

2 Frame of reference

The objective of this chapter is to provide a frame of reference for the study's research questions. I will therefore introduce the innovation concept (section 2.1) by distinguishing between innovation as an outcome (section 2.1.1) and innovation as a process (section 2.1.2). Subsequently, I will highlight the front-end of innovation as the innovation process phase that is most relevant in the context of this study (section 2.2). The chapter closes with a short introduction to the open innovation paradigm, and the major idea evaluation challenges that firms need to face when obtaining large numbers of new product ideas from external sources (section 2.3).

2.1 The concept of innovation

What is innovation? In research, as well as practice, innovation is a broadly defined term used in a variety of contexts (Gaubinger et al., 2015). Theory and practice have failed to agree on a generally accepted definition of the term "innovation." Over the years, the innovation concept has been expanded and modified, resulting in various definitions of innovation (Hauschildt and Salomo, 2007). These various definitions of innovation might also be a reason why the term is often confused with the term "invention." An "invention comes either from combining technological components in a novel manner, or through reconfiguring existing combinations" (Fleming and Sorenson, 2004: 910). However, an invention does not qualify as an innovation. Only by introducing an invention to the market and, thus, diffusing the invention to other parties beyond the inventor, do inventions become innovations (Hauschildt and Salomo, 2007). Despite these various definitions, the literature seems to agree that innovation can be categorized into two groups: (i) innovation as an outcome (what is created), and (ii) innovation as a process (how it is created) (Crossan and Apaydin, 2010). Both interpretations will be discussed in the following sections.

2.1.1 Innovation as an outcome

Following the belief that the successful development and commercialization of different types of innovations may require different processes, skills, and techniques (Reid and Brentani, 2004; Veryzer, 1998a; Song and Montoya-Weiss, 1998), research scholars have

for decades been discussing classification schemes for defining innovations (Garcia and Calantone, 2002). The classification scheme that has received most attention in research and practice refers to the degree of innovativeness that captures the change when compared to the given status quo, i.e., “highly innovative products are seen as having a high degree of newness” (Garcia and Calantone, 2002: 112).

However, determining the newness of an innovation is not a trivial task, as it depends on (i) the perspective from which the newness is assessed, as well as (ii) the dimensions against which the newness is measured (Garcia and Calantone, 2002; Schultz, Salomo, and Talke, 2013). Innovation management literature has developed an abundance of different constructs in an effort to accurately measure an innovation’s degree of newness. Consequently, conceptualizing innovativeness varies across different studies (Szymanski, Kroff, and Troy, 2007). Nonetheless, researchers seem to have reached agreement that it is beneficial to define innovativeness as a continuous, multi-dimensional construct (Gatignon et al., 2002; Green, Gavin M. B., and Aiman-Smith, 1995). With this multi-dimensional approach having become the state-of-the-art approach to measure innovativeness (Gemünden, Salomo, and Hölzle, 2007), two dimensions have emerged as the predominant measurements of innovativeness: (i) the market-related dimension and (ii) the technology-related dimension (Garcia and Calantone, 2002).²

The *market-related dimension* reflects that highly innovative products deliver a substantially higher user value compared to preceding or competitive products by either fulfilling unsatisfied needs, and/or creating completely new consumer benefits (Chandy and Tellis, 1998; Veryzer, 1998a). In some cases, this might ultimately lead to the creation of an entirely new market (Song and Montoya-Weiss, 1998).

The *technology-related dimension* reflects the belief that highly innovative products are based on the introduction of new technological principles, or the use of completely new components that call for a new knowledge base in the firm (Schultz, Salomo, and Talke, 2013). Developing highly innovative new products thus usually involve expanding

² Research scholars have added further dimensions to measure innovativeness. One example is the scale of innovativeness developed by Schultz, Salomo, and Talke (2013). This scale measures innovativeness as a multi-dimensional construct along market-related, technology-related, firm-related, and environment-related dimensions. However, this dissertation adopts the more widely used approach of Garcia and Calantone (2002), and only defines innovativeness along market-related, and technology-related dimensions.

technological capabilities beyond the existing boundaries (Veryzer, 1998a). Consequently, existing knowledge may become obsolete to some degree (Gemünden, Salomo, and Hölzle, 2007).

Acknowledging these two dimensions, the degree of innovativeness can therefore either be assessed separately for each dimension, or by combining both dimensions into an overall degree of innovativeness (Schultz, Salomo, and Talke, 2013; Green, Gavin M. B., and Aiman-Smith, 1995; Garcia and Calantone, 2002). Following common language in the innovation management literature, the two extremes of these two-dimensional construct are described as incremental innovations and radical innovations (see Figure 2).

Incremental innovations (also referred to as “sustaining,” “continuous,” “minor,” or “evolutionary innovations” (Garcia and Calantone, 2002)) are defined as refinements, modifications, or improvements to an existing product or product line that help firms maintain, or strengthen, their positions in extant markets through product enhancements and increases in production efficiencies (Hartmann, 2014). Consequently, incremental innovations build on firms’ existing knowledge and are characterized by minor technological changes (Green, Gavin M. B., and Aiman-Smith, 1995). Thus, lower risk and high predictability characterize incremental innovations (Garcia, 2010).

Radical innovations (also referred to as “breakthrough,” “discontinuous,” or “disruptive” innovations (Garcia and Calantone, 2002)) are defined by changes in technology components embodied in a new product, enabling it to fulfill currently unsatisfied consumer needs, or even create completely new ones (Chandy and Tellis, 1998; Veryzer, 1998a). Based on these characteristics, radical innovations offer a significant product advantage providing firms with the means to gain competitive advantages, but also come at the cost of lower consumer familiarity and difficulties with successfully developing and marketing the products (Calantone, Chan, and Cui, 2006). Thus, radical innovations require significant changes in consumer usage patterns, as well as consumer thinking (Veryzer, 1998b), and bear sizable financial risks for firms (Green, Gavin M. B., and Aiman-Smith, 1995).

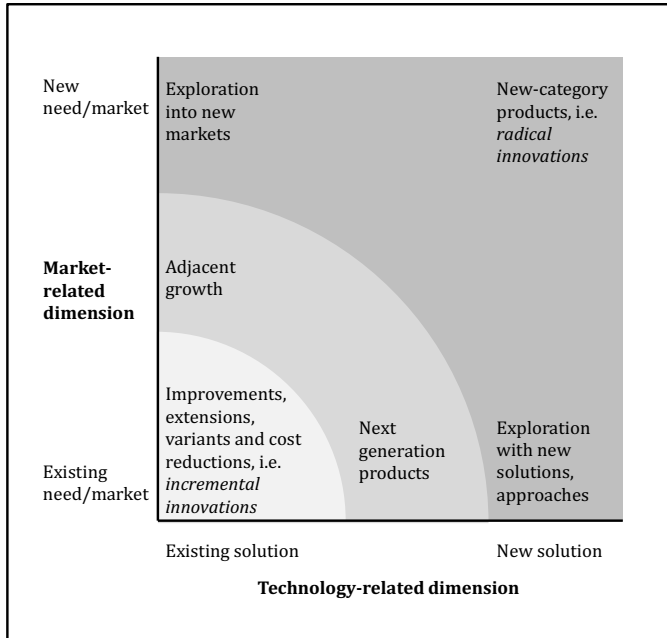


Figure 2: Types of innovation³

To summarize, the outcome of an innovation process can be classified by its degree of innovativeness. This innovativeness can be defined as a multi-dimensional construct believed to have a market-related, as well as a technology-related, dimension. Depending on the magnitude of innovativeness in both dimensions, innovations can thus be classified on a continuous construct with incremental innovations forming the lowest level of innovativeness and radical innovations forming the highest.

2.1.2 Innovation as a process

The second interpretation of the term innovation does not refer to a static outcome, but to the dynamic element of innovation. In this sense, innovation refers to the process that

³ Author's illustration, adapted from Terwiesch and Ulrich (2009).

starts with the identification of an opportunity, and ends with the commercialization of the outcome of the process (Song and Montoya-Weiss, 1998; Cooper, 2011; Koen et al., 2001).

Over the years, the innovation management literature has developed many process models to structure the innovation process in order to provide firms with a structure to move product development projects proficiently from idea to launch and beyond (Cooper, 2011). However, despite the differences between these models, innovation management research scholars seem to agree that the innovation process comprises three major phases: (i) the front-end of innovation, (ii) new product development, and (iii) commercialization (Song and Montoya-Weiss, 1998; Cooper, 2011; Koen et al., 2001).



Figure 3: Simplified innovation process⁴

The front-end of innovation (FEI) includes all activities with regard to the generation, evaluation, and selection of new product ideas, the formulation of potential concepts, and the initial planning of the potential development project (the FEI is discussed in more detail in section 2.2). In the new product development phase, the selected concepts are developed, tested, and validated. The last phase constitutes the commercialization of the product. This includes commencing with full operations or production, as well as marketing and selling the product (for details on these two phases see Cooper and Kleinschmidt, 1986; Cooper, 2011; Song and Montoya-Weiss, 1998).

Among the many different innovation process models, the Stage-Gate® system, developed by Cooper (1983), has probably garnered the researcher and practitioner most attention. A large number of major NPD firms have implemented more, or less, modified versions of

⁴ Author's illustration, based on Koen et al. (2001: 51).

the Stage-Gate system (Barczak, Griffin, and Kahn, 2009; Griffin, 1997). That is why I will refer to a stage-gate system throughout this thesis when I use the term innovation process.

The Stage-Gate system breaks the innovation process down into a set of information-gathering stages, each followed by a go/no-go decision gate (Cooper, 2008). This system of stages and gates aims to provide a clear structure for moving an idea to the launch stage, and is therefore referred to as “idea-to-launch system” (Cooper, 2008: 213). According to Cooper (2011), each stage consists of a set of activities to gather the information needed to advance the project to the next gate. The information gathered helps reduce the decision makers’ uncertainty at the gates and supports the decision making process on whether, or not, to proceed with the project. A typical Stage-Gate system consists of the following stages (Cooper, 2011: 100):

- *“Discovery:* pre-work designed to discover and uncover opportunities and generate ideas.
- *Scoping:* a quick, preliminary investigation and scoping of the project [...].
- *Build the Business Case:* a much more detailed investigation involving primary research – both market and technical – leading to a Business Case, including product and project definition, project justification, and project plan.
- *Development:* the actual detailed design and development of the new product, and the design of the operations or production processes.
- *Testing and validation:* tests or trials in the marketplace, lab, and plant to verify and validate the proposed new product, and its marketing and production/operations.
- *Launch:* commercialization–beginning of full operations or production, marketing and selling.”

Each stage is followed by a gate that serves as Go/Kill decision point where projects are prioritized, are allocated resources, or are rejected. Thus, the gates in the Stage-Gate system are checkpoints in the development process to determine whether, or not, the firm is (i) selecting the projects correctly, and (ii) is selecting the right projects (Cooper, 2011). Each gate follows a similar structure comprising the following (Cooper, 2008: 215):

- “Deliverables: [define]⁵ what the project leader and team bring to the decision point (e.g. the results of a set of completed activities). These deliverables are

⁵ Added by the author.

visible, are based on a standard menu for each gate, and are decided at the output of the previous gate.

- *Criteria* against which the project is judged: These include *must-meet criteria* or knock-out questions (a checklist) designed to weed out misfit projects quickly; and should-meet criteria that are scored and added (a point count system), which are used to prioritize projects.
- *Outputs*: a decision (*Go/Kill/Hold/Recycle*), along with an approved action plan for the next stage (an agreed-to timeline and resources committed), and a list of deliverables and date for the next gate."

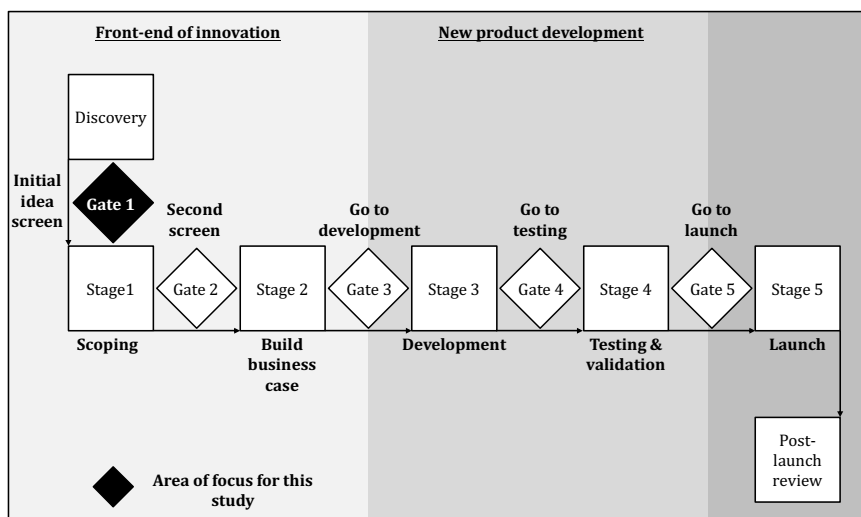


Figure 4: Five-stage, five-gate Stage-Gate system⁶

As depicted in Figure 4, the evaluation of early-stage new product ideas is an activity carried out to reduce the decision makers' uncertainty at the first gate of the innovation process. Thus, new product idea evaluation is an activity in the front-end of innovation. This first phase of the innovation process is described in more detail in the following section.

⁶ Author's illustration, based on Cooper (2008: 215).

2.2 The front-end of innovation

The front-end of innovation (FEI)⁷ is the first phase of the innovation process, comprising the generation, evaluation, and selection of new product or service ideas, the formulation of potential concepts, and the initial planning of the potential development project (Koen et al., 2001). The FEI ends when the company decides to start the formal, and well-structured, new product development phase (Murphy and Kumar, 1996; Koen et al., 2001; Herstatt and Verworn, 2007).

The literature on the FEI has shown that the characteristics of this phase differ fundamentally from those of the subsequent development phase (Kim and Wilemon, 2002). Although the characteristics of the FEI may be specific to the firm and its context, and might therefore not follow a single pattern (Verworn and Herstatt, 2007), Kim and Wilemon (2002: 270) have identified several common characteristics that can be used as a baseline to distinguish the FEI from the subsequent development phase (see Table 1).

In addition to these characteristics, research scholars have pointed out that the high degree of uncertainty with regard to strategic fit, customer needs, technology, and required resources is the FEI's most important characteristic (Gaubinger et al., 2015; Verworn and Herstatt, 2007).

⁷ Also referred to as fuzzy front end of innovation, e.g. Koen et al. (2001); Khurana and Rosenthal (1997).

Table 1: Comparison of characteristics between the FEI phase and the development phase

Factors	General characteristics of the FEI phase	General characteristics of the development phase
State of an idea	Probable, fuzzy, easy to change	Determined to develop, clear, specific, difficult to change
Features of information for decision-making	Qualitative, informal, approximate	Quantitative, formal, precise
Outcome (/action)	A blueprint (/diminishing ambiguity to decide whether to make it happen)	A product (/making it happen)
Width and depth of focus	Broad but thin	Narrow but detailed
Ease of rejecting an idea	Easy	More difficult
Degree of formalization	Low	High
Personnel involvement	Individual or small project team	A full development team
Management methods	Unstructured, experimental, creativity needed	Structured, systematic
(Visible) damage if abandoned	Usually small	Substantial
Commitment of the CEO	None or small	Usually high

**Figure 5: Characteristics of the front-end of innovation⁸**

⁸ Source: Gaubinger et al. (2015: 46).

Therefore, the innovation management literature has repeatedly underlined the need to reduce uncertainty in the FEI in order to ensure successful product development (Herstatt and Verworn, 2007; Moenart et al., 1995; Kim and Wilemon, 2002; Zhang and Doll, 2001). Thus, it is not surprising that the majority of authors agree that the most important purpose of the activities carried out throughout the FEI is to reduce uncertainty in the dimensions related to consumer uncertainty, competitive uncertainty, resource uncertainty, and technological uncertainty (Moenart and Souder, 1990; Zhang and Doll, 2001).

This reduction in uncertainty has such specific relevance in the FEI, because, in this phase, decision makers still have the greatest possibility to influence the overall outcome of the innovation process (Wheelwright and Clark, 1995; Herstatt and Verworn, 2001). They can do so, because the activities and decisions during the FEI affect all downstream decisions in the innovation process, including the development time and cost (Cooper, 2011; Verworn and Herstatt, 2007; Herstatt and Verworn, 2007; Zhang and Doll, 2001).

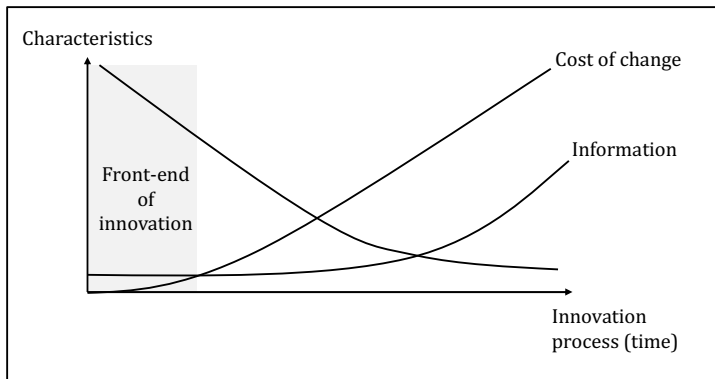


Figure 6: Influence, cost of changes, and information during the innovation process⁹

Given the FEI activities' high impact on the development outcome, it is not surprising that a number of empirical research studies have found that proficiency in carrying out FEI activities is a key success factor in new product development (Evanschitzky et al., 2012;

⁹ Author's illustration, based on Herstatt and Verworn (2001: 5).

Langerak, Hultink, and Robben, 2004; Markham, 2013). Based on several empirical studies comparing the best practices of the best, and the worst, performing NPD firms, leading innovation management researchers have even concluded that the biggest differences between successful and unsuccessful NPD firms lie in the execution quality of pre-development activities in the FEI (e.g. Cooper and Kleinschmidt, 1995).

In an effort to improve proficiency in the FEI, innovation management researchers have developed a number of theoretical process models. Some well-known process models include the *Stage-Gate® Process* of Cooper (2011) – as explained in section 2.1.2 – the *Three Phase Front End Model* of Khurana and Rosenthal (1997) and the *New Concept Development Model* of Koen et al. (2001). Gaubinger and Rabl (2014: 16) summarized the pros, and cons, of these different models:

However, despite the existence of these process models, neither academics nor practitioners seem to fully understand how to execute the FEI proficiently (Eling, 2014). Therefore, it is not surprising that many firms still strive to improve the outcomes of this critical phase (Markham, 2013).

Table 2: Pros and cons of front-end process models

Model	Pros	Cons
Stage-gate process (Cooper)	Very famous and frequently cited model	Product concepts can be stopped too early
	Flexible to both radical and incremental innovations	Gatekeepers low level of knowledge can lead to wrong decisions
	Integrates both the market and technological perspective	Lack of flexibility due to sequential approach, except third generation
	Activities are performed in parallel model fashion	
Three phase front end model (Khurana and Rosenthal)	Additional consideration of elements of the organizational environment (foundation elements)	No feedback loops
	Useful tool to visualize and structure front-end activities, reduce the fuzziness and ease communication	No description of the preliminary opportunity identification and idea generation in detail
		Tool lacks flexibility
		Decision making could be enhanced by a more structured process (especially in the pre-phase zero and phase one phases)
New concept development model (Koen et al.)	Includes all company related factors	Abstract model that is hardly transferable to a business situation
	Stimulates innovation due to its non-sequential order of phases	Practitioners criticize the lack of application of these methodologies
	Flexible with regards to both radical and incremental innovations	Model mainly focuses on product development
		Influencing factors are not controllable

2.3 The open innovation paradigm

At the beginning of this millennium, Chesbrough (2006b)¹⁰ postulated a paradigm shift in the way firms innovate, moving from a closed innovation model to an open innovation model. This paradigm shift has received extensive attention in the literature,¹¹ and – more than 10 years later – is still proposed as a research priority for innovation management research (Barczak, 2014).

The open innovation paradigm proposes that the abilities and assets for creating innovation do not necessarily have to be collocated with those of commercialization. In other words, “Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas [...] as they look to advance their technology” (Chesbrough, 2006a: 1). The underlying logic of the open innovation paradigm is summarized as follows (Chesbrough, 2006b: xxvi):

- A firm does not need to employ only smart people, but should instead work with them inside and outside the firm.
- Internal innovation activities are needed to gain some significant value, which external innovation efforts can create.
- In order to beat the competition, it is more important to have a better business model than to get to the market first.
- Beating the competition does not require producing the best and most ideas, but making the best use of internal and external ideas.
- Proactive IP management allows other firms to use the firm’s IP. It also considers buying other firms’ IP whenever advancing the own business model.

Following this logic, firms should supplement their traditional R&D practices with the sourcing of external knowledge throughout the entire innovation process (Chesbrough, Vanhaverbeke, and West, 2006; Chesbrough, 2006b). Thus, open innovation applies to all major phases of the innovation process, and is not limited to the FEI. Based on an extensive

¹⁰ The first edition of “Open innovation - The new imperative for creating and profiting from technology” published in 2003.

¹¹ A comprehensive review of research on open innovation can be found in West and Bogers (2014), and West et al. (2014).

literature review, open innovation research scholars have depicted the major steps that constitute the open innovation approach in a four-phase, integrated model (Figure 7).

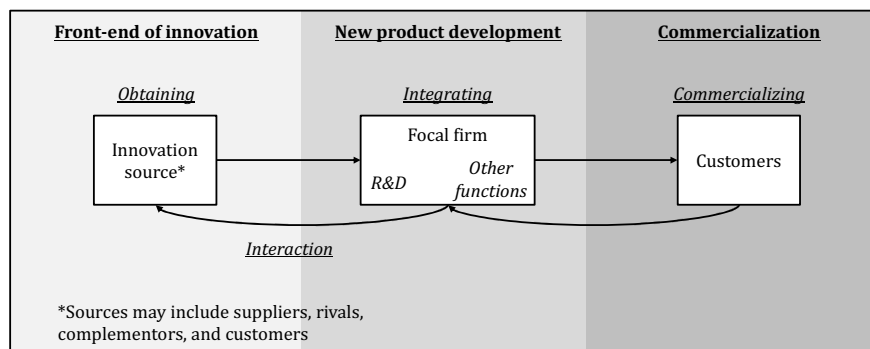


Figure 7: A four-phase process model for leveraging external sources of innovation¹²

According to this model, firms have to follow three major steps in order to successfully engage in open innovation: (i) obtaining innovations from external sources, (ii) integrating innovations, and (iii) commercializing innovations¹³ (West and Bogers (2014) provide a comprehensive review of the published literature on each of these steps).

Obtaining new knowledge and ideas from external sources during the front-end of innovation is of special importance in the context of this study. In recent years, firms have increasingly started exploring new ways of obtaining innovations from external sources in an effort to source market knowledge, technical knowledge, components, or even actual new product ideas/inventions (Bogers and West, 2012) by facilitating online communities (Dahlander and Wallin, 2006), innovation tournaments/contests (Terwiesch and Ulrich, 2009; Terwiesch and Xu, 2008), innovation toolkits (Piller and Walcher, 2006), crowdsourcing, and broadcast searches (Jeppesen and Lakani, 2010; Ebner, Leimeister, and Krcmar, 2009).

¹² Author's illustration, based on West and Bogers (2014: 816).

¹³ To account for innovation not following a unidirectional linear path, West and Bogers (2014) extend the phases with a fourth phase – interaction mechanisms.

However, leveraging external sources to obtain new product ideas results in a major follow-up challenge – how to effectively identify the most valuable new product ideas from hundreds, or even thousands, of submissions (West and Bogers, 2014). Once a firm has elicited ideas from external sources, these ideas need to be evaluated. The challenge then arises that the massive number of new product ideas resulting from these initiatives can be overwhelming for many firms (Piezunka and Dahlander, 2015; Blohm, Leimeister, and Krcmar, 2013). This is due to the traditional method of employing experts internal to firms (see chapter 3.2.3.1) being useless (Terwiesch and Ulrich, 2009) due to limited in-house expert resources. Research scholars have suggested outsourcing the idea evaluation process beyond the firms' internal experts (see chapter 3.2.2.3), thus leveraging external knowledge in an effort to accelerate and improve new product idea evaluation, as a strategy to face this challenge. Strongly related to the open innovation model, this approach has also been referred to as open evaluation (Haller, 2013; Velamuri et al., 2015).

To summarize, by leveraging external sources to obtain new product ideas, firms might face a major challenge in the initial evaluation of early-stage new product ideas as they will have to evaluate a massive number of ideas. Thus, proficient idea evaluation in the front-end of innovation becomes increasingly important if firms want to truly benefit from obtaining knowledge and ideas from external sources.

2.4 Interim summary

The term innovation refers to innovation as an outcome and as a process. The outcomes of an innovation process can be classified as more incremental and more radical innovations, depending on their degree of innovativeness. In the context of this dissertation, innovativeness includes a market-related dimension and a technology-related dimension.

Another interpretation of the term innovation describes the process to move new product development projects from idea to launch, and beyond. This process can be divided into three major phases: (i) the front-end of innovation, (ii) new product development, and (iii) commercialization. Research has shown that proficient execution of the front-end phase is a key success factor in new product development (Evanschitzky et al., 2012; Langerak, Hultink, and Robben, 2004). Nonetheless, neither academics, nor practitioners, seem to fully understand how to execute the FEI proficiently (Eling, 2014).

With the emergence of the open innovation paradigm, NPD firms face a new challenge compelling them to confer even more importance to the proficient execution of front-end activities. In an effort to obtain new product ideas from external sources, firms have increasingly started facilitating these, for example, innovation tournaments/contests (Terwiesch and Ulrich, 2009; Terwiesch and Xu, 2008), crowdsourcing, and broadcast searches (Jeppesen and Lakani, 2010; Ebner, Leimeister, and Krcmar, 2009). Such initiatives can easily generate hundreds, or thousands, of ideas (Piezunka and Dahlander, 2015; Blohm, Leimeister, and Krcmar, 2013) that subsequently need to be evaluated proficiently for firms to ultimately benefit from open innovation.

Therefore, in order to advance the existing knowledge of how to proficiently execute the FEI, this dissertation focuses on developing a deeper understanding of increasing the proficiency of one key activity during the FEI – the evaluation of early-stage new product ideas.

The Crucial Role of Domain Knowledge in Evaluating
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