscious, and holistic associations" (Dane and Pratt, 2007, p. 40)	Personal judgment (Eling et al., 2014; Seo and Barrett, 2007)	Express an opinion or express a (personal) value Judge a certain action as desirable or undesirable Express a preference for/against a certain action Take time to reflect
	Gut feeling (Khatri and Ng, 2000; Sadler-Smith and Shefy, 2004; Past experience (Agor, 1986; Sadler-Smith and Shefy, 2004)	Refer to one's gut feeling Make gestures (e.g. to the stomach) Refer to one's experience and expertise Refer to doing something automatically Refer to doing something fast and out of habit Raise voice
	Emotional moments (Agor, 1986; Eling et al., 2014; Seo and Barrett, 2007) Felt fit (Eling et al., 2014; Seo and Barrett, 2007)	Express an emotion (e.g. frustration or enthusiasm) Express that something feels right/does not feel right Evaluate the whole situation, instead of aspects of it Express insight: "knowing," sudden apprehension

Table III.
Coding scheme
decision-making
dimensions

Table III.

Concept	Categories	Codes
Political decision-making: "Decisions emerge from a process in which decision makers have different goals, forming alliances to achieve their goals in which the preferences of the most powerful prevail" (Elbanna and Child, 2007, p. 434)	Negotiation/bargaining/power (Elbanna and Child, 2007; Kester et al., 2011; Nutt, 1993; Thompson, 1965)	Trade favors
		Effectuate a decision (e.g. using one's hierarchical position in the firm)
		Predominance of individual(s) that is (are) high in the hierarchy
		Centralize the decision making capacity
		Use pressure
		Refer to one's status
		Demand an action or solution from others
	Interests and preferences (Francioni et al., 2015; Kester et al., 2011)	Express or prioritize a personal or group interest or preference
		Express a necessity for action
		Argue from a necessity or a need
	Forming alliances (Elbanna and Child, 2007; Francioni et al., 2015)	One individual talks to another to form a group to effectuate an interest
		Associations with others outside of the formal process
	Information flow (Bourgeois and Eisenhardt, 1988)	Hold back information
		Not share information
		Not have access to all necessary information
		Restrict flow of information

Decision-making dimension	Exemplary quotes
Intuitive	A general manager, indicating the importance of gut feeling: "Sometimes it is important to listen to our guts […] […] Even in the literature you will not find Columbus' egg [a simple solution to a problem]" (Unit 1)
	Two co-workers, expressing their feelings about the innovation project: "In my opinion this is way too easy. Honestly, I think […] yes, that is nonsense!" (Unit 2) and "I think this is great […] this is absolutely fantastic" (Unit 2)
	A manager, explaining a feel for what will succeed or not: "I am a creative-chaotic type of person […] and I just know – based on my rich work experience – that some are going to succeed and others aren't" (Unit 2)
	A manager, indicating that feelings can ignite but also impede innovative behavior: "It is fed by my gut feeling. If I don't have that feeling, I completely disengage in those things; I don't spend energy on it" (Unit 4)
	A manager, stressing the importance of feelings for a project or initiative: "I very much act upon my feeling, and I have had a lot of fights with people within Magnus […] it doesn't bother me to step on people's toes" (Unit 4)
	An engineer, stating that intuition guides the problem-solving process in an innovation project: "[My manager's advice] was very pragmatic-just follow your common sense, use your intuition, so to say. To apply adjustments in the software, it is necessary to find orientation without using a manual to understand how it all works. It is important to be a little intuitive" (Unit 4)
Political	An employee stressing that the positioning of an innovation project can be of crucial importance: "You have to make sure to place your initiative high enough [in the decision hierarchy], but not so high that everybody interferes, because then it will be dead before you can even start" (Unit 1)
	A leading innovation manager explained that an innovation project was protected from people who could frustrate the project: "We do not keep it secret, but we keep it under the decision-making radar" (Unit 1)
	An engineer who tells how his manager tries to provide space for his people to work on innovation undisturbed: "[My boss] granted us autonomy […] He is very active, but it is never visible. Formation, politics, he did all of that. He kept our group out of discussions" (Unit 2)
	A manager, explaining that innovation is people's work and people's interest: "It's a quest. [Finding what is interesting for more parties] often is […] not something mathematical [the manager uses his hands to imitate a set of scales]" (Unit 2)
	A general manager, explaining how an innovation step was supported by developing consensus among team members: "(The meeting went well) because each person was given space to say something, and, in my opinion, others really asked them 'What do you mean?' […] and 'What do you think?' Then you are really listening, instead of saying 'I think it should be this or that'" (Unit 2)
	An engineer, observing the process of negotiation between people in the innovation project: "Alex pulls in one direction; Marc pulls in one direction; Michael pulls in one direction; and Andy thinks 'Hmmmm' and adjusts afterwards" (Unit 3)
	An engineer telling that some ideas are just being introduced to keep certain people committed: "We've been doing a lot of these things since three or four years, and now the idea box is back on the table. Well, at least ask briefly how it went in the past and why it didn't work out […] Now we just do it again, and that bothers me because – yes cool idea – but we have tried, and it failed for a number of reasons that are not up to us" (Unit 3)
	A manager, stressing that innovation is something that should be and stay in the heads of people: "I think innovation is incredibly important and I try to put it on the agenda and to keep it there. Sometimes, this is a crusade" (Unit 4)
Rational	A director, stating that innovation is based on ongoing learning and knowledge capture: "This is a learning curve to understand which new technologies to introduce into which new markets" (Unit 1)

Table IV.
Exemplary quotes for
the decision-making
dimensions

| Decision-making dimension	Exemplary quotes
	An engineer, explaining that working with checks and balances is an important factor: "In some cases you want to safeguard yourself by doing everything right and by doing the right checks, etc. You want some security before you make the decision" (Unit 2)
	An engineer, explaining that making ideas concrete is an important final aspect of the innovation process: "It is in principle a decision based on the feeling of the product, like 'this could be an interesting field for us to invest in,' and then the next step is, can we make it more concrete" (Unit 2)
	An engineer, stressing the importance of acting on facts and figures: "I have to compliment [our manager] because he organized weekly meetings […] He organized the meetings and presented data and numbers" (Unit 4)
	An engineer, telling that the exact specifications of the innovations needed to be clear and concrete: "The technicians had to know exactly what we wanted" (Unit 4)

Table IV.

rational decision-making. All three decision-making dimensions were active in the embedded cases we studied.

Based on a further analysis of the data we found that the dominance of a certain dimension changed over time and that the three dimensions of decision-making also interacted over time. We synthesized this development in Figure 3. The following narrative, illustrated by a selection of exemplary quotes, further specifies this development of dominant decision-making dimensions over time.

From intuitive to political to rational decision-making
The embedded case study findings pointed at a sequential three-phase pattern of decision-making dimensions over time. Although all dimensions of decision-making appeared to be present at all phases of the decision-making process, three consecutive phases could be identified in which one decision-making dimension was dominant over the other two decision-making dimensions. Intuitive decision-making was found to
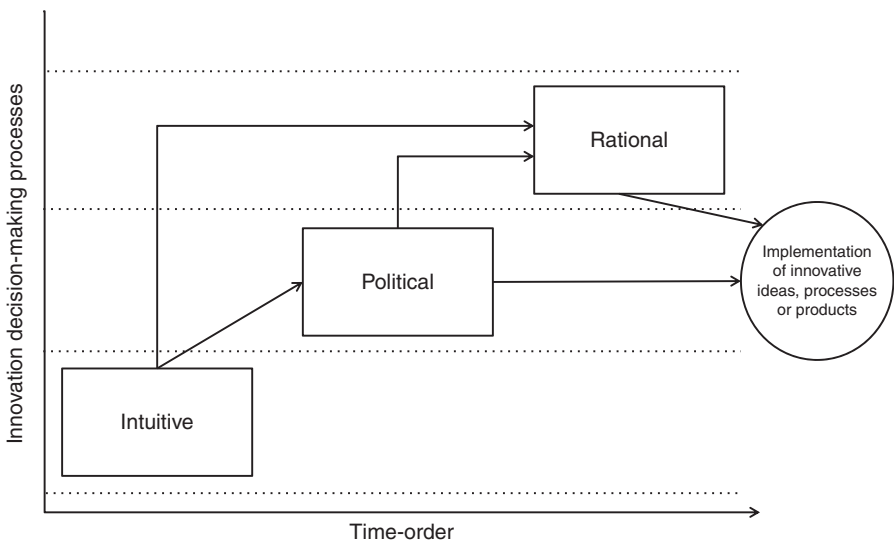
Figure 3.
The dominant R&D decision-making dimensions at Magnus over time

precede and drive political decision-making and rational decision-making. Furthermore, political decision-making in its turn preceded and drove rational decision-making (see Figure 3).

Starting with an intuitive decision-making phase
The data indicate that in the first phase managers relied on intuitive decision-making strategies to identify innovative opportunities, followed by political decision-making strategies in the following phase to implement innovation management processes within their divisions. The intuitive dimension in the first phase had an important influence on whether managers engaged in the political dimension in the following phase to try to implement an innovative strategy. Intuitive decision-making was important for identifying innovative opportunities. When managers did not have a gut feeling that investing time in a certain area was worthwhile, they did not pursue it. For example:

> It is fed by my gut feeling. If I don't have that feeling, I completely disengage in those things; I don't spend energy on it. (Unit 4)

On the contrary, when people were convinced of a certain direction, they endured resistance along the way to pursue their personal innovation interest. Another quote of a manager who was ready to stick to his intuition to conduct innovation:

> I very much act upon my feeling, and I have had a lot of fights with people within Magnus […] […] it doesn't bother me to step on people's toes. (Unit 4)

Intuition also was an important aid in maneuvering toward the political process. Managers indicated that over the course of years they had learned to get a feel for evaluating the political feasibility of a project. For example:

> I am a creative-chaotic type of person […] and I just know – based on my rich work experience – that some [people] are going to succeed and others aren't. (Unit 2)

> It's a quest. [Finding what is interesting for more parties] often is […] not something mathematical [the manager uses his hands to imitate a set of scales]. (Unit 2)

Managers were aware that engaging in innovative activities also implied investing a vast amount of energy in the political dimension:

> I think innovation is incredibly important and I try to put it on the agenda and to keep it there. Sometimes, this is a crusade. (Unit 4)

In the first phase, intuitive decision-making helped managers to see the urgency to realize their innovative vision and to know which political pathways to follow in the subsequent phase. This strong initial reliance on a feeling of what was right to do, gave the respondents the strength to endure conflict and to respond to the frustration of other decision makers. Intuitive decision-making in the initial phase intensified decision makers' firmness in political decision-making processes that became dominant in the subsequent phase.

Followed by a political decision-making phase
The embedded case studies indicated that the way in which intuition was communicated had a significant influence on the quality of the political decision-making process in the next phase. Intuitive decision-making influenced how smoothly political decision-making worked. The findings in Units 1–3 indicated that decision-making processes in a meeting differed to the extent that intuitive decision-making was expressed openly or managed openly by the respective chairperson of the meeting. In Unit 2, some meetings were strongly marked by negative, affectively charged judgments, such as one participant's comment: "In my opinion

this is way too easy. Honestly, I think […] yes, that is nonsense!" Other decision makers responded emotionally to such strong negative expressions, and some left the meeting. However, not all meetings in Unit 2 included negative judgments, and some were marked by positive responses, such as: "I think this is great […] this is absolutely fantastic."

Negatively charged judgments did not necessarily lead to unmanageable conflict, depending on how the judgment was managed and whether other decision makers attempted to understand the remarks. In Unit 2, participants communicated openly and listened to others' intuitive take of the decision-making process; behavior that was encouraged by management. Management stimulated this form of political decision-making, i.e. people trying to influence each other's opinion, to arrive at a widely supported innovation decision-making process. A positive example of how to handle the intuitive dimension of decision-making in order to positively influence the political dimension came from an innovation team steering group meeting in Unit 2, in which the steering group discussed whether to continue or stop new product development projects. All decision makers had the opportunity to express their takes based on emotions, and all listened to each other. The head of the meeting said about this:

> (The meeting went well) because each person was given space to say something, and, in my opinion, others really asked them "What do you mean?" […] and "What do you think?" Then you are really listening, instead of saying "I think it should be this, or that." (Unit 2)

On the other hand, intuitive arguments in the decision-making process were not openly discussed in Unit 3. The decision makers, who were trying to come up with a common innovation strategy, were quick to offer their own opinions, judgments and visions, largely ignored others' intuitions, and did not engage in a dialogue. For example, one of the managers proposed his plan to implement idea boxes in the firm. Some managers agreed with the plan, but one individual expressed strong reservations. After one meeting, he said:

> We've been doing a lot of these things since three or four years, and now the idea box is back on the table. Well, at least ask briefly how it went in the past and why it didn't work out […] Now we just do it again, and that bothers me because – yes cool idea – but we have tried, and it failed for a number of reasons that are not up to us. (Unit 3)

Another manager also supported him, but the remaining decision makers systematically ignored their concerns and formed an implicit alliance to overrule them. The political habit not to listen to one another led to multiple individual strategies instead of creating one common goal.

Completed by a rational decision-making phase
The embedded case studies hinted at a not so important role for rational decision-making, compared with intuitive and political decision-making, in implementing innovative organizational and managerial changes in the R&D organization. It was found that in the third and last phase rational decision-making was above all applied to create rational support for what was already decided on intuitive and/or political grounds.

Rational decision-making was used in Unit 2 to formalize and rationalize the innovation process. Several respondents said that they used rational decision-making to verify and communicate their intuitions, intuitions that drove both political as well as rational decision-making. For example:

> It is in principle a decision based on the feeling of the product, like "this could be an interesting field for us to invest in," and then the next step is, can we make it more concrete. (Unit 2)

> In some cases you want to safeguard yourself by doing everything right and by doing the right checks, etc. You want some security before you make the decision. (Unit 2)

The most important functions of rational decision-making in the embedded units of the case were to logically justify the use of intuitive decision-making in innovative R&D, and to formalize political decision processes. Rationality served as a tool to rationally communicate, support and legitimize R&D decisions, but not necessarily to make them.

Eventually, both political decision-making and rational decision-making led to an innovative result, i.e. the improvement of an innovative organizational aspect of the cases under study (see Figure 3). The sequential pattern depicted in Figure 3 indicates that the applied decision-making dimension can be contingent upon the phase of the innovation process, and upon the used dominant decision-making dimension in the phase preceding the current phase.

5. Discussion and conclusion

Our main findings can be observed by comparing Figure 1 and Figure 3. Figure 1 frames our approach of studying of the rational, intuitive and political decision-making dimensions over time. Based on the four embedded case studies, we develop the model into an empirically specified model for innovation decision-making dimensions in R&D over time. This study found an empirical pattern of dominant sequential and interactive innovation decision-making dimensions over time in the four embedded cases at Magnus, as depicted in Figure 3. The pattern of the dominant decision-making dimensions over time is first intuitive decision-making, then political decision-making, and finally, rational decision-making. Intuitive decision-making influenced both political and rational decision-making; and political decision-making influenced rational decision-making. A further finding is that communication impacted the quality of the relationship between the intuitive decision-making and political decision-making dimensions. Overall, these findings indicate that the dominant decision-making dimension can be contingent upon the phase of the innovation process and upon the decision-making dimension that is dominant in the previous phase(s) of the innovation process. This leads to two propositions that can guide future research:

P1. The choice for the rational, intuitive and political decision-making dimension is contingent upon the phase of the innovation process.

P2. The use of a rational, intuitive and political decision-making dimension is contingent upon the decision-making dimension that is dominant in the preceding phase of the innovation process.

In this study, the innovation decision-making dimensions and their interactions influenced the innovation process in three important ways. First, the embedded units indicated that intuitive decision-making was necessary to identify innovation interests, and to decide whether to engage in the political decision-making dimension. Managers mobilized energy to invest in an activity only when their gut feelings told them the activity was worthwhile. In line with Dane and Pratt (2007) we found that intuitive decision-making facilitated holistic and associative assessment of complex contents and stimuli. Therefore, this dimension could be better suited than the rational decision-making dimension for complex innovation decision-making in R&D. Furthermore, although rational decision-making played a role in all innovation decision-making in this study, decision makers in innovation processes were not primarily concerned with building solid, comprehensive argumentations based on information and data. On the contrary, construction of such argumentations may have curtailed the most innovative approaches within the R&D department. For this study, rational decision-making did not drive innovation as strongly as intuitive decision-making and political decision-making did. This finding seems to confirm earlier assumptions that a rational decision culture can diminish the positive effects of intuition (Eling *et al.*, 2014). Further research and evidence is necessary to gain a deeper insight in a possible

pre-eminence of intuitive decision-making over rational decision-making. This research could focus on the following proposition:

P3. Intuitive decision-making is better suited than rational decision-making for making innovation decisions in R&D.

Other research that was reported in the literature indicates that teams with an innovation assignment use analytical processes in a project's explorative and ambiguous stages (Visser, 2013), but in contrast to this, the embedded cases in this study indicate the opposite. In Magnus, rational decision-making was used to orient and optimize the innovative activities once intuitive and political decision-making gave direction to the innovative behavior. Rational decision-making also was used to formalize innovative activities and make the innovation process more efficient. It is in line with research by Oh and Barker (2018), who found that R&D investment decisions made by CEOs were primarily guided by their ties to other firms and by the R&D practices in these firms, and then were rationalized afterwards, once the decision was made. This leads to the fourth proposition:

P4. The rational decision-making dimension is not used to make innovation decisions in R&D, but is used to justify and further specify decisions that originate from the intuitive and political decision-making dimensions in innovation decision-making in R&D.

In general, these specific findings may have implications for effective interaction of the three innovation decision-making dimensions in R&D. More precisely, the way in which intuitive decision-making is used in the embedded cases throughout the innovation decision-making process may have important implications for gaining insights into the effectiveness of political decision-making. Earlier research has pointed out the disadvantages of political decision-making on the decision-making process, because different interests may compete with each other (see Elbanna and Child, 2007). Potentially, as Eling et al. (2014) suggested, political decision-making may involve opposing intuitive judgments of different decision makers. Contrariwise, this study's embedded cases indicate that political decision-making might have positive implications on innovation decision-making in R&D if intuitive decision-making is communicated successfully. Such communication of intuitive decision-making can improve the alignment between different actors, and bridge the gap between decision makers, even when they have opposing preferences based on their intuitive decision-making.

To date, the literature proposed that rational decision-making approaches could be used to overcome conflicts, for example, by focusing the debate around facts (Eisenhardt et al., 1997). Following a reasoning based on Eisenhardt et al.'s (1997) proposition, feelings could be suppressed, controlled or expressed very carefully, emphasizing rational arguments (Hochschild, 2003; Morris and Feldman, 1996). However, the embedded cases in this study point in a slightly different direction. They imply that individuals may leave a meeting unconvinced and uncommitted when intuition-based doubts are continuously countered with rational arguments.

In contrast, in the studied cases it was observed that when people were allowed to state their concerns openly and to engage in intuitive dialogue, decision makers appeared to be more agreeable to the overall process. These findings align with findings of Seo and Barrett (2007), who pronounce that intense feelings can promote decision-making, and individuals can improve decision-making when they learn to identify their emotions and feelings and thus, by means of explicitly engaging in, and being aware of their intuitive decision-making have better awareness of and control over their biases. Decision makers' underlying beliefs and attitudes are revealed when team members address their colleagues' affectively charged expressions. When people adjust the underlying attitudes and belief structures they may be able to objectify their behavior and reach different outcomes (Argyris, 1976).

Making attitudes explicit through discussion can be a first step to bringing decision makers with different intuitive decision-making outcomes closer together. In line with this, research from the area of public-private R&D collaborations indicates that projects can profit from a well-designed dialogue between different stakeholders that facilitates learning (Roelofsen *et al.*, 2011). This embedded case study research shows that such a carefully designed dialogue can also be necessary when different stakeholders work within the same firm in R&D. This leads to the fifth proposition:

P5. Communication between decision makers positively moderates the effectiveness of the intuitive decision-making dimension's support for the political decision-making dimension in innovation decision-making in R&D.

The importance of the rational decision-making dimension has large support in the literature and is emphasized in theoretical approaches like behavioral analysis (Dean and Sharfman, 1993a), mathematical game theory (Jekunen, 2014) and real options reasoning (Child and Hsieh, 2014; Johal *et al.*, 2007). Yet, a growing number of recent research publications stresses the notion that rational decision-making may often be intermingled with, or combined with intuitive and political decision-making, especially in innovation decision-making processes (Calabretta *et al.*, 2017; Elbanna, 2006; Kester *et al.*, 2009; Stanczyk *et al.*, 2015). This study also provides support for this notion. Moreover, it even indicates that the intuitive and political decision-making dimensions can function as key driving forces behind the rational decision-making dimension in the innovation decision-making process in R&D. This implies that this study supports the call for more attention in future research to impulse driven, behavioral and political logics behind innovation decision-making, to complement the existing attention to the intendedly rational logics of decision-making (see Lerner *et al.*, 2018). This study supports the call for more future research that not only takes into account the rational dimension of innovation decision-making, but also the behavioral, more intuitive and political dimension of decision-making. Future research could further delve into areas like decisional bricolage (Baker and Nelson, 2005) and improvisation (Miner *et al.*, 2001; Moorman and Miner, 1998), as well as the political dimension of decision-making (Francioni *et al.*, 2015).

Theoretical and practical contribution
This study develops and applies a model that differentiates between rational, intuitive and political decision-making dimensions, addresses the interactions among these dimensions, and identifies the contingent use of these decision-making dimensions, in innovation decision-making in R&D, over time. With this, this study offers three contributions to the existing innovation decision-making literature. First, it extends the literature by showing the value that a contingency perspective may bring to further our understanding of the relations between the three decision-making dimensions. The process model of innovation decision-making underpins this result (Figure 3). This contribution is a response to calls from other researchers to study the ordering and interaction between the three decision-making dimensions over time (Dean and Sharfman, 1993a, 1996; Elbanna and Child, 2007; Ilori and Irefin, 1997; Kester *et al.*, 2011; Stanczyk *et al.*, 2015). It finds and concludes that the dominant use of rational, intuitive and political decision-making in innovation processes in an R&D setting can be contingent upon innovation phase, and upon the used dominant decision-making dimension in the previous phase(s).

A second contribution is that this study, following Stanczyk *et al.* (2015), is among the first to research the interaction between rational, intuitive and political decision-making, and is the first to study this interaction over time. Most earlier research tended to disregard the relationship between the three dimensions, and most existing research has focused instead on the rationality-intuition interaction (e.g. Agor, 1986; Calabretta *et al.*, 2017; Dane and Pratt, 2009;

Elbanna and Child, 2007; Shapiro and Spence, 1997; Skrepnek and Sarnowski, 2007), the rationality-political interaction (Dean and Sharfman, 1993b) or the intuitive-political interaction (Brinkerink and Bammens, 2018; Elbanna *et al.*, 2015) in innovation decision-making.

Third, this study indicates that rather than focusing primarily on the rational decision-making dimension, researchers in innovation and R&D management can examine the three decision-making dimensions in conjunction (Stanczyk *et al.*, 2015). Earlier research has shown that rational decision-making is less promotional to decision-making in uncertain innovation contexts (Atuahene-Gima and Li, 2004; Kester *et al.*, 2011). This study supports this finding and suggests that the rational decision-making dimension should be applied in conjunction with the intuitive and political decision-making dimensions.

In the business world, rational decision-making is often considered desirable, sometimes even superior. Clear expressions of intuitions and strong emotions are oftentimes seen as reprehensible, and are avoided regularly. Also in many practical situations political behavior may be associated with human characteristics that are preferred to avoid, like dishonesty, manipulation and deceit. Yet, this study indicates that business innovation decision-making in R&D requires attention to all three decision-making dimensions, also the less promoted intuitive and political decision-making dimensions. This study also indicates that innovation managers may need to change their decision-making style when an innovation trajectory moves to another phase in the R&D process. Employing different styles consecutively and in interaction may be more successful than employing one style throughout the innovation process. We do not find that sudden transitions in decision-making occur. The transition from one decision-making dimension to the next is more fluid. Moreover, the fact that one dimension may be dominant in a certain phase, does not imply the other dimensions are completely irrelevant. To professionals in practice this implies that they have to invest in their awareness of innovation decision-making in R&D as a process in which decision-making is multi-dimensional, interwoven, and contingent upon previous phases. This raises an interesting third implication for practice. Not every manager may be adept at using all three decision-making dimensions. Companies may therefore incorporate an assessment of the decision-making behavior of managers before assigning them to an R&D project. If a manager is less able in using a dimension, companies may see whether others in an R&D project team can compensate for that or possibly offer coaching or training to a manager to make up for deficiencies.

Limitations and scope of the research
While this research offers new insights into the dynamics and changes of the innovation decision-making process in an R&D context over time, it also has limitations. Because of the limited sample size of four embedded units of study, and more specifically, the single case in which these units are embedded, the findings cannot be generalized to a larger population, and therefore, statistical validity is nonexistent. This study delved deep into the practice of four embedded units of an R&D department of a large multinational high-tech company. The nature of the innovation decision-making processes in these units is predominantly proactive, and aims to assure the firm's continuity by means of continuously improving the R&D organization of the firm. Yet, many firms with an R&D function do not invest in such pro-active R&D, and merely focus on reactive R&D, on R&D that secures short-term survival in a highly competitive technology race through development of more or less incrementally innovative products and services. The findings of this study do not have analytical validity for the latter type of reactive firms, and do not provide insights in how to speed up or improve the new product and service development process and its output in these firms. On the other hand, this case study research approach does develop insights that can have analytical validity for comparable cases. This holds in particular for organizations focusing on the proactive improvement of the R&D organization and strategy, and aiming

to stay ahead of competition by means of leading the technology race. And, with regard to innovation decision-making in general, this study's findings could be a first step to generalizing these findings to broader theory (Yin, 2009). The changing dominance of either rational, intuitive or political decision-making in an innovation process over time; the dominant decision-making dimension being contingent upon the phase of the innovation process, and being contingent upon the dominant decision-making dimension(s) in earlier phase(s), can be seen as a theoretical direction that is worth studying further.

References

Agor, W.H. (1986), "The logic of intuition: how top executives make important decisions", *Organizational Dynamics*, Vol. 14 No. 3, pp. 5-18.

Argyris, C. (1976), "Single-loop and double-loop models in research on decision making", *Administrative Science Quarterly*, Vol. 21 No. 3, pp. 363-375.

Atuahene-Gima, K. and Li, H. (2004), "Strategic decision comprehensiveness and new product development outcomes in new technology ventures", *The Academy of Management Journal*, Vol. 47 No. 4, pp. 583-597.

Baker, T. and Nelson, R.E. (2005), "Creating something from nothing: resource construction through entrepreneurial bricolage", *Administrative Science Quarterly*, Vol. 50 No. 3, pp. 329-366.

Baker, T., Miner, A.S. and Eesley, D.T. (2003), "Improvising firms: bricolage, account giving and improvisational competencies in the founding process", *Research Policy*, Vol. 32 No. 2, pp. 255-276.

Beach, L.R. (1993), "Broadening the definition of decision-making: the role of prechoice screening of options", *Psychological Science*, Vol. 4 No. 4, pp. 215-220.

Behrens, J. (2016), "A lack of insight: an experimental analysis of R&D managers' decision making in innovation portfolio management", *Creativity and Innovation Management*, Vol. 25 No. 2, pp. 239-250.

Blattberg, R.C. and Hoch, S.J. (1990), "Database models and managerial intuition: 50% model + 50% manager", *Management Science*, Vol. 36 No. 8, pp. 887-899.

Bourgeois, L.J. and Eisenhardt, K.M. (1988), "Strategic decision processes in high velocity environments: four cases in the microcomputer industry", *Management Science*, Vol. 34 No. 7, pp. 816-835.

Brews, P.J. and Hunt, M.R. (1999), "Learning to plan and planning to learn: resolving the planning school/learning school debate", *Strategic Management Journal*, Vol. 20 No. 10, pp. 889-913.

Brinkerink, J. and Bammens, Y. (2018), "Family influence and R&D spending in Dutch manufacturing SMEs: the role of identity and socioemotional decision considerations", *Journal of Product Innovation Management*, Vol. 35 No. 4, pp. 588-608.

Burke, L.A. and Miller, M.K. (1999), "Taking the mystery out of intuitive decision making", *Academy of Management Executive*, Vol. 13 No. 4, pp. 91-99.

Calabretta, G., Gemser, G. and Wijnberg, N.M. (2017), "The interplay between intuition and rationality in strategic decision making: A paradox perspective", *Organization Studies*, Vol. 38 Nos 3-4, pp. 365-401.

Charmaz, K. (2014), *Constructing Grounded Theory*, Sage, London.

Child, J. and Hsieh, L.H.Y. (2014), "Decision mode, information and network attachment in the internationalization of SMEs: a configurational and contingency analysis", *Journal of World Business*, Vol. 49 No. 4, pp. 598-610.

Colman, A.M. (1995), *Game Theory and its Applications in the Social and Biological Sciences*, Butterworth-Heinemann, Oxford.

Cowlrick, I., Hedner, T., Wolf, R., Olausson, M. and Klofsten, M. (2011), "Decision making in the pharmaceutical industry: analysis of entrepreneurial risk and attitude using uncertain information", *R&D Management*, Vol. 41 No. 4, pp. 321-336.

Dane, E. and Pratt, M.G. (2007), "Exploring intuition and its role in managerial decision making", *The Academy of Management Review Archive*, Vol. 32 No. 1, pp. 33-54.

Dane, E. and Pratt, M.G. (2009), "Conceptualizing and measuring intuition: a review of recent trends", in Hodgkinson, G.P. and Ford, J.K. (Eds), *International Review of Industrial and Organizational Psychology*, Wiley, Chichester, pp. 1-40.

Dayan, M. and Elbanna, S. (2011), "Antecedents of team intuition and its impact on the success of new product development projects", *Journal of Product Innovation Management*, Vol. 28 No. 1, pp. 159-174.

Dean, J.W. and Sharfman, M.P. (1993a), "The relationship between procedural rationality and political behavior in strategic decision making", *Decision Sciences*, Vol. 24 No. 6, pp. 1069-1083.

Dean, J.W. and Sharfman, M.P. (1993b), "Procedural rationality in the strategic decision-making process", *Journal of Management Studies*, Vol. 30 No. 4, pp. 587-610.

Dean, J.W. and Sharfman, M.P. (1996), "Does decision process matter? A study of strategic decision-making effectiveness", *The Academy of Management Journal*, Vol. 39 No. 2, pp. 368-396.

Eisenhardt, K.M. (1989), "Building theories from case study research", *Academy of Management Review*, Vol. 14 No. 4, pp. 532-550.

Eisenhardt, K.M., Kahwajy, J.L. and Bourgeois, L.J. (1997), "How management teams can have a good fight", *Harvard Business Review*, Vol. 75 No. 4, pp. 77-85.

Elbanna, S. (2006), "Strategic decision-making: process perspectives", *International Journal of Management Reviews*, Vol. 8 No. 1, pp. 1-20.

Elbanna, S. and Child, J. (2007), "Influences on strategic decision effectiveness: development and test of an integrative model", *Strategic Management Journal*, Vol. 28 No. 4, pp. 431-453.

Elbanna, S., Di Benedetto, C.A. and Gherib, J. (2015), "Do environment and intuition matter in the relationship between decision politics and success?", *Journal of Management & Organization*, Vol. 21 No. 1, pp. 60-81.

Eling, K., Griffin, A. and Langerak, F. (2014), "Using intuition in fuzzy front-end decision-making: a conceptual framework", *Journal of Product Innovation Management*, Vol. 31 No. 5, pp. 956-972.

Francioni, B., Musso, F. and Cioppi, M. (2015), "Decision-maker characteristics and international decisions for SMEs", *Management Decision*, Vol. 53 No. 10, pp. 2226-2249.

Fredrickson, J.W. and Mitchell, T.R. (1984), "Strategic decision processes: comprehensiveness and performance in an industry with an unstable environment", *Academy of Management Journal*, Vol. 27 No. 2, pp. 399-423.

Gavetti, G. and Levinthal, D. (2000), "Looking forward and looking backward: cognitive and experiential search", *Administrative Science Quarterly*, Vol. 45 No. 1, pp. 113-137.

Glaser, B.G. and Strauss, A.L. (2009), *The Discovery of Grounded Theory: Strategies for Qualitative Research*, Transaction Publishers, Piscataway, NJ.

Hochschild, A.R. (2003), *The Managed Heart: Commercialization of Human Feeling*, 20th Anniversary ed., University of California Press, London.

Ilori, M.O. and Irefin, I.A. (1997), "Technology decision making in organisations", *Technovation*, Vol. 17 No. 3, pp. 153-160.

Jekunen, A. (2014), "Decision-making in product portfolios of pharmaceutical research and development – managing streams of innovation in highly regulated markets", *Drug Design, Development and Therapy*, Vol. 8, pp. 2009-2016.

Johal, S.S., Oliver, P. and Williams, H.C. (2007), "Better decision-making for evaluating new medical device projects: a real options approach", *Journal of Medical Marketing*, Vol. 8 No. 2, pp. 101-112.

Kahneman, D. and Klein, G. (2009), "Conditions for intuitive expertise: a failure to disagree", *American Psychologist*, Vol. 64 No. 6, pp. 515-526.

Kester, L., Hultink, E.J. and Lauche, K. (2009), "Portfolio decision-making genres: a case study", *Journal of Engineering Technology Management*, Vol. 26 No. 4, pp. 327-341.

Kester, L., Griffin, A., Hultink, E.J. and Lauche, K. (2011), "Exploring portfolio decision-making processes", *Journal of Product Innovation Management*, Vol. 28 No. 5, pp. 641-661.

Khatri, N. and Ng, H.A. (2000), "The role of intuition in strategic decision making", *Human Relations*, Vol. 53 No. 1, pp. 57-86.

Langley, A., Mintzberg, H., Pitcher, P., Posada, E. and Saint-Macary, J. (1995), "Opening up decision making: the view from the black stool", *Organization Science*, Vol. 6 No. 3, pp. 260-279.

Lerner, D.A., Hunt, R.A. and Dimov, D. (2018), "Action! Moving beyond the intendedly-rational logics of entrepreneurship", *Journal of Business Venturing*, Vol. 33 No. 1, pp. 52-69.

McGrath, R.G. (1999), "Failing forward: real options reasoning and entrepreneurial failure", *The Academy of Management Review*, Vol. 24 No. 1, pp. 13-30.

McMillan, J. (1992), *Games, Strategies and Managers*, Oxford University Press, New York, NY.

McNally, R.C., Durmusoglu, S.S., Calantone, R.J. and Harmancioglu, N. (2009), "Exploring new product portfolio management decisions: the role of managers' dispositional traits", *Industrial Marketing Management*, Vol. 38 No. 1, pp. 127-143.

Miles, M.B. and Huberman, A.M. (1994), *Qualitative Data Analysis: An Expanded Sourcebook*, Sage, Beverly Hills, CA.

Miner, A.S., Basoff, P. and Moorman, C. (2001), "Organizational improvisation and learning: a field study", *Administrative Science Quarterly*, Vol. 46 No. 2, pp. 304-337.

Moorman, C. and Miner, A. (1998), "Organizational improvisation and organizational memory", *The Academy of Management Review*, Vol. 23 No. 4, pp. 698-723.

Morris, J.A. and Feldman, D.C. (1996), "The dimensions, antecedents, and consequences of emotional labor", *Academy of Management Review*, Vol. 21 No. 4, pp. 986-1010.

Nutt, P.C. (1993), "The formulation processes and tactics used in organizational decision making", *Organization Science*, Vol. 4 No. 2, pp. 226-251.

Oh, W.Y. and Barker, V.L. (2018), "Not all ties are equal: CEO outside directorships and strategic imitation in R&D investment", *Journal of Management*, Vol. 44 No. 4, pp. 1312-1337.

Ram, J. and Ronggui, D. (2018), "Research and development projects: an empirical investigation of project managers' traits", *International Journal of Managing Projects in Business*, Vol. 11 No. 4, pp. 913-934.

Roelofsen, A., Boon, W.P.C., Kloet, R.R. and Broerse, J.E.W. (2011), "Stakeholder interaction within research consortia on emerging technologies: learning how and what?", *Research Policy*, Vol. 40 No. 3, pp. 341-354.

Sadler-Smith, E. and Shefy, E. (2004), "The intuitive executive: understanding and applying 'gut feel' in decision-making", *The Academy of Management Executive*, Vol. 18 No. 4, pp. 76-91.

Sayegh, L., Anthony, W.P. and Perrewé, P.L. (2004), "Managerial decision-making under crisis: the role of emotion in an intuitive decision process", *Human Resource Management Review*, Vol. 14 No. 2, pp. 179-199.

Schwenk, C.R. (1995), "Strategic decision making", *Journal of Management*, Vol. 21 No. 3, pp. 471-493.

Seo, M.G. and Barrett, L.F. (2007), "Being emotional during decision making – good or bad? An empirical investigation", *Academy of Management Journal*, Vol. 50 No. 4, pp. 923-940.

Shapiro, S. and Spence, M.T. (1997), "Managerial intuition: a conceptual and operational framework", *Business Horizons*, Vol. 40 No. 1, pp. 63-68.

Shepherd, D.A., Williams, T.A. and Patzelt, H. (2015), "Thinking about entrepreneurial decision making: review and research agenda", *Journal of Management*, Vol. 41 No. 1, pp. 11-46.

Skrepnek, G.H. and Sarnowski, J.J. (2007), "Decision-making associated with drug candidates in the biotechnology research and development (R&D) pipeline", *Journal of Commercial Biotechnology*, Vol. 13 No. 2, pp. 99-110.

Stanczyk, A., Foerstl, K., Busse, C. and Blome, C. (2015), "Global sourcing decision-making processes: politics, intuition, and procedural rationality", *Journal of Business Logistics*, Vol. 36 No. 2, pp. 160-181.

Swan, J., Newell, S., Scarbrough, H. and Hislop, D. (1999), "Knowledge management and innovation: networks and networking", *Journal of Knowledge Management*, Vol. 3 No. 4, pp. 262-275.

Teisman, G.R. (2000), "Models for research into decision-making processes: on phases, streams and decision-making rounds", *Public Administration*, Vol. 78 No. 4, pp. 937-956.

Thompson, V.A. (1965), "Bureaucracy and innovation", *Administrative Science Quarterly*, Vol. 10 No. 1, pp. 1-20.

Tripsas, M. and Gavetti, G. (2000), "Capabilities, cognition, and inertia: evidence from digital imaging", *Strategic Management Journal*, Vol. 21 Nos 10-11, pp. 1147-1161.

Van Riel, A.C.R., Lemmink, J. and Ouwersloot, H. (2004), "High-technology service innovation success: a decision-making perspective", *Journal of Product Innovation Management*, Vol. 21 No. 5, pp. 348-359.

Visser, M. de (2013), "Individual, team and organizational antecedents of explorative and exploitative innovation in manufacturing firms", doctoral dissertation, University of Twente, Enschede, available at: http://purl.utwente.nl/publications/85258

Yin, R.K. (2009), *Case Study Research: Design and Methods*, Sage Publications, Thousand Oaks, CA.

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