University of Twente
School of Management and Governance
Chair of Technology Management
Prof. Dr. Holger Schiele

Master Thesis

From the market, to the market: How to find need-driven opportunities for high-degree innovation

- Public version -

2nd supervisor University of Twente:	Dr. Petra Hoffmann
2nd supervisor TU Berlin:	Prof. Dr. Jan Kratzer
Supervisor STILL GmbH	Willi Schmidt-Güldenstein
Submitted by:	Hannes Cordsen
	Student no. s1359088 (University of Twente)
	Student no. 338480 (TU Berlin)
	h.cordsen@gmx.de

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List of abbreviations

B2B	Business-to-business
B2C	Business-to-consumer
FFE	Fuzzy front end [of innovation]
[redacted]	[redacted]
IT	Information technology
OECD	Organisation for Economic Co-operation and Development
UPS	United Parcel Service
US	United States

1 Introduction: Limited practical advice calls for further research

1.1 Only limited advice on finding need-driven opportunities for radical innovation

In the competitive arena, shaped by challenging trends such as still increasing global competition, firms must be able to keep up with their rivals by providing market offerings that meet customers' needs better than others.[1] One strategic option is differentiation by innovation: To come up with new products that nobody else has on offer so far. Despite the risk inherent in new product development projects for such highly innovative products, it has been shown that high innovativeness positively influences their chances for success.[2] However, it is important to soundly manage these projects: As in the beginning of a new product development uncertainty is highest and at the same time activities and decisions have significant influence on later stages, the successful management of the first phase of the innovation process, the so-called fuzzy front end (FFE) has been identified as an important influencing factor:[3] It is defined as reaching from opportunity recognition to concept development, with the steps opportunity analysis, idea generation and idea selection in between.[4]

Among the methods proposed for opportunity recognition are environmental scanning,[5] lead user involvement,[6] scenario techniques,[7] university-industry collaboration, technology scouting[8] and technology roadmapping.[9] For idea generation, a number of creativity techniques exist.[10] Selection mechanisms often take into account estimations of market characteristics (size, competitive situation), technological capabilities, and strategic fit.[11] However, large parts of the literature on organising the fuzzy front end have, at least implicitly, focused on incremental innovations,[12] for instance by proposing to define narrow search fields[13] or to adhere strictly to existing customers' demands, both

[1] See Backhaus & Voeth (2011), p. 13.
[2] See Tushman & Anderson (1986), p. 459; Kleinschmidt & Cooper (1991), p. 250; Sorescu et al. (2003), p. 97.
[3] See Cooper (1988), p. 247; Dahl & Moreau (2002), p. 47; Verworn et al. (2008), p. 14.
[4] See Koen et al. (2001), pp. 47–48.
[5] See Börjesson et al. (2006), p. 775.
[6] See Urban & von Hippel (1988), p. 569.
[7] See Bessant et al. (2010), p. 352; Oliveira & Rozenfeld (2010), p. 1352.
[8] See Rohrbeck (2010), p. 172.
[9] See Oliveira & Rozenfeld (2010), p. 1339.
[10] See Rochford (1991), pp. 289–290.
[11] See Martinsuo & Poskela (2011), p. 910.
[12] See Reid & de Brentani (2004), p. 170.
[13] See Börjesson et al. (2006), p. 780.

approaches limiting the chances to find radically new ideas.[14] Consequently, a stream of literature has emerged that deals with the organisation of the fuzzy front end for radical innovation.[15]

However, this stream is still emerging. Although studies exist that discuss ways of deriving ideas for radical innovations from market requirements and present selections of methods which can be expected to deliver more radical innovation ideas than others,[16] advice on how to implement these to achieve the desired output is limited and restricted to single parameters: Lettl (2007) finds in a case study in the context of medical equipment that users need certain additional characteristics compared to lead users as defined by von Hippel (1986)[17]. Additionally, the firms need certain skills to make use of their input.[18] Coviello and Joseph (2012) propose that young technology firms can profit from user involvement in the context of radical innovation if they apply an iterative involvement approach and stay open to new ideas until late in the development process.[19] Additionally, Govindarajan et al. (2011) find in an empirical setting that orientation towards existing customers decreases innovativeness, while orientation towards potential ones is beneficial for innovativeness.[20] Kristensson and Magnusson (2010) show in an experiment that the awareness of technical restrictions makes service users less innovative compared to users who are not aware of such restrictions.[21] What is also left open is the question what methods fit which organisations and why. Therefore, this thesis does not only intend to provide advice to the case company on what methods to use to actively search for opportunities and ideas and on how to organise their FFE processes with regard to idea selection and responsibilities. It also wants to add to prior research by suggesting selection criteria for front end methods and providing implementation ideas that might also be informative to other organisations.

[14] See Slater & Narver (1998), p. 1001; Arnold et al. (2010), p. 244.
[15] See for example Rice et al. (2001), p. 409; Reid & de Brentani (2004), p. 170; Aagaard & Gertsen (2011), p. 330.
[16] See O'Connor (1998), p. 152; Nicholas et al. (2013), p. 30.
[17] See Lettl (2007), p. 68.
[18] See Lettl (2007), p. 69.
[19] See Coviello & Joseph (2012), pp. 93–94.
[20] See Govindarajan et al. (2011), p. 126.
[21] See Kristensson & Magnusson (2010), p. 153.

1.2 Research question: What methods are suitable for finding need-driven opportunities for high-degree innovation and how can they be arranged?

This thesis takes an approach of theory-based business problem solving as outlined by van Aken et al. (2007). The problem of STILL GmbH (in the following referred to as STILL), a manufacturer of forklifts and warehouse handling equipment, can be described as follows: [redacted] Consequently, the central question of the thesis states: How can a medium-sized manufacturing company find market-driven opportunities and ideas for high-degree innovations in a structured manner and filter them efficiently in order to come up with a manageable number of concepts for detailed evaluation?

This question is narrowed down to the following research questions:

- What methods are available to find and filter market-driven opportunities and ideas for high-degree innovation?
- What combination of methods is suitable for STILL?
- How should STILL organise its market-oriented front end?
- What lessons can be learned from this case for other companies?

In order to answer these questions, the work is structured as follows: First, a review of empirical research in the field of innovation management concerned with the fuzzy front end of innovation, radical innovation and market orientation of innovation is conducted. It is complemented by an analysis of five methods that prior literature considers most useful for finding opportunities and ideas for radical innovation as well as a summary of scholarly advice on idea selection. Subsequently, an analysis of the case company's situation is conducted, followed by the description of the methodological approach of the thesis. A world café workshop with managers of the affected units forms the basis for a profound

[22] Cf. chapter 3.1
[23] Cf. chapter 3.3

design proposal with regard to suitable methods, processes and organisational set-up. Finally, implications and limitations are being discussed.

1.3 Innovations generating additional sales for the case company in the focus

This work is situated at the intersection of three fields of innovation management research, as illustrated in Figure 1. Works on the fuzzy front end of innovation, on radical innovation and market- or need-driven innovation are being considered. The thesis therefore leaves both the later stages of the product development process as well as ideas and opportunities for innovation that originate purely from technological advancements out of account. However, it is acknowledged by the principal of the thesis that a process of collecting need-based opportunities for innovation cannot be restricted to radical innovations only due to the threat that any formal up-front filter could turn down too many ideas with high potential.[24] At the same time, it is beneficial not to leave any incremental innovations unattended as these are still important for product success.[25] Therefore, the intention is to build a front end of innovation geared towards need-based opportunities that concentrates on finding opportunities and ideas as radical as possible (illustrated in dark grey in Figure 1), but still processes the ones that are more incremental in nature (light grey area).

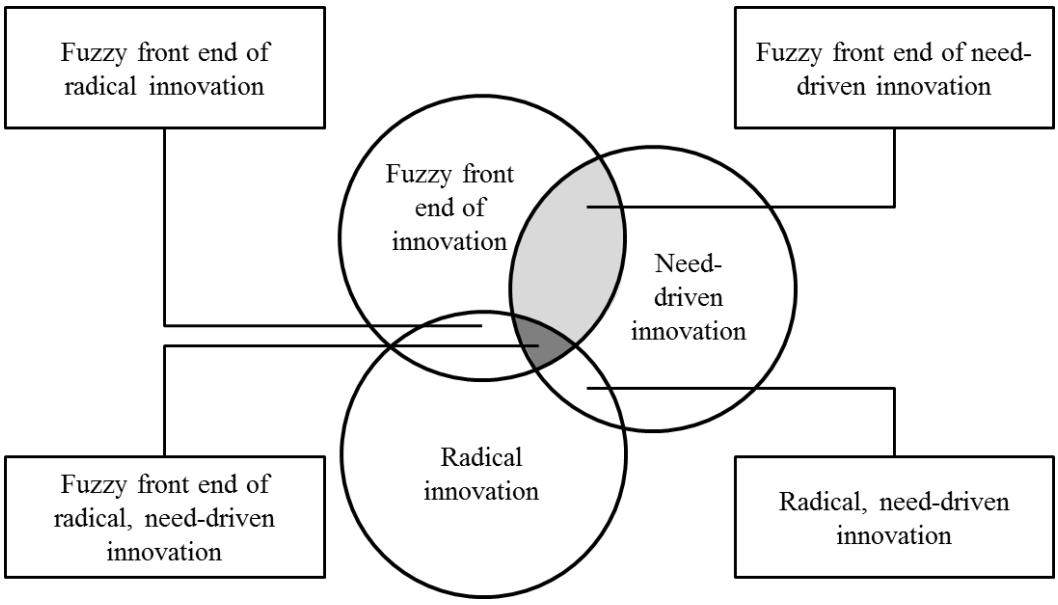

Figure 1: Positioning of the thesis in related research fields
Source: Author's illustration

[24] See also Martinsuo & Poskela (2011), p. 910.
[25] See O'Reilly & Tushman (2004), p. 76; Baker & Sinkula (2007), p. 316.

The fuzzy front end of innovation, a term that was brought up by Smith and Reinertsen,[26] has been defined as the time frame reaching from the first impulse or opportunity for a new product to the point where product development begins,[27] or as all activities that take place before a formal and structured new product development process starts.[28] Although the term has been criticised for ignoring that certain possibilities for structuring the FFE do exist and it is therefore not necessarily fuzzy,[29] it is still used in recent literature.[30]

In the well-established Stage-Gate® process model developed and improved by Cooper (see Figure 2),[31] the FFE would end right after gate three, when substantial resources are being committed to a project.[32] However, other authors have criticised this sequential concept and argue in favour of a more flexible, iterative approach towards the FFE.[33]

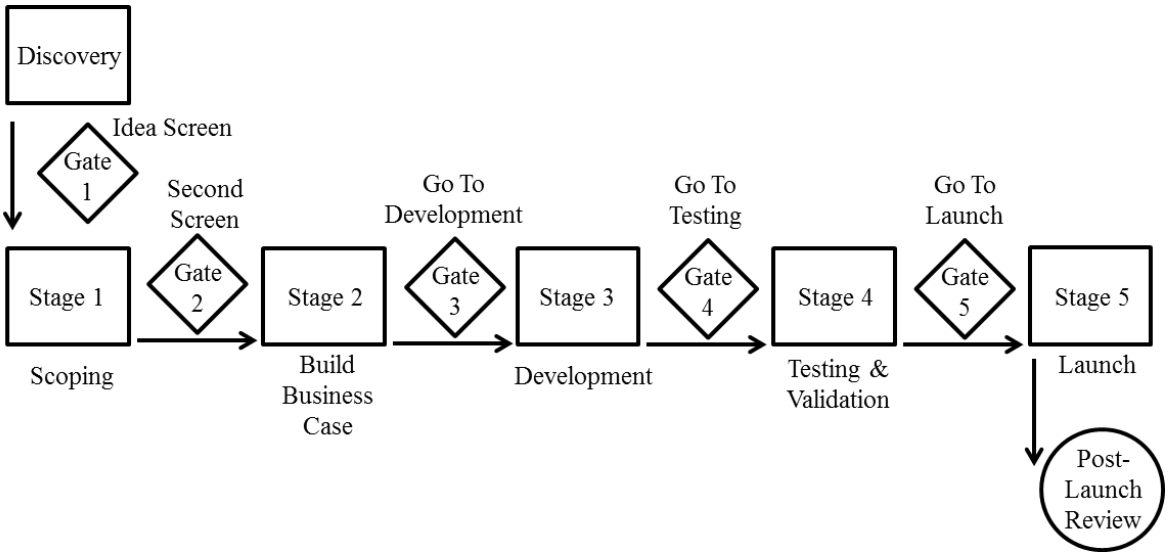

Figure 2: Stage-Gate® process model
Source: Cooper (2008), p. 215

Regarding the degree of innovativeness, several classifications exist. One of the most common distinguishes innovations along the dimensions of *technology* and *markets*, both being either new or existing.[34] The focus of the principal's intention and of the thesis is on ideas that go beyond existing product lines, leaving ideas for incremental innovations out

[26] See Moenaert et al. (1995), p. 243; Khurana & Rosenthal (1997), p. 118.
[27] See Verworn & Herstatt (2007), p. 8.
[28] See Koen et al. (2001), p. 46.
[29] See Reinertsen (1999), p. 25; Koen et al. (2001), p. 46; Sandmeier et al. (2004), p. 2.
[30] See Nijssen et al. (2012), p. 99; Soukhoroukova et al. (2012), p. 100; Creusen et al. (2013), p. 81.
[31] See Cooper (2008), p. 215.
[32] See Cooper (1988), p. 243.
[33] See Koen et al. (2001), pp. 48–49; Nobelius & Trygg (2002), p. 339.
[34] See Chandy & Tellis (1998), p. 476.

of the central focus. The latter have been defined as involving "relatively minor changes in technology and […] relatively low incremental customer benefits per dollar."[35] At the same time, pure technological changes without improved customer benefits are not of interest, as the company intends to increase sales and market share with increased innovativeness. Therefore, both application innovations, where new markets for existing technologies are explored, and radical innovations are to be captured, as both increase customer benefits and therefore bear greater chances of winning new customers. Another frequently used distinction between higher and lower degrees of innovativeness which is more practitioner-oriented is provided by the Rensselaer Radical Innovation Research Project: They define an innovation project as being radical if its outcome offers either an entirely new set of performance features, more than five times improvement in performance, or a cost reduction of at least 30 per cent.[36]

Finally, the focus of the thesis is on need-driven innovation (also called market pull or need pull or demand pull innovation[37]) as opposed to technology-push innovations. While for the latter type the initial stimulus is a technological advancement, followed by a search for possible applications, in the case of need-driven innovation the need or problem is discovered first and afterwards a solution is developed.[38] [redacted] Despite the manufacturing focus of the company, both physical products as well as services and new business models are explicitly in the focus of all innovation activities and this thesis, following the definition of OECD and Eurostat stating that an innovation is "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations".[41]

[35] Chandy & Tellis, 1998, p. 476.
[36] See Leifer et al. (2000), p. 5.
[37] See Brem & Voigt (2009), p. 355.
[38] See Brem & Voigt (2009), p. 355.
[39] Cf. chapter 3.3
[redacted]
[41] OECD & Eurostat (2005), p. 46.

2 Literature review: Relevance empirically backed, first hints on design options

2.1 Positive effect of product innovativeness on performance found

Researchers investigating managerial issues in the context of radical innovation have brought up several arguments to justify the need to achieve high levels of innovativeness: Especially for companies not only competing on costs, such products bear the possibility to differentiate substantially from competitors,[42] to fulfil customers' needs significantly better than other products,[43] and therefore to build a sustainable competitive advantage that might enable the innovator to realise temporary monopoly rents.[44]

These conceptual arguments are tested by a number of empirical studies that investigate the effect of innovativeness on product performance. One of the most frequently cited, especially in the literature on radical innovation, is the one of Kleinschmidt and Cooper (1991).[45] In a sample of 195 new industrial products launched by 125 firms, they find that high innovativeness is indeed more beneficial for commercial performance of products than moderate and low innovativeness, but their result suggests a u-shaped relationship rather than a linear one.[46] In a similar study, using a sample of 163 really new and 169 incremental product developments brought to the market by US companies, Song and Montoya-Weiss (1998) find significantly higher success levels for the products with higher innovativeness.[47] Sorescu et al. (2003) investigate the same relationship in a setting of 66 pharmaceutical companies with 255 breakthrough innovations and 3,891 product launches in total. They find that the breakthrough innovations received considerably higher valuations in terms of net present value than innovations either brought to a new market only or being only technologically new.[48] In a survey among 350 Chinese firms active in the B2C sector, Zhou et al. (2005) also find a positive effect of technology- as well as market-based innovativeness on both product and firm performance, thereby not considering their degree of innovativeness.[49] Already in 1986, Tushman and Anderson have examined the effect of early adoption of technological breakthroughs on firm performance in the US airlines and

[42] See Griffin et al. (2009), p. 223.
[43] See Veryzer (1998), p. 307.
[44] See Kleinschmidt & Cooper (1991), p. 240.
[45] See for example Chandy & Tellis (1998), p. 485; Baker & Sinkula (2007), p. 320; Reid & de Brentani (2010), p. 500; de Brentani & Reid (2012), p. 125.
[46] See Kleinschmidt & Cooper (1991), p. 246.
[47] See Song & Montoya-Weiss (1998), p. 131.
[48] See Sorescu et al. (2003), p. 94.
[49] See Zhou et al. (2005), p. 52.

minicomputer industry and found that early adopters experienced significantly higher revenue growth rates than their competitors.[50]

Despite this rich body of literature backing the notion that innovations, and especially those with a high level of innovativeness, do improve performance, other authors claim that high innovativeness is not only risky, but even harmful to performance due to high uncertainty regarding both technology and markets.[51] Another argument is brought up, among others, by Trommsdorff and Steinhoff (2006), saying that radical innovations require adopters to unlearn long-known truths and get used to new procedures and circumstances.[52] There is also empirical studies evoking scepticism: In a reconsideration of the data obtained by Kleinschmidt and Cooper (1991), Danneels and Kleinschmidt (2001) find that if a company has to move out of its marketing and technological competency in order to innovate, these projects are likely to be financially unsuccessful.[53] Additionally, Tatikonda and Rosenthal (2000) find for a sample of 120 projects from 57 firms that technological novelty has a negative influence on cost and time dimensions of development project success.[54]

A possible explanation for this contradiction is provided by Kock (2007). He decomposes the innovativeness-measure into the four dimensions market newness, product advantage, technology and organisation, and examines the individual effects on project success in a meta-study of 40 empirical papers on the topic. He finds a clearly positive relationship between product advantage from the customers' perspective and project success, while the change effort needed within the innovative organisation has a clearly negative influence.[55] For the market and technology dimension, no significant influence could be found. In a later study by Kock et al. (2011), the authors use a similar decomposition and test it in a sample of 144 German firms, with 75 of them being surveyed again at a later point in time. They find that market innovativeness is positively related to commercial success, while organisational innovativeness has negative influence, both being largely influenced by technological innovativeness.[56] Therefore, innovativeness is only positive as long as it contributes to customer value, and the negative influence of organisational innovativeness

[50] See Tushman & Anderson (1986), p. 459.
[51] See Lynn et al. (1996), p. 10; Danneels & Kleinschmidt (2001), p. 357.
[52] See Deszca et al. (1999), p. 618; Trommsdorff & Steinhoff (2006), p. 189.
[53] See Danneels & Kleinschmidt (2001), p. 370.
[54] See Tatikonda & Rosenthal (2000), pp. 80–81.
[55] See Kock (2007), p. 14.
[56] See Kock et al. (2011), p. 38.

shows that firms can be more successful when they are able to build on existing competencies and structures.

2.2 Market orientation beneficial for success, if understood correctly

As outlined in the previous chapter, the creation of customer value is imperative for achieving commercial success with new products. Although many ideas for radical innovations are of a technology push-type,[57] prior research has argued that, in order not to leave the degree of customer value provided to chance, firms should actively orient towards customers.[58] Market orientation has been defined as ‘‘the organisationwide generation of market intelligence pertaining to current and future customer needs, dissemination of the intelligence across departments, and organisationwide responsiveness to it’’.[59] However, there is also a set of arguments that warns companies against adhering too strictly to existing customers’ needs: First of all, customers might not be able to express their latent needs, and do especially have difficulties to assess the consequences of significant changes in functionality.[60] Also, too strict adherence to requirements of current markets might hinder creativity and discourage major leaps in functionality.[61] Additionally, listening only to existing customers bears the threat of being outpaced by companies that create initially inferior products in small markets unattractive for large, established firms and develop these further until they reach the performance levels necessary in the incumbents’ markets.[62] The latter effect is often referred to as the “innovator’s dilemma”, a term brought up by Christensen (1997). Taking these dangers into account, Slater and Narver (1998) argue that being market-oriented not only means reacting to immediate demands expressed by current customers, but to also pursue a long-term orientation by trying to uncover latent needs and unserved markets.[63]

There are a number of studies dealing with the effects of market orientation: In one of the first works, Ettlie (1984) empirically backs the sceptical position, as he finds in a sample of 147 food processing firms that a market-dominated strategy strengthens structural arrangements more suitable for incremental packaging innovations, and that for radical

[57] See Gassmann et al. (2006), p. 50.
[58] See Flint (2002), p. 314.
[59] See Kohli & Jaworski (1990), p. 6.
[60] See Slater & Narver (1998), p. 1002.
[61] See Moenaert et al. (1995), p. 245; Di Benedetto et al. (2008), p. 422.
[62] See Christensen (1997), p. xvi.
[63] See Slater & Narver (1998), p. 1005.

packaging innovation a strong technology-orientation is beneficial.[64] Similarly, Atuahene-Gima (1996) finds in a sample of 298 Australian service and manufacturing firms that market orientation has a negative effect on product newness as experienced by customers.[65] However, results of later studies are more encouraging for market-oriented firms: Vázquez et al. (2001) study 264 Spanish industrial firms, finding an indirect but positive effect of market orientation on innovation performance.[66] Sandvik and Sandvik (2003) investigate the effect of market orientation on both firm performance and level of innovativeness – market orientation was found to have no direct effect on firm performance, but an indirect one. It had a positive influence on product innovativeness in a sample of 298 hotels, which in turn did benefit firm performance.[67] Steinhoff (2006) confirms these findings in a setting of 103 German industrial firms: Her study finds a positive influence of customer orientation on innovation success, and she adds that the positive effect is even higher for products with higher innovativeness.[68] In a cross-industry study among 243 companies, Baker and Sinkula (2007) find high market orientation to be associated with having a balanced innovation portfolio containing both incremental and radical projects, while low market orientation makes companies tend to focus on incremental innovations.[69] Sainio et al. (2012) provide a more differentiated result among 213 Finnish companies: They find that customer relationship orientation has a beneficial effect on technological and business-model radicalness, but do not find a significant effect on market radicalness, backing the above mentioned notion that orienting towards existing customers makes companies disregard new markets.[70] Berghman et al. (2012) propose to actively try to supply customers which are known to be innovative in their end markets, as their innovative ability is likely to be mirrored by the focal firm.[71]

All in all, the results indicate that market orientation is beneficial for both the level of innovativeness as well as for firm performance, if it is understood in the sense of Slater and Narver (1998): Balancing efforts of both serving current customers and actively searching for new markets and needs is beneficial for innovativeness and success.

[64] See Ettlie (1984), pp. 692–694.
[65] See Atuahene-Gima (1996), pp. 98–99.
[66] See Vázquez et al. (2001), p. 82.
[67] See Sandvik & Sandvik (2003), p. 371.
[68] See Steinhoff (2006), p. 264.
[69] See Baker & Sinkula (2007), p. 326.
[70] See Sainio et al. (2012), p. 597.
[71] See Berghman et al. (2012), p. 35.

2.3 Activities before committing development resources form the fuzzy front end

2.3.1 The fuzzy front end as strong lever for innovation success

The fuzzy front end of innovation encompasses all activities of the innovation process that take place before a decision is taken to commit resources to a project in the concept stage and to actually start developing a product.[72] While Cooper (1988) distinguishes the stages idea (idea generation, initial assessment), preliminary assessment (market and technical) and concept (market and technical concept development, market study) with their respective steps,[73] Khurana and Rosenthal (1998) split the FFE into pre-phase zero (preliminary opportunity identification, idea generation, market and technological analysis as well as product and portfolio strategy), phase zero (product concept) and phase one (feasibility and project planning).[74] Koen et al. (2001) differentiate five activities: Opportunity identification, opportunity analysis, idea genesis, idea selection and concept and technology development.[75] Reid and de Brentani (2004) sort the activities into early and late ones: Early, problem structuring, opportunity recognition and information collection take place, later, idea generation, concept development, further innovation collection and pre-screening come into play.[76] Obviously, the four models differ less in what activities they consider important for the fuzzy front end than in arranging these.

The term “fuzzy” in this context refers to the fact that the activities are often undertaken in a fairly unstructured and dynamic manner, as well as to the high level of uncertainty that is present:[77] Both market chances as well as technological possibilities are typically not well known in the beginning of any innovation project, which is why an important goal of fuzzy front end activities is to reduce uncertainty.[78] Some scholars have, however, criticised the term for presuming that any efforts to structure and optimise the activities are naturally limited in their chances for success.[79] In recent literature, both works that use the term “fuzzy front end”[80] as well as works that use the more neutral form “front end of innovation”, as proposed by Koen et al. (2001, p. 46), can be found.[81]

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[72] See Khurana & Rosenthal (1998), p. 59; Verworn & Herstatt (2007), p. 8.
[73] See Cooper (1988), p. 243.
[74] See Khurana & Rosenthal (1998), p. 59.
[75] See Koen et al. (2001), p. 47.
[76] See Reid & de Brentani (2004), p. 171.
[77] See Kim & Wilemon (2002), p. 270.
[78] See Moenaert et al. (1995), p. 249.
[79] See Koen et al. (2001), p. 46; Sandmeier et al. (2004), p. 2.
[80] See Nijssen et al. (2012), p. 99; Soukhoroukova et al. (2012), p. 100; Creusen et al. (2013), p. 81.
[81] See Aagaard & Gertsen (2011), p. 330; Martinsuo & Poskela (2011), p. 896; Frishammar et al. (2012), p. 469.

In the course of any development project, actions and decisions taken in the earlier stages do significantly influence later activities.[82] Therefore, the FFE does not only have a major impact on project and product success, it does also bear the possibility to improve project outcomes with comparably low effort.[83]

Empirical studies dealing with the effect of front end activities on project outcomes support this argument: Already in 1986, Cooper found in a sample of 203 industrial product launches that the proficiency with which activities such as initial screening, preliminary and more detailed market as well as technical assessments were carried out did highly correlate with product success.[84] Later, Reinertsen (1999) quantitatively modelled the idea screening part of the fuzzy front end and showed the monetary outcome of different optimisation strategies given certain circumstances.[85]

In a small sample of 23 companies, which are not specified any further, Koen et al. (2001) find that more innovative companies show significantly higher levels of proficiency in carrying out front end activities than did less innovative companies, while for the later stages the differences were far less clear.[86] The influence of idea generation activities and idea quality on innovativeness is, among other factors, also investigated by Koc and Ceylan (2007): They find in a sample of 119 Turkish manufacturing companies that the two factors, which are mainly influenced during the fuzzy front end, do have an impact on innovativeness, although they are less important than technology strategy and technology acquisition and exploitation.[87]

In a cross-industry sample of 497 Japanese firms, Verworn et al. (2008) find that the intensity with which the FFE-activities are carried out influences the degree to which market- and technological uncertainty are reduced, which in turn influence project success variables with regard to both efficiency and effectiveness. In total, the three front-end variables were found to explain 17% of the variance in efficiency and 24% of the variance in effectiveness, underlining the high influence the FFE has on project outcomes.[88]

[82] See Verworn & Herstatt (2007), p. 14.
[83] See Aagaard & Gertsen (2011), p. 331.
[84] See Cooper & Kleinschmidt (1986), p. 82.
[85] See Reinertsen (1999), p. 27.
[86] See Koen et al. (2001), p. 52.
[87] See Koc & Ceylan (2007), p. 111.
[88] See Verworn et al. (2008), p. 12.

2.3.2 How to organise the front end processes: Iterative instead of linear?

Given the importance of the front end for new product development project outcomes, the question of how to best organise the FFE has been dealt with by several authors. While for the later stages of the product development process the Stage-Gate®-model has emerged as a widely used, basic standard which is usually adapted to company-specific circumstances,[89] such a clear consensus does not exist for the early phases: One the one hand, there is authors such as Cooper (1988)[90] and Flint (2002) who argue in favour of a formalised and sequential front end process, while others, such as Koen et al. (2001) propose an iterative approach, or differentiate depending on the degree of innovativeness, as for instance Khurana and Rosenthal (1998).

Cooper (1998) argues that a structured approach helps managers to control the activities in the front end and thereby to avoid common pitfalls and takes the sequential nature of the different steps as a given.[91] Smith (1999), based on two in-depth case studies, also comes to the conclusion that the front end of innovation is not much different to the later phases, therefore an organisation in stages and gates is helpful and the process especially benefits from strict selection criteria, customer involvement and strategic alignment.[92] Flint (2002) aims at reducing the development time by formalising the front end: By putting efforts geared towards deep customer understanding and market intelligence collection upfront all other activities, the author wants to avoid time-consuming iterations and development failures.[93] Boeddrich (2004) concentrates on the management of ideas, thereby also arguing that a formalised sequence of stages and selection gates is a requirement applying to any idea management system and helps to design a supportive software system.[94]

However, especially in the literature dealing with ways to achieve higher degrees of innovation, there is a number of authors opposing a strictly formalised front end: Khurana and Rosenthal (1998) find in a multiple case study that companies adapting their front end of innovation to the degree of radicalness were more successful than those applying a one-fits-all approach: While incremental projects did benefit from a higher degree of formalisation, for example characterised by clearly defined product advantage, market characteristics and financial details, more radical products did profit from being evaluated

[89] See Cooper (2008), p. 213.
[90] Cf. chapter 1.3 and 2.3.1
[91] See Cooper (1988), p. 247.
[92] See Smith (1999), p. 24.
[93] See Flint (2002), p. 313.
[94] See Boeddrich (2004), p. 282.

using other measures such as effects on other product's features or the companies' competence base in a promising field of technology. [95] Similarly, Veryzer (1998) argues against formal structuring of discontinuous projects based on a study of eight cases.[96] Song and Montoya-Weiss (1998) investigate the effect of certain new product development activities (including the front end activities pre-development project planning and market and opportunity analysis) on project success in an empirical study. They find that incremental projects require a different treatment than radical ones in order to be successful: Specifically, extensive market studies are more helpful for incremental projects, while thorough strategic planning did benefit radical ones to a higher degree.[97]

Earlier, Lynn et al. (1996) had already provided case-based evidence that a sequential approach towards the development of breakthrough innovations might not be the most beneficial one, and suggest to adopt an experimental, iterative process of testing early versions of the innovative product with customers to collect insights that can be used for further development.[98] Similarly, Garud and Karnøe (2003) show that the experimental development approach of Danish wind-turbine manufacturers, involving all affected parties and making small, but safe steps made them eventually outpace their US-American competitors and argue that this approach can be especially valuable in uncertain, complex and dynamic environments.[99] Given that certain prerequisites are fulfilled, such as modularity of both customer needs and the development process, existence of cross-functional teams as well as development process flexibility, Gassmann et al. (2006) also propose an iterative approach: Inspired by a software development paradigm, they argue that by developing innovations step by step, highly relevant market feedback can be collected regularly and latent customer needs can be discovered when users interact with what is already there.[100] In a more recent work of Cooper (2008), the author also acknowledges the necessity not to follow the Stage-Gate® process strictly sequentially, and points out that revisions and iterations are not in conflict with his idea, [101] although critics have argued that they impose significant delays and cost increases.[102]

[95] See Khurana & Rosenthal (1998), p. 70.
[96] See Veryzer (1998), p. 318.
[97] See Song & Montoya-Weiss (1998), p. 132.
[98] See Lynn et al. (1996), p. 32.
[99] See Garud & Karnøe (2003), p. 296.
[100] See Gassmann et al. (2006), p. 61.
[101] See Cooper (2008), pp. 224–225.
[102] See Koen et al. (2001), p. 49.

2.3.3 Individual-level factors: Especially important for radical innovation

In addition to the organisational perspective on the fuzzy front end, research has been conducted from the perspective of the individuals involved. Often, such works focus on more radical innovations and highlight the importance of individual-level factors in this context: O'Connor and Rice (2001) point out that the initial idea or the recognition of an opportunity often is a truly individual process, and the decision on whether to further pursue and forward the idea is made individually as well.[103] They argue that processes and structures therefore need to take individual-level factors into account and propose to motivate employees to articulate their ideas by establishing strategic guidelines, building receptive structures, initiating active calls for ideas voiced by top management and by nurturing cross-functional cooperation.[104] In a later study, Reid and de Brentani (2004) pick up this notion and highlight that individuals situated at the boundaries of an organisation are especially important, as they can detect innovation-relevant knowledge in the environment and transfer it to the organisational decision-making structures.[105] Such boundary-spanners or gate-keepers had already been researched in the general context of innovation.[106]

Another role that has been found to be important both in the front end of innovation as well as in later stages is the champion, or promoter. Especially in cases where organisational structures are not as receptive as proposed by O'Connor and Rice (2001), these individuals help to overcome organisational inertia. The ideal champion, as sketched by Howell (2005), actively searches for ideas, uses different channels to gather support and eventually overcomes all barriers to the implementation of the innovation.[107] Gemünden et al. (2007) argue that the tasks of such a catalysing role can also be spread across several persons in an organisation.[108]

In both concepts, as well as in the literature on the front end of innovation, leadership plays a major role: In the championing context, managers need to recruit people suitable for such tasks and need to help them develop their abilities by mentoring and providing a context where failure is seen as a learning opportunity.[109] In works on radical innovation, top

[103] See O'Connor & Rice (2001), p. 109.
[104] See O'Connor & Rice (2001), pp. 109–113.
[105] See Reid & de Brentani (2004), pp. 178–180.
[106] See for example Nochur & Allen (1992), p. 265.
[107] See Howell (2005), p. 112.
[108] See Gemünden et al. (2007), p. 412.
[109] See Howell (2005), p. 116.

management involvement already in decisions made in the early stages as well as later on has been proposed in order to sustain support for the projects and to keep the people working in the projects motivated.[110] In a study on success factors of idea management systems, Brem and Voigt (2007) also find that the continuing motivation of all people involved is essential for success.[111] Griffiths-Hemans (2006) points out in this context that intrinsic motivation or "love of the task" is especially important for the people who actually have the ideas and are creative, while efforts aiming at increasing extrinsic motivation even have detrimental effects.[112] As ways to keep up motivation, the author proposes to provide training and foster social interaction. Griffin et al. (2009) add that the intent to help solve other peoples' problems is also a reason for successful innovators to be creative, counting this intent as a form of external motivation.[113] Motivation to implement radical innovations has also been found to be important for middle managers: As they are often bound with operational goals that encourage the improvement of current operations, they might be reluctant to invest efforts in the implementation of innovations which tend to pay off late and therefore compromise current goal achievement.[114]

In general, creativity and innovativeness is also influenced by corporate culture: Together with leadership, Koen et al. (2001) have termed culture as the "engine" of the front end of innovation, being essential for keeping the front end processes running.[115] Stringer (2000) also mentions that a culture not conducive to change is an important barrier to implementing radical innovations.[116] Consequently, there is authors such as von Stamm (2009) who provide practical advice on how managers can influence organisational culture by changing their leadership style in order to foster innovativeness.

2.4 Methods for need–driven opportunity recognition for radical innovation

2.4.1 Six methods being mentioned repeatedly by prior research

Given the importance of market orientation and the front end for innovation success, prior research has dealt with the question what methods are available to ensure market orientation in the early phases of new product development. This question is even more

[110] See Bessant et al. (2010), p. 351.
[111] See Brem & Voigt (2007), p. 316.
[112] See Griffiths-Hemans (2006), p. 37.
[113] See Griffin et al. (2009), p. 235.
[114] See Gassmann et al. (2012), p. 129.
[115] See Koen et al. (2001), p. 53.
[116] See Stringer (2000), p. 72.

important since Chesbrough (2003) pointed out in his seminal work that external partners can be very helpful to innovate and to achieve innovation success,[117] indicating that the involvement of market partners can also be a source of opportunities and ideas.

Several methods exist that could be used to develop or collect new product ideas and opportunities for innovation. However, not every method is indeed helpful, and some methods are more suitable for incremental than for more radical innovation. Prior studies have examined certain methods with regard to their value in the context of high levels of innovativeness: O'Connor (1998) investigated in a multiple case study what methods were used in which stage of radical innovation projects. In the cases studied, visioning and imagining the future was found to be used early, while the involvement of customers and users was mostly done later.[118] Deszca et al. (1999) identified suitable methods based on conceptual reasoning, finding diffusion models, visioning techniques, lead user research, information acceleration, empathic design and customer immersion sessions suitable. Steinhoff (2006) conducted a literature review: She found that focus groups, future analysis, ethnography, simulations, lead user method and experimental approaches to the market where most often found to be useful for achieving high degrees of innovativeness by prior research,[119] although she also discovered empirically that not all of these methods were widely used in practice.[120] Cooper and Edgett (2008) also surveyed 160 companies on what methods for ideation they use, intending to measure both popularity and effectiveness of the methods. They find that focus groups, customer visits, lead user method and visioning were among the techniques rated high on both scales, while especially ethnography was found to be very effective, but seldom used.[121] However, it should be noted that the study did not control for the level of innovativeness achieved or aimed at. Recently, Nicholas et al. (2013) conducted a survey of 107 Irish companies on the frequency and the importance of the search strategies they used in the context of radical innovation. They find that working with active users, probe and learn, ethnographic research (termed "deep diving" in the study) as well as scouting were rated as the most important techniques and were also used most frequently. Interestingly, they see exploitation instead of exploration as the primary focus of working with users and ethnography. [122]

[117] See Chesbrough (2003), p. 37.
[118] See O'Connor (1998), p. 158.
[119] See Steinhoff (2006), pp. 205–207.
[120] See Steinhoff (2006), p. 209.
[121] See Cooper & Edgett (2008), p. 15.

In order to narrow down the scope of this thesis, it builds on the insights of the five studies: As user observation or ethnographic methods were mentioned by all studies and were additionally rated high in effectiveness by both Nicholas et al. (2013) as well as Cooper and Edgett (2008), the method was included in the thesis. Similarly, the lead user method was mentioned explicitly by three studies and rated high in effectiveness by Cooper and Edgett (2008), while the other two works suggest to actively work with users without mentioning a concrete method. Additionally, there is further research that points out the effectiveness of the lead user method.[123] Scenario techniques were also proposed by three of the studies, while two suggest visioning of the future, which can be done with the help of scenarios. Focus groups were mentioned by three studies and scored high in both scales used by Cooper and Edgett (2008), while the most recent study did not include any evaluation of the method. Finally, technology scouting was chosen for further examination: Mentioned by two studies, plus O'Connor (1998) pointing out professional conferences as a source of ideas, the method received the highest importance rating by Nicholas et al. (2013). Experimental approaches such as "probe and learn" as described by Lynn et al. (1996) were also mentioned by three studies, and the approach received a high effectiveness rating by Nicholas et al. (2013). However, it was not further considered in this thesis, as it rather deals with the product development phase than with the front end and is only suitable for products of extraordinary strategic importance.[124]

An overview of the methods and their occurrence in the five studies is provided in Table 1, while the full lists of the considered methods can be found on pages A1-A3.

	O'Connor (1998)	Deszca et al. (1999)	Steinhoff (2006)	Cooper and Edgett (2008)	Nicholas et al. (2013)
Ethnography	X	X	X	X	X
Lead user method	(X)	X	X	X	(X)
Scenario techniques	X	(X)	X	(X)	X
Focus groups	X	(X)	X	X	-
Probe and learn	(X)	X	X	-	X
Technology scouting	(X)	-	-	X	X

Table 1: The six methods mentioned most frequently in selected articles (brackets indicate that closely related approaches were mentioned and described)

Source: Author's illustration

[122] See Nicholas et al. (2013), pp. 31–32.

[123] See Lilien et al. (2002), p.55; Eisenberg (2011), pp. 57–58.

[124] See Lynn et al. (1996), p. 29.

2.4.2 Lead user method: Working with users being ahead of others

The lead user method was developed in the 1980s by von Hippel, who explicitly aimed at complementing existing market research techniques with a method that is suitable for identifying opportunities as well as developing solution ideas and product concepts for new products with high levels of innovativeness.[125] It is based on the assumption that users with two characteristics exist: They face certain needs at an early point in time, which will be common to most users later, and they expect to gain significant benefits from a solution to these needs.[126] The first characteristic enables lead users to contribute better to a solution design than ordinary users, as they do not have to imagine themselves being in a future problem situation, while the second characteristic is an important motivation for lead users to contribute.[127] If the perceived benefit of having a solution is high enough, lead users might even develop solutions themselves.[128] It has been argued that in markets with highly diverse requirements, the occurrence of such user innovations is especially likely.[129]

A typical lead user project is carried out in four phases:[130] In the first place a team is assembled, typically with members from both marketing and technical departments. This team then defines the general target market as well as the type and level of innovation it aims to generate. In the second phase, the team collects data about the target market and identifies emerging trends. Correspondingly, they identify experts in the field in order to gather deeper insights into these trends and choose the most promising ones as focal point of the project. Next, the lead users and, if existing, their solution concepts are being identified: While in the first projects parallel screening of a certain population for users with the described characteristics was applied,[131] it has been shown that sequential pyramiding techniques, using the knowledge users have about their peers, are more efficient:[132] Based on the notion that every expert in a certain field is aware of others that are more expert or have related specialist knowledge in a different field, project teams can work their selves up and across pyramids of expertise, whereas the latter is especially useful for radical innovation.[133] Lead users can possibly be found in the target market, when users

[125] See von Hippel (1986), p. 791.
[126] See von Hippel (1986), p. 796.
[127] See von Hippel (1986), p. 797; Urban & von Hippel (1988), p. 570.
[128] See Urban & von Hippel (1988), p. 573; von Hippel et al. (1999), p. 48.
[129] See Lüthje & Herstatt (2004), p. 558.
[130] See Lilien et al. (2002), pp. 1044–1045.
[131] See Urban & von Hippel (1988), pp. 572–573.
[132] See von Hippel et al. (2009), p. 1403.
[133] See Poetz & Prügl (2010), p. 909.

experience certain needs earlier than others, or in different markets, where users face similar needs in a more extreme form. Examples are braking systems for airplanes that could also be used in cars or make-up artists having the same need to apply fabric to skin as surgeons.[134] The fourth step is typically carried out as a workshop: Up to ten of the identified lead users which have been found to be both capable and willing to contribute meet for two to three days with the project team and possibly with some of the experts interviewed. They may start with the solution concepts that already exist or start with the focal trend, first in smaller ideation groups and later as a whole to refine the developed concepts. These are then evaluated, so that in the end one or more concepts are agreed upon and presented to the project sponsors for release into the development process.[135]

The lead user method has been used in a number of contexts, both in industrial as well as in consumer markets.[136] Results of these efforts have been published for at least four projects: Urban and von Hippel (1988) report that a new generation of computer aided design software developed in a lead user project was strongly preferred by ordinary users over competing offers.[137] A project at toolmaker HILTI, as described by Herstatt and von Hippel (1992), also led to a novel pipe hanging solution which was highly welcomed by ordinary users and developed in nearly half the time and budget compared to earlier projects with comparable results.[138] Lilien et al. (2002) investigated the results of a lead user project in the medical division of 3M and found that not only did the developed products show significantly higher levels of innovativeness, but their estimated sales were also many times higher than for products developed with conventional techniques.[139] However, in a longitudinal study Olson and Bakke (2001) revealed that at the Norwegian IT-company Cinet the method was abandoned despite its success. This development was found to be caused by the resignation of key employees and high pressure on the development teams exerted by current customers to fulfil their immediate needs.[140] Therefore, the success of lead user projects does not only depend on the identification of users capable of and willing to participate, but also on continuous management support and a long-term oriented culture open for input from leading-edge customers.

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[134] See von Hippel et al., 1999, pp. 48, 54.
[135] See Lilien et al. (2002), p. 1045.
[136] See Eisenberg (2011), p. 51.
[137] See Urban & von Hippel (1988), p. 576.
[138] See Herstatt & von Hippel (1992), pp. 219–220.
[139] See Lilien et al. (2002), p. 1051.
[140] See Olson & Bakke (2001), p. 392.

2.4.3 Ethnography: Analysing users in their daily life

Originally being an approach of anthropologists studying native tribes, ethnographic research has been picked up by market researchers in the 1970s,[141] mainly in the B2C-context, but increasingly also in industrial marketing.[142] Ethnographic approaches are being termed variously, with user observation, empathic design, or user shadowing among the most common names.[143] Although the approach makes use of several data collection methods, such as observation, interviews, audio- and videotaping, they all have in common that users are studied in their own environments, in the natural context of product use (which is, in a B2B context, usually the work place).[144] The approach specifically aims at identifying latent needs, which the users of a product are not aware of and, consequently, cannot express.[145] It has been argued that the insights gained with ethnography go beyond those that can be achieved with focus groups or surveys, and that the approach is suitable for finding opportunities for both radical and incremental innovation:[146] When customers are studied using existing products in order to find improvement opportunities, for example regarding usability, incremental innovations are more likely, while investigating users performing certain actions and looking for potential to assist them with new products or services bears the chance of achieving higher levels of innovativeness. Additionally, there is always a high level of initial ambiguity involved that needs to be planned for: Even if a clear objective has been defined, there is still the chance to gain unexpected, but potentially valuable insights – however, these are easily ignored.[147]

At the outset of an ethnographic market research project, the goals and scope of the effort are being defined, and a research team of marketers, designers and most often specialised ethnographers is assembled.[148] Afterwards, a suitable sample can be defined: If a product is to be improved, current users with differing characteristics are chosen in order to gain insights from a broad base of use cases. In case new products are to be developed, the sample can consist of people who use competitive products or none at all. Once suitable and motivated participants are recruited, the exact methodology to be used can be

[141] See Schröder & Steinhoff (2009), p. 1977.
[142] See Rosenthal & Capper (2006), p. 222; Goffin et al. (2010), p. 82.
[143] See Schröder & Steinhoff (2009), p. 1977.
[144] See Arnould & Wallendorf (1994), p. 485; Goffin et al. (2012), p. 47.
[145] See Leonard & Rayport (1997), p. 103; Rosenthal & Capper (2006), p. 216; Schröder & Steinhoff (2009), p. 1977.
[146] See Leonard & Rayport (1997), p. 113; Schröder & Steinhoff (2009), p. 1977; Goffin et al. (2012), p. 49.
[147] See Rosenthal & Capper (2006), pp. 222–223.
[148] See for the subsequent description McQuarrie (1991), p. 21; Rosenthal & Capper (2006), pp. 223–234; Schröder & Steinhoff (2009), p. 1978.

determined. Before data collection starts, a field guide is usually prepared to aid researchers in their work: It can, for example, contain an interview guide in case contextual interviews are used, or details on required interactions if interaction of a respondent with a product is to be observed. However, the guide does only serve as an orientation and procedures can be adapted to unplanned circumstances. During the data collection, extensive documentation is required to ease the subsequent analysis. Especially videotaping has been found to be effective as insights gathered by the ethnographers can easily be visualised to product designers and executives. The analysis of the collected data and the integration of opportunities and ideas into the front end of innovation form the final step: One approach to make sense of the often large amounts of data is coding,[149] another is the development of user profiles.[150] In the case reported by Schröder and Steinhoff (2009), the stored data could even be re-analysed in a different context at a later point in time.[151] Insights gained are often verified with traditional market research.

Several examples for the use of ethnographic techniques in market research have been published: Goffin et al. (2012) report that BOSCH used both usual as well as contextual interviews and observations to gain insights on what problems workers in the pharmaceutical sector face with packaging machines. The contextual interviews revealed that assembly and maintenance of the machines was highly complicated, a fact that had never been brought up in the usual interviews, and enabled BOSCH to successfully enter the market despite being a late follower.[152] Schröder and Steinhoff (2009) recount how Deutsche Telekom used participatory observation to investigate why mobile internet use was not developing as quickly as expected among businessmen and came up with a number of ideas on how to improve their service.[153] Rosenthal and Capper (2006) also describe two cases of ethnographic research in consumer settings, and additionally give a cost range for such projects based on twelve cases.[154] These costs, however, only include the effort for external consultants, pointing at a main issue: For most projects, the help of experienced ethnographers was found to be necessary.[155] Another problem is the restriction to products that are, in some way, used by somebody.[156]

[149] See Goffin et al. (2012), p. 48.
[150] See Schröder & Steinhoff (2009), p. 1980.
[151] See Schröder & Steinhoff (2009), p. 1980.
[152] See Goffin et al. (2012), pp. 49–50.
[153] See Schröder & Steinhoff (2009), pp. 1979–1980.
[154] See Rosenthal & Capper (2006), p. 235.
[155] See Goffin et al. (2012), p. 52.
[156] See Rosenthal & Capper (2006), p. 236.

2.4.4 Scenario development: Imagining multiple futures

With their origins in the military, scenario techniques have gained importance in strategic planning since the 1970s, when Shell successfully applied the method in the business context.[157] Recently, scenarios have also been discussed for different functions in the front end of innovation: Postma et al. (2012) as well as Farrington et al. (2012) point out the utility of scenarios for idea development and opportunity recognition.[158] Additionally, scenarios can be used to evaluate ideas or technologies: By imagining multiple futures with regard to, for instance, the development of technological possibilities and customer requirements, their influence on a certain product idea can be assessed.[159] Due to their long term orientation, scenarios have been found to be especially useful for achieving high levels of innovativeness.[160]

Scenarios are very different from predictions of the future or forecasts, as they do not extrapolate trends of the past.[161] They are rather defined as a rich description of a future state and the sequence of events that led to this state[162] and are capable of detecting weak signals and important uncertainties that could easily be overlooked by other approaches.[163]

There are numerous types of scenarios and different classifications available, for example regarding the scope or topic, time horizon, quantification and intended use.[164] Similarly, different approaches towards developing scenarios have been proposed – however, in practice, these are converging.[165] Von Reibnitz (1988) proposes eight steps in an inductive approach:[166] After having started with a problem analysis and goal definition, the most important influencing factors on the development of the focal phenomenon are identified. For each of these factors or drivers, different projections of their future development in a given time horizon are made. These projections are then checked pairwise for consistency: Is projection 1 for driver A consistent with projection 3 for driver D? For smaller numbers of drivers and projections a simple consistency matrix can be used, while for more complex situations specialised software eases the procedure.[167] Additionally, drivers might

[157] See Mietzner & Reger (2005), pp. 221–222.
[158] See Farrington et al. (2012), p. 26; Postma et al. (2012), pp. 645–646.
[159] See Drew (2006), p. 243; Postma et al. (2012), p. 645.
[160] See van der Duin (2006), p. 164; Farrington et al. (2012), p. 26; Postma et al. (2012), p. 646.
[161] See de Smedt et al. (2013), p. 432.
[162] See Godet & Roubelat (1996), p. 166.
[163] See Mietzner & Reger (2005), p. 235.
[164] See for a comprehensive overview Mietzner & Reger (2005), pp. 225–227.
[165] See Mietzner & Reger (2005), p. 235.
[166] See von Reibnitz (1988), pp. 31–56.
[167] See Fink et al. (2001), p. 89.

be weighted according to their importance. The fifth step is then to choose up to four consistent sets of projections as scenarios: Different, plausible, challenging scenarios having decision making utility are preferred.[168] Scenarios are especially useful if they enable different people to clearly imagine the future situation, and therefore benefit from extensive visualisation. Thus, broad communication and discussions about the scenarios and their consequences are central to increase their value. Building on the insights of as many stakeholders as possible, the consequences from the scenarios can be derived. If, for example, the scenarios have described the future of car traffic in 2025, a car manufacturer could derive products and features to fulfil the changed customer needs, as well as possible risks for staying with the current product portfolio. Additionally, disruptive events can be included in order to analyse the impact of such unexpected and fundamental changes. The final task is then to transfer the insights derived from the scenarios to the company's business processes, be it strategic planning or new product development.[169]

An example for the application of scenarios to derive insights for product development is DaimlerChrysler: Here, the future of loading and storage of goods was imagined to develop the next generation of vans.[170] Specifically, the company involved both external experts and internal staff to build the scenarios and then identified areas where innovation was necessary, followed by ideation workshops to find ideas for filling these gaps, which were subsequently analysed for feasibility. Similarly, a Dutch construction company network has used scenarios for ideation.[171] In a B2C-context, PepsiCo used scenarios to get an idea of future consumer preferences, which were then stored, monitored and used as orientations for long-term product development.[172] Although two of the companies report to be satisfied with the results of their efforts,[173] explicit analyses of the success of the developed ideas are not available. However, the studies highlight certain success factors: As scenario building is a time- and resource-intensive exercise, continuous management support is important, as well as the involvement of a broad range of stakeholders to increase both scenario quality and acceptance.[174] Additionally, the integration of the derived insights into day-to-day processes has proven difficult, but vital for success.[175]

[168] See Mietzner & Reger (2005), p. 233.
[169] See von Reibnitz (1988), pp. 54–55.
[170] See van der Duin (2006), p. 108.
[171] See Postma et al. (2012), p. 649.
[172] See Farrington et al. (2012), p. 32.
[173] See van der Duin (2006), pp. 110–112; Farrington et al. (2012), p. 33.
[174] See van der Duin (2006), p. 164; Farrington et al. (2012), p. 32; Postma et al. (2012), p. 653.
[175] See Farrington et al. (2012), p. 32.

2.4.5 Technology scouting: Transferable to the market side?

Technology scouting has been defined by Rohrbeck (2010) as assigning employees or external consultants to gather science- and technology-related information. The scouts thereby rely on both formal and informal sources, especially in their personal network, and can either search in defined technological areas or undirected to identify technological developments the company is not aware of at all. Scouts therefore contribute both to technology foresight as well as to technology sourcing, as the network built by the scouts can also facilitate the insourcing of technology.[176] Typical information sources for scouts are, among others, universities, suppliers and customers as well as conferences and fairs, especially in innovative clusters.[177] Gassmann and Gaso (2004) developed a similar concept called "listening posts", defined as decentralised research and development units for knowledge sourcing.[178] The authors thereby distinguish between three configurations, differing in the way they either concentrate more on technological insights or on applications, and in the sources of information they use.[179] Although it seems straightforward that scouts are being assigned to a search field and then feed gathered information which they consider helpful back into the organisation, it has been found that it is an important and time-consuming task for scouts to find out what they should be looking for, a process that has been labelled as internal scouting.[180] To transfer knowledge back into the organisation, both face-to-face meetings as well as written memos have been proposed,[181] whereas memos have the advantage of being easy to forward, while in face-to-face meetings higher quality of information can be achieved.

According to Rohrbeck (2010), the personal requirements for technology scouts are similar to those that have been defined for the related concept of the technology gatekeeper: Both should be lateral thinkers, knowledgeable in science and technology, respected inside the company, cross-disciplinary orientated, and imaginative.[182] Gatekeepers, however, are defined as being situated more centrally in the organisation compared to scouts, and are not necessarily nominated, but rather take action on their own.[183] In order to ease communication with the home organisation, job rotation and short stays in the field are proposed for

[176] See Rohrbeck (2010), p. 171.
[177] See Gassmann & Gaso (2004), p. 4; Birkinshaw & Montero (2007), p. 23; Rohrbeck (2010), p. 173.
[178] See Gassmann & Gaso (2004), p. 4.
[179] See Gassmann & Gaso (2004), p. 7.
[180] See Birkinshaw & Montero (2007), p. 24.
[181] See Gassmann & Gaso (2004), p. 12; Birkinshaw & Montero (2007), pp. 28–29.
[182] See Rohrbeck (2010), pp. 170–171.
[183] See Nochur & Allen (1992), p. 268.

parts of the scouting staff, while core scouts stay long-term in order to establish stable relationships with informants.[184]

Examples of companies using technology scouts can be found especially in fast-moving industries, such as information and communication technology: Birkinshaw and Montero (2007) report on the scouting activities of a European telecommunication services provider trying to keep abreast with the newest developments in its industry by establishing scouting units in innovative clusters such as Palo Alto, Tokyo and Beijing as well as part-time scouts in Israel and India.[185] They find out that scouts did also deliver hints on how market-proof already known technologies were, additional to finding new ones.[186] Rohrbeck (2010) describes that Deutsche Telekom, Telefónica and British Telecom used a wide-spread network of scouts to look out for disruptive technologies, facilitate technology sourcing and stimulate innovation.[187] However, the broader concept of Gassman and Gaso (2004) is being applied by manufacturing firms as well: While Hitachi and Daimler-Chrysler concentrate on connecting to foreign research communities, BMW uses a network of trend scouts, which are not restricted to technological developments, but also consider emerging applications and needs.[188]

Such a wider focus of scouts is also proposed by other authors: Sandmeier et al. (2004) report on the innovation front end of Bayer MaterialScience, describing that the company uses market- as well as technology scouts in their central innovation units.[189] In a recent paper, Gassmann et al. (2012) mention the same example and add that Siemens, Gore and Lonza Group also have central units with the specific task of developing radical innovations which perform trend scouting.[190] Unfortunately, none of these papers give any hints on how successful the described efforts have been, neither with regard to business potential nor concerning the level of innovativeness. However, an obvious advantage of the scouting approach is that it is relatively straightforward: Once receptive central structures have been built and employees with the needed characteristics have been identified, they can be assigned with the scouting task without the necessity to involve external consultants.

[184] See Gassmann & Gaso (2004), p. 12.
[185] See Birkinshaw & Montero (2007), p. 15.
[186] See Birkinshaw & Montero (2007), p. 33.
[187] See Rohrbeck (2010), p. 177.
[188] See Gassmann & Gaso (2004), pp. 7–10.
[189] See Sandmeier et al. (2004), p. 4.
[190] See Gassmann et al. (2012), p. 123.

2.4.6 Customer focus groups: Common method, heavily criticised

Focus groups have been defined as groups of people, often between eight and twelve, who discuss a certain topic under the lead of a moderator.[191] The method is based on the assumption that group members stimulate each other, for instance by building on each other's ideas or bringing up issues other members have not thought of, making group sessions more productive than individual interviews.[192] The approach is not restricted to the business context, but it is used for a number of market research purposes in companies: Exploring opinions and attitudes of customers, testing product concepts or commercials, identifying questionnaire items for later surveys,[193] and idea generation[194] are frequently mentioned. Customer focus groups have been found to be a wide-spread method,[195] presumably due to the comparably low cost and time needed,[196] although the indirect costs for preparation and analysis of the group sessions should not be underestimated.[197]

According to Welch (1985), six steps form a typical focus group project:[198] First, the purpose and justification for the study need to be clarified, then objectives can be set. Based on those, screening criteria for participants can be defined and customers invited. It has been argued that the level of homogeneity needs to be carefully gauged.[199] To help the moderator, a guide is outlined. After the session, which usually takes up to two hours, the results are analysed and a report is compiled for distribution. Taping the session eases analysis significantly. What is done during the session itself depends on its purpose – for idea generation, brainstorming techniques are a common method: Participants are asked to generate as many ideas as possible on a certain topic, as for example a need they have in common, without any concerns for quality. Additionally, certain rules of interaction are established, as for instance not to criticise, but to build on the ideas of others. [200] If the focus group aims at concept evaluation, McQuarrie and McIntyre (1986) propose that participants are first asked about improvement potential they see for existing products, then they are confronted with the new product concept and asked to evaluate it. Afterwards, the

[191] See Calder (1977), p. 353; McQuarrie & McIntyre (1986), p. 40; Parent et al. (2000), p. 49.
[192] See McQuarrie & McIntyre (1986), p. 42; de Ruyter (1996), p. 44.
[193] See Fern (1982), p. 1.
[194] See McQuarrie & McIntyre (1986), p. 41.
[195] See Fern (1982), p. 1; Cooper & Edgett (2008), p. 15; Schirr (2012), p. 478.
[196] See McQuarrie & McIntyre (1986), p. 40.
[197] See Welch (1985), p. 250.
[198] See for the following paragraph Welch (1985), p. 247.
[199] See Corfman (1995), p. 354.
[200] See Paulus & Yang (2000), p. 77.

authors suggest assessing the willingness to pay for the product, and discussing possible modifications and optional extensions to the presented product version.[201]

The effectiveness of focus groups for need assessment and idea generation has been subject of empirical studies: Griffin and Hauser (1993) conducted both focus groups and individual interviews to assess the needs of users of a complex piece of office equipment and compared how many needs were identified by the two methods. They found that two interviews were as effective as an eight person focus group, suggesting that synergies are not present in focus groups and that interviews are more cost efficient.[202] Similarly, Fern (1982) found in a setting of women discussing job opportunities in the military that individual interviews with as many interviewees as group session participants led to significantly more ideas, regardless of the focus group size being four or eight members.[203]

Based on these rather discouraging results, it is argued to either restrict the use of focus group to concept testing,[204] or to adapt the group techniques used: Ciccantelli and Magidson (1993) propose to enlarge the time frame of the session to an entire day and make the participants design their ideal product for a certain purpose, regardless of technical restrictions. During the sessions, brainstorming and selection rounds are performed, and moderators ask the participants for the reasons they choose certain features instead of others, in order to get valuable insights on the needs the participants seek to solve.[205] Another adaptation of the focus group is the nominal grouping session: In this approach, the moderator presents the topic, but instead of discussing it, participants are asked to write their ideas down. Later, these ideas are voiced and written on a blackboard one by one and in rounds, so that other participants can still build on them. Afterwards, the ideas are given a rank order by the participants.[206] Similarly, Girotra et al. (2010) propose a phase of individual idea generation in the first place, followed by group discussion and further development of ideas to increase both quantity and quality.[207]

[201] See McQuarrie & McIntyre (1986), p. 43.
[202] See Griffin & Hauser (1993), p. 7.
[203] See Fern (1982), p. 7.
[204] See McQuarrie & McIntyre (1986), p. 46.
[205] See Ciccantelli & Magidson (1993), pp. 342–343.
[206] See de Ruyter (1996), p. 45.
[207] See Girotra et al. (2010), pp. 597–598.

2.4.7 Gearing the described methods towards more radical innovation

Focus groups are not the only method that researchers have tried to improve in order to generate ideas and identify opportunities with higher levels of innovativeness. Although adaptations have mostly been developed for a specific method, the direction of such changes might allow insights for other methods as well.

One way to higher innovativeness which is often mentioned is the choice of the right data sources: Drew (2006) recommends to use non-traditional data sources and participants for scenario techniques. As he puts it, such "information from the periphery" has the potential to lead to new business models and future core revenue streams.[208] In the same context, de Smedt et al. (2013) advise to broaden the system boundaries and to enrich the future images to increase their innovation potential.[209] Similarly, Börjesson et al. (2006) point out in their case study of Volvo Cars that market research data from established sources is also available to competitors and therefore being confined to such data limits the chance to develop unique ideas and concepts in the front end.[210]

Abstraction from a concrete problem is also a pattern that is proposed in prior literature: Von Hippel (1986) mentions in his critique of the focus group method that, in order to derive valuable information from the discussion, analysts have to accurately and completely abstract.[211] Ulwick (2002) builds his interview technique on the notion that customer input should not focus on solutions, but on outcomes: He proposes to already shape data collection in a way that it does capture what customers want to achieve with a product, not on the features of the product itself.[212]

Abstraction is, however, already necessary during the problem definition phase of any innovation project, as Gassmann and Zeschky (2008) argue, because it allows to generate wider search terms that open the space in which a possible solution can be found.[213] This definition of search terms is connected to the choice of data sources as described above and to the definition of search fields: Both Govindarajan et al. (2011) as well as Rosenthal and Capper (2006) propose to search for innovative ideas within customer groups which are not yet purchasing from the focal organisation, but either buy from competitors or do not

[208] See Drew (2006), p. 243.
[209] See de Smedt et al. (2013), p. 438.
[210] See Börjesson et al. (2006), p. 780.
[211] See von Hippel (1986), p. 793.
[212] See Ulwick (2002), p. 92.
[213] See Gassmann & Zeschky (2008), p. 104.

buy at all.[214] The former authors also confirm this notion empirically in a mixed industry sample of 129 business units in 19 corporations, showing that a firm's orientation towards emerging customer segments is beneficial for innovativeness.

Altogether, three directions seem to be available to increase innovativeness: Abstraction, using unusual sources and defining wider search fields. Unusual sources can possibly be applied to all five methods described: For scenarios, the information on which the projections are based can be collected from a wide range of sources in order to capture developments which will become relevant in the future [redacted]. Similarly, scouts can try to get access to sources competitors are likely to lack [redacted]. The subjects for ethnographic research can also be recruited from industries which are not core markets of the company in order to gain richer insights; similarly, lead users can be searched for in areas where current products do not yet satisfy the existing needs. For focus groups, potential customers can also be invited besides existing ones in order to widen the companies' perspective. It is, however, likely that the effort necessary to assess such unusual sources is significantly higher compared to established ones.

Wider search terms appear to be especially useful for scenario building and scouts, but can possibly also be applied to focus groups: If the phenomenon the scenarios aim to describe is termed [redacted] instead of [redacted], the scenario exercise will certainly become more complex, but might at the same time reveal important drivers which influence the importance of the individual modes of transport. If focus groups are used for ideation, the topics under which ideas are collected can be widened similarly. Additionally, scouts can include remote markets or technological areas in their search range or consult informants having access to these.

Abstraction, however, seems to be important for both ethnography and focus groups: In both techniques, the immediate results are likely to be bound to a concrete customer problem, and in order to not only solve those but also create value for other problems and customers, abstraction is necessary [redacted]

[214] See Rosenthal & Capper (2006), p. 223; Govindarajan et al. (2011), p. 130.

2.5 Selection mechanisms to be adapted to idea characteristics

2.5.1 Different criteria needed depending on the degree of radicalness

As development resources are scarce, only a small portion of the collected ideas can be pursued. Regardless of whether an iterative or linear front end has been chosen, some sort of selection gate will be needed.[215] In order not to spend resources on product ideas which eventually cannot be realised or do not pay off, a careful selection is necessary – at the same time, too strict selection mechanisms are also costly, if they are falsely abandoning projects with high potential.[216] Additionally, clear selection criteria aid innovating employees in arguing for their ideas, thereby increasing the chance that the ideas are not only being voiced, but also heard by managers.[217]

As criteria for selection can relate to very different areas of expertise, such as marketing, strategy, or technology, it is usually assumed that selection decisions are made by cross-functional teams. Research backs this common approach, showing that teams indeed do make better decisions than individuals.[218] However, the use of teams makes the selection process also more costly, leading to the question of how to most efficiently organise it: One possibility is to install a two-step approach with a brief set of criteria first to weed out infeasible ideas and to develop the remaining ones to concepts which are then evaluated in more detail.[219] Recently, another approach has been brought up that tries to engage more people in order to benefit from an even broader knowledge base, simultaneously limiting the number of ideas that need to be reviewed formally: Soukhoroukova et al. (2012) base their concept of a company-wide online idea market on stock trading mechanisms. A new idea needs to reach an initial threshold of virtual investments before it is traded in the virtual market, when the price relative to other ideas represents the idea quality.[220] However, this approach was only tested in a single company and consensus between traders and managers about idea quality was only moderate.

For any screen, careful selection of the respective criteria is crucial for success: Empirical studies have first investigated the use of different criteria in a purely descriptive manner; later a link to product success was established. Hart et al. (2003) found in a survey of 166 managers of British and Dutch industrial firms that the most widely used criteria for idea

[215] See Cooper (1988), p. 243; Koen et al. (2001), p. 47.
[216] See Reinertsen (1999), pp. 26–27.
[217] See Rice et al. (2001), p. 419.
[218] See Schmidt et al. (2001), p. 591.
[219] See Kim & Wilemon (2002), p. 273.
[220] See Soukhoroukova et al. (2012), pp. 105–106.

screening in the Netherlands were technical feasibility, intuition and market potential, while in the United Kingdom product uniqueness was in the top three instead of intuition. During concept screening, customer acceptance and again technical feasibility were used most frequently in both countries, complemented with product performance in the Netherlands and market potential in the United Kingdom.[221] Among 77 Spanish manufacturing companies showing above-average innovativeness, another study found that for concept evaluation customer acceptance and technical criteria were the most important ones, while the most widely used was strategic fit.[222] Using the same sample, it was also shown that the use of technical, strategic and customer acceptance criteria at the concept evaluation screen was positive for product success – however, for radical projects the use of customer acceptance, financial and market-related criteria had less influence.[223] In another attempt to establish a link between review practices and product performance, Schmidt et al. (2009) found in a survey among 425 practitioners organised in the Product Development & Management Association that the initial screen, following the opportunity identification phase, had a significant influence on product success, while the concept evaluation and the final launch gate did not. Additionally, it was found that only the proficiency of using marketing criteria was significantly related to performance.[224] Martinsuo and Poskela (2011) use a more fine-grained approach in a sample of 107 Finnish industrial firms: They found that the use of market and technical criteria in the front end positively influences competitive advantage, while the use of technical and strategic criteria is beneficial for future business potential.[225] The authors also argue that formal evaluation systems are less useful for radically innovative ideas than for incremental ones. Using different evaluation criteria had also been proposed by others: Leifer et al. (2000) especially argue that quantitative assessments are necessarily based on very uncertain assumptions in the case of high levels of innovativeness and therefore cannot form a solid base for decision making.[226] Consequently, more qualitative assessments, such as estimation of long-term effects on the firm's technical capabilities, are more suitable in the case of radical innovation.[227]

[221] See Hart et al. (2003), p. 29.
[222] See Carbonell-Foulquié, Munuera Aleman et al. (2004), p. 311.
[223] See Carbonell-Foulquié, Rodriguez Escudero et al. (2004), p. 92.
[224] See Schmidt et al. (2009), p. 532.
[225] See Martinsuo & Poskela (2011), p. 908.
[226] See Leifer et al. (2000), p. 44.
[227] See Martinsuo & Poskela (2011), p. 910.

In any case, ideas that have not passed do not need to be forgotten, but rather be stored for possible later reuse:[228] What is too costly to realise at the moment might become cheaper in the future, and what seems unattractive to customers in the present might fulfil needs that are still to emerge.

2.5.2 Portfolio approaches helpful for selecting the right ideas

As both incremental as well as more radical innovation projects are necessary for firm success,[229] the ideal result of any screening system is a portfolio of projects that balances risks and maximises rewards.[230] Although decisions are often made on the level of the single idea or concept,[231] scholars propose to structure innovation project portfolios by criteria such as customer groups, markets or technologies in order to benefit from possible synergies that exist between projects in similar fields.[232] These fields can also be used to steer ideation efforts[233] – however, limiting the scope of search efforts in this way bears the risk of incrementalism, making it advisable to rather structure the portfolio according to the level of innovativeness. Such a portfolio view also eases the selection of ideas to pursue, as it prevents decision makers from consistently choosing low-risk, low-reward concepts over riskier, but potentially more valuable projects.[234]

Both selection criteria as well as resource allocation can be tied to each section of the portfolio: If the portfolio is split, it can be decided what share of the total development budget is dedicated to incremental and to radical projects, respectively.[235] From that moment on, radical ideas do not compete with incremental ones for the same budget, but only with similar ones for the money in the same "strategic bucket". If necessary, a more fine-grained distinction is also possible (see Figure 3), although it increases complexity: For instance, incremental projects could be split into cost savings and functional improvements, while projects with higher levels of innovativeness could be divided into new technologies and new products.[236] For selection, different sets of criteria can be applied, making decisions easier and more transparent, as criteria can be used that fit the character

[228] See Rochford (1991), p. 292.
[229] See O'Reilly & Tushman (2004), p. 76; Baker & Sinkula (2007), p. 316.
[230] See Martinsuo & Poskela (2011), p. 896.
[231] See Heising (2012), p. 592.
[232] See Salomo et al. (2008), p. 561.
[233] See Heising (2012), p. 588.
[234] See Chao & Kavadias (2008), p. 907; Bessant et al. (2010), p. 347.
[235] See Chao & Kavadias (2008), p. 908.
[236] See Chao & Kavadias (2008), p. 908.

of each concept and do not require a stretch to make radical concepts fit into criteria for incremental innovations.[237] Additionally, the decision making process can be adapted to the portfolio section: An approach of how to organise such a two-lane evaluation mechanism is described by Bessant et al. (2010). While the companies the authors examined used clear go/no go decisions for incremental ideas, there was the possibility that for radical projects a further refinement or learning loop was mandated and funded, after which the idea would again be evaluated at the same gate. This iterative loop can be repeated as often as the reviewers consider it necessary and useful.[238]

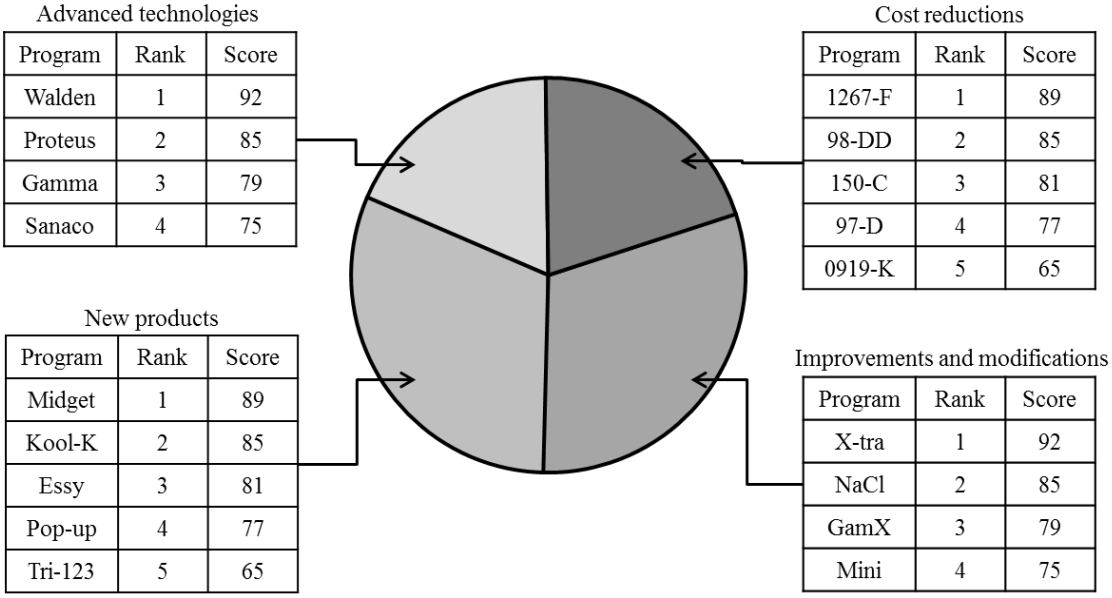

Figure 3: New product development budget divided into strategic buckets
Source: Chao & Kavadias (2008), p. 908.

Finally, it is an option to install different levels of formality: As Martinsuo and Poskela (2011) point out, it is not only helpful to apply different selection criteria for more radical projects, but at the same time, higher flexibility on how these are applied is beneficial.[239]

The decision on what path to follow might be taken in the initial screen. This way, the people working on concept development could already take advantage of the knowledge that iterations are possible if the idea is interesting, and do not waste time on preparing submissions that do not fit the characteristics of the idea.

[237] See Cooper (2007), p. 69.
[238] See Bessant et al. (2010), p. 348.
[239] See Martinsuo & Poskela (2011), p. 910.

2.6 Pre-selection of methods and advice on process design provided by literature

Summarising the findings of prior research, there is strong empirical backing for the chosen approach of strengthening the market-based front end of innovation with a focus on high-degree innovations: The importance of the front end has been shown in empirical studies as well as the positive impact of correctly understood market orientation and higher degrees of innovativeness on product success. Regarding the set-up of the front end, there are authors proposing a sequential design in stages and gates, while others highlight the importance of iteration loops especially for radical innovation. Together with the notion that for radical innovations it is also beneficial to apply different selection criteria, a two-lane front end seems to be advisable: While a sequential process with strict selection criteria is suitable for ideas and opportunities incremental in nature, for higher degrees of innovativeness a process with the option of back-loops and more qualitative, flexible selection criteria appears more adequate. In order to further acknowledge the differences in innovativeness, the split of development budgets has been proposed.

Regarding the methods for identifying opportunities and ideas for innovation, a cross-section of prior research identifies six approaches which are supposed to provide better chances of finding opportunities and ideas for higher-degree innovation than others: The lead user method, working together with users that experience certain needs before the broad market and have a high motivation to satisfy them, is frequently mentioned in this context. Ethnographic approaches aim at identifying latent needs by observing or interviewing users in their daily work. Scenarios can be developed in order to imagine the future and derive customer requirements that might emerge given certain circumstances. Scouts can be sent out both to find new technologies, but also to reveal upcoming market trends and customer requirements. Focus groups are an established method to involve customers in ideation, but have been criticised for the low degree of innovativeness that can be expected. The probe and learn approach was not further considered as it encompasses the entire new product development process and is only suitable for innovations of high strategic relevance. For all methods, ways of increasing innovativeness exist: Namely abstraction, using unusual sources and defining wider search fields.

Additionally, individual-level factors have been identified as an important factor to the success of any front end activity: Leadership and culture influence employee motivation, which is an important driving force for developing innovative ideas.

3 Case analysis: STILL's innovative potential not fully exploited

3.1 STILL as an innovation leader in the material handling industry

STILL is a manufacturer of forklifts and material handling equipment, also offering the development of material flow concepts, automation services and software products for fleet management and analysis.[240] The company employs more than 7,000 employees in four production sites in Hamburg and Reutlingen (Germany), Luzzara (Italy) and Sao Paulo (Brazil) as well as in numerous sales and service locations, generating revenues of around two billion euros. STILL is one of six brands of the KION corporation, the world's second largest material handling equipment manufacturer. The core markets are in Western Europe, with Eastern Europe and Russia gaining importance. In other countries, the company's presence is limited: While steps were taken to enter South American and Asian markets, there are practically no activities in North America and Africa.[241] Within STILL, functions such as product development, marketing and human resources are fully centralised, operational functions are bound to the production sites and sales and service units are decentralised in order to stay close to current and potential customers. Additional to the countries where own branches exist, certain markets are covered by dealers.[242]

The core product of the company is forklift trucks, powered with either diesel, gas or electricity; however, the current product range does encompass a wide range of vehicles for material handling.[243] STILL has a long track record of innovations, including side battery change for electric trucks as well as a highly flexible tugger train concept[244] and is also recognised as an innovative company.[245] One of the landmark projects in this regard is the hybrid drive available for diesel forklifts: By complementing a downsized engine with a capacitor loaded by recuperated energy, such trucks have shown 12% higher fuel efficiency than their conventional brothers and 34% compared to the market average.[246] Another innovation was triggered by both technology and regulatory forces: Following the call of French forklift fleet operators needing information on truck usage and maintenance activities due to upcoming regulations, the idea was born to also collect existing sensor

[240] See Company Presentation, p. 3.
[241] See Company Presentation, pp. 4-5.
[242] See Organisational Chart
[243] See STILL Product Range, p. 3.
[244] See Company Presentation, p. 10.
[245] Interviews Bonk, 2013-06-26; Klostermann, 2013-07-15
[246] See Data Sheet RX 70, p. 2; Egberts, 2012, p. 59.

data and provide customers with even richer performance reports. The implementation of a board computer also enabled STILL to offer electronic access control for its trucks – today, all these ideas have been framed under three distinct software solutions.

However, not all innovations at STILL have been initiated by technological progress: One example is the tugger train – initially designed for a German car manufacturer, the concept was recognised to support LEAN production processes very well and was quickly adopted by other customers. [redacted]

3.2 [redacted]

3.2.1 [redacted]

Within STILL, different departments already use a number of techniques to gather innovation ideas. [redacted]

[redacted]

3.3 [redacted]

[redacted]

[redacted]

[redacted]

4 Methodology: Theory-based solution design based on workshop and interviews

4.1 Theory-based problem solving as general approach of the thesis

The starting point of this thesis was the recognition of STILL's product management department that a problem exists, which is worth to be approached on a sound basis of prior knowledge. Guidance to such a way of theory-based, design-focused business problem solving is given by van Aken et al. (2007).[268] The authors suggest the following sequence of steps for developing a solution: First, an orientation process is started in order to come up with a research project proposal. For the thesis at hand, discussions with the principal of the thesis, the product manager in charge of innovation management, were complemented by consultations with the thesis supervisor of the university and other product managers. The next step is the theory-based problem diagnosis,[269] in this case based on interviews: Details on the current processes, methods and experiences as well as results of earlier activities were obtained in order not to develop the new design on a blank page, but to build on existing knowledge and consider existing structures.

The main step is the solution design, where potential solutions to the problem are explored, in order to choose the most suitable one and describe it in further detail.[270] Options were derived from literature and then assessed and refined in a world café workshop with managers and employees from the departments involved in the innovation process. Although operational employees did participate in the workshop in order to add another perspective, the decision was made to invite mainly managers because of two reasons: Firstly, according to Bohlmann et al. (2013), managers are more likely to take the perspective of the firm than regular employees.[271] Secondly, a goal was to build commitment to the chosen solution by making the affected managers participate in the decision. As they are the ones who ultimately need to provide the resources in order to make the solution work, their support is key to ease implementation. To further increase commitment, the need for a well-designed, market oriented front end of innovation was outlined by building a line of empirically backed arguments from the importance of front end activities and market orientation for innovativeness to the effect innovativeness has on firm performance.

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[268] See van Aken et al. (2007), p. 17.
[269] See van Aken et al. (2007), p. 63.
[270] See van Aken et al. (2007), p. 84.
[271] See Bohlmann et al. (2013), p. 232.

In addition to the business problem solution, the thesis aims at providing insights also useful outside the case company: From the analysis of and solution for the case, insights are to be derived which can serve as input and inspiration for similar projects or even be subject to being tested by further research. Such a dual outcome, which to provide is also the aim of other business-problem research approaches such as action research,[272] satisfies the needs of both research and practice and scores high in relevance as well as rigor.

4.2 Data collection methods: Semi-structured interviews followed by a world café

In the first step of data collection, existing methods, processes and structures for innovation management were analysed in semi-structured interviews with stakeholders from different units. Participants were chosen using purposive sampling:[273] Firstly, managers were interviewed expecting that they have the broadest knowledge of procedures, interfaces, strengths and weaknesses. However, it was assumed that they might not have in-depth knowledge – therefore, operational employees were interviewed as well. All interviews were conducted in a semi-structured way asking open questions, owing to their purpose of getting detailed insights into how activities are conducted and how respondents judge these.[274] The questions were adapted to the respondents' area of expertise, and insights gained or questions raised during interviews were considered in later ones.[275] The research context and the purpose of the interviews where introduced both upfront by the principal of the thesis as well as by the researcher in the beginning of each interview.

The subsequent workshop for assessing the methods found during the literature review with regard to their suitability for the case company followed the world café approach: Developed in the 1990s, it has been successfully applied in diverse settings including the development of innovative service delivery in hospitals,[276] market research for financial products[277] and the investigation of changes in the identity of academic staff.[278] Recently, the approach has also gained attention in scientific research as a quick way of bringing researchers and practitioners together in order to improve practical relevance.[279]

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[272] See Dick (2002), p. 159; French (2009), pp. 189–190.
[273] See Cooper & Schindler (2011), p. 173.
[274] See Quinlan (2011), p. 293.
[275] See Ghauri & Gronhaug (2010), p. 197.
[276] See Burke & Sheldon (2010), p. 16.
[277] See Ritch & Brennan (2010), p. 406.
[278] See Churchman & King (2009), p. 510.
[279] See Hoffmann (2011), p. 18; Schiele et al. (2012), p. 11.

The core principle of the world café is that conversation takes place in groups of four to five people seated at tables, where statements and ideas arising during the conversation are written down on a sheet of paper. Groups stay together for around 20-30 minutes, then the participants change tables, while one person at each table stays to introduce the results of the previous round to the new one (see Figure 6).[280] In the end, the insights from all tables are consolidated and validated with the entire group. It is possible to explore one and the same question at all tables or to present different problems.[281] The effect of this way of exchanging ideas from different viewpoints is that thinking is stimulated, perspectives connected[282] and hierarchies which might exist between participants are levelled out.[283]

The world café conducted followed the example of Hoffmann (2011) and the advice of Schiele et al. (2012): After a presentation of the five innovation methods and the world café principles, the sixteen participants were divided into three groups. Discussions took place in three rounds of 25 minutes each under the lead of moderators, which were not recruited from among the participants but from the product management department hosting the workshop.[284] As five methods had to be deployed to the three tables, the lead user method was chosen for individual discussion due to its complexity. Instead of using table cloths, large sheets of paper were hung to the wall to ease reading the notes. Apart from these changes, it was tried to stay close to the seven design principles set up by the developers of the method:[285] Participants came from different units and hierarchies (see Figure 5 [redacted]) and the meeting room was made hospitable with biscuits, coffee and cold beverages. The discussions dealt with two questions: What are advantages and disadvantages of the five methods, and how could they be set up at STILL? Their high relevance for the audience was indicated by the fact that of eighteen invitees only four declined due to vacations, of which two sent substitutes. Participants were asked to build on each other's contributions, and in the end, all results were presented by the moderators and rated by the participants with stickers in order to share and harvest results.[286] For the rating, each participant distributed five stickers among the methods, allowing a strong preference for a single method as well as no preference for any of them.

[280] See Schieffer et al. (2004a), p. 3.
[281] See Tan & Brown (2005), p. 88; Latham (2008), p. 10.
[282] See Ritch & Brennan (2010), p. 406.
[283] See Tan & Brown (2005), p. 86.
[284] See Schiele et al. (2012), p. 16.
[285] See Schieffer et al. (2004b), p. 4; Brown & Isaacs (2007), pp. 43–44.
[286] See Schiele et al. (2012), p. 17.

Figure 5: Participants' functional units
Source: Author's illustration

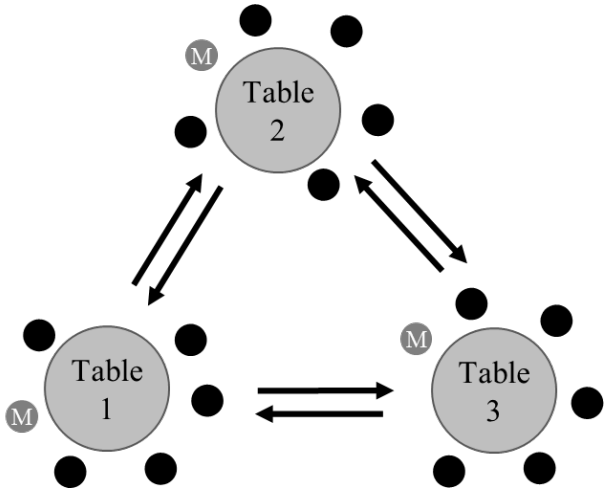

Figure 6: World café principle
Source: Author's illustration based on Hoffmann (2011), p. 20

The combination of interviews and world café was chosen after considering alternatives: An evaluation of the innovation methods could have been done in interviews as well; however, this way the methods had to be presented to each interviewee individually, and the different perspectives had to be connected by the researcher without the possibility to directly discuss and build on each other's ideas. Alternatively, a different workshop approach could have been chosen, for instance with a plenary discussion of each innovation method. Given the high number of participants required, the speaking time for each of them would have been shorter, and similar to focus groups such discussions are subject to the risk that some participants dominate the discussion and others do hardly bring in their perspective.[287] In contrast, the small groups used in a world café provide better chances of balanced and more intensive participation.[288] However, a disadvantage of both world café and focus groups is the need to bring together many people at one date.

For the as-is analysis, more structured interviews were considered but rejected due to the high diversity among the interview partners. Participant observation of the current use of certain methods, such as focus group sessions or workshops, was also taken into consideration, but could not be realised as such activities did not take place during the analysis phase of the research. Historical analysis would have been an option [redacted], but documentation was not available anymore.

[287] See Fern (1982), p. 2.
[288] See Ritch & Brennan (2010), p. 408.

4.3 Using a single case study to derive managerial and research implications

The thesis is design-oriented and set up as a single case study, as its main purpose is to study the situation of the focal company in detail and give sound recommendations. At the same time, it has an exploratory character, since it aims at identifying methods that, if used, are expected to lead to higher levels of company innovativeness as well as selection criteria for these methods. STILL is, with regard to the company's structure, size, products and strategy, a typical German manufacturing firm.[289] Although its orientation towards innovation might be somewhat stronger compared to its competitors, it can therefore be considered a typical case in the sense of Yin (2009), making the findings of the study informative for many similar companies as well.[290] However, as the impact of implementing the recommendations cannot be tested in this thesis due to constraints in time and scope, no direct link between method use and innovativeness can be established. To make the results of the study relevant to other cases despite this shortcoming, much attention was paid to increasing scientific rigor. Yin (2009) has established four criteria for assessing the quality of case study research: Construct validity, internal validity, external validity and reliability.[291] As internal validity does apply to explanatory studies only, it was tried to fulfil the remaining three as far as possible.

In order to increase construct validity, a criterion judging to what extent a measurement does capture the phenomenon it intends to capture, several measures were taken based on the recommendations of Yin (2009). First of all, multiple sources of evidence were used, allowing for triangulation:[292] When analysing the current situation, interviews were complemented with company documents (for instance, process descriptions, meeting minutes, presentations, transcribed interviews from an earlier thesis). Additionally, interviews were held with informants from different units and hierarchy levels in order to gain insights into a multitude of perspectives. By using the world café approach in assessing suitable idea generation methods, the same principle was applied, as again participants of multiple functions and hierarchies did discuss the methods from different angles. Using the world café, the two other principles for increasing construct validity are applied as well: As participants can build on the thoughts of each other in an iterative process, a chain of

[289] Cf. chapter 3.1
[290] See Yin (2009), p. 48.
[291] See Yin (2009), p. 41.
[292] See Eisenhardt (1989), p. 537; Yin (2009), p. 42.

evidence can be established; by summarising and collectively discussing the findings in the end, informants have the chance to review the results which build on their input.[293]

External validity, the degree to which findings can be generalised to other cases, is naturally limited in a single case study. However, it was tackled in two ways: Firstly, the thesis and its findings are theoretically grounded as they build on a thorough literature review, following the advice of Yin (2009).[294] Secondly, the fact that the focal company forms a typical case in the manufacturing industry also increases the generalizability of findings.

Reliability refers to the degree to which it can be expected that a replication of the study, possibly conducted by a different researcher, would yield the same results and conclusions. To satisfy this criterion, a comprehensive case study database was compiled to document the procedures used and the data they provided. The data stored includes a list of interview partners, the respective interview guides as well as recordings of the interviews (for those interviews where the partners agreed on recording) and the company documents that were used to complement the interview results. From the world café workshop, the introductory presentation, photographs of the notes taken and the rating as well as audiotapes of eight of the nine discussion sessions (in one session, the recorder did not work) with short transcriptions and coding scheme are available. All material not included in the appendix is available from the author upon request, as long as a transfer is not hindered by confidentiality considerations.

To analyse the interviews, these were not fully transcribed, but analysed in a simple open coding approach described by Quinlan (2011): While reviewing audiotapes and notes, key ideas were noted, connected and condensed [redacted]. The occurring themes were organised in a matrix spanned by themes and respondents to see parallels and contradictions.[295] Similarly, the advantages and disadvantages brought up during the world café workshop were coded looking for recurring themes the arguments could be linked to [redacted]. These were then grouped, leading to a set of criteria the methods can be evaluated with in other contexts as well. Ideas on the implementation were collected as key sentences and described narratively [redacted]. In discussions with the thesis principal and two managers of product management, these were then reviewed and realisation sketches were drafted.

[293] See Schiele et al. (2012), p. 26.
[294] See Yin (2009), p. 44.
[295] See Quinlan (2011), p. 426.

5 Results

5.1

[redacted]

5.2 First ideas on implementation as starting point for recommendations

[redacted]

[redacted]

[296] See Meyer (2012), p. 178.256.

5.3 Implementation options and selection criteria deducible from workshop results

[redacted]

[redacted]

As an additional outcome of the workshop, the arguments brought up and outlined in chapter 5.1 can be clustered in order to arrive at a set of properties of the innovation meth-

[redacted]

ods that appear to be relevant for selection. Twenty of such criteria have been identified, which can be grouped into seven areas (see Table 2 for an overview [redacted]): Most arguments dealt with the characteristics of the expected results, such as their expected degree of innovativeness, their value and the time needed to develop a marketable product from the method output. Methodological issues like complexity and risk of failure were also brought up frequently. Customer relationship issues, as for instance business development potential or potential risks for the relationship, as well as applicability considerations in terms of possible search fields and breadth of questions to be covered were the next frequent criteria. Most seldom, arguments relating to the expected effort, utilisation of existing resources and methodological rigor were brought forward.

Criterion **Sub-criterion**	**Number of arguments / statements**
Expected results	21
Degree of innovativeness	9
Value / quality	6
Type of result	4
Time-to-market	2
Methodology characteristics	15
Risk of failure	8
Complexity	3
Suitability for idea selection	2
Synergies with other methods	2
Customer relationship issues	11
Effect on customer relationship	8
Business development potential	2
Spillover risk	1
Applicability	8
Breadth of issues that can be covered	5
Applicable search fields	3
Effort	5
External	3
Internal	2
Rigor	5
Input basis	3
Level of systematisation	2
Utilisation of existing resources	4
Customers	2
Knowledge	1
Staff	1

Table 2: Criteria and sub-criteria with frequency of use during the world café

Source: Author's illustration based on world café workshop [redacted]

6 Design proposal:

6.1

[redacted]

[redacted]

6.3 [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

7 Discussion: Market-based high-degree innovation possible, but not trivial

7.1 Balanced and structured front end set-up outlined by the thesis

This thesis set out to find ways of capturing market-based opportunities and ideas for new products with a high degree of innovativeness for the case company. A review of the literature provided empirical backing for the importance of innovativeness and market orientation as well as of the front end of innovation for product success. Among the manifold methods available for opportunity recognition and idea development, a cross-section of available studies showed that the lead user method, customer focus groups, ethnography, scenario technique and scouting can be expected to provide the best chances to find the seeds for high-degree innovations. Analysing these five methods from the perspective of a medium-sized manufacturing company led to a comprehensive set of advantages and disadvantages for each of them. Additionally, many of the method characteristics were confirmed by the practitioners.

7.2 [redacted]

[redacted]

Other companies aiming at improving their market-based innovativeness can use this thesis as an inspiration in different ways: First of all, it provides a set of methods for high-degree, market-based innovation that can serve as a starting point for selection. Directions for improving the chances to find high-degree innovations with these methods by abstracting, using unusual data sources and widening the search fields have been outlined. Moreover, not only a set of practitioner-based criteria to be evaluated when choosing suitable methods is provided, but also manifold ideas on how to actually implement these can be found. A comparative overview of the five methods discussed in this thesis can be found in Table 5:

Using the criteria identified as relevant for STILL, managers from other companies might be able to use this overview for a first assessment of the five methods for their situation.

	Lead user	Scenarios	Scouts	Ethnography	Focus groups
Expected results					
Degree of innovation	very high	very high	high	high	rather low
Value / quality	high potential for long-term cooperation	good decision basis, shows interdepend-encies	broad basis for idea gen-eration	high customer value	cross-pollination of different backgrounds
Type of result	ideas, concepts	opportunities	opportunities	opportunities	ideas, opportunities
Time-to-market	rather low	very high	high	moderate	moderate
Methodology characteristics					
Failure risk	very high	high	moderate	moderate	moderate
Complexity	high	very high	low	moderate	moderate
Suitability for idea selection	partly (takes place during workshop)	yes	no	no	yes
Synergies with other methods	none	follow-up with scouts	input for scenarios, lead user	input for focus groups	participant selection for lead user
Customer relationship issues					
Effect on customer relationship	potentially positive	none	none	customer acceptance necessary	potentially positive
Business development potential	high	low	low	moderate	moderate
Spillover risk	existing	low	low	low	existing
Applicability					
Breadth of issues that can be covered	search field defined in the process	very broad	fine line between breadth and focus	defined field, potential for unplanned discoveries	narrow, defined fields
Applicable search fields	no specific ones	no specific ones	services	processes, problems	no specific ones
Effort					
External	moderate	high	none/low	moderate	none/low
Internal	high	high	very high	moderate	moderate
Rigor					
Input basis	rather small	very broad	broad	small	rather broad
Systematisa-tion	high	very high	low	moderate	moderate
Utilisation of existing resources					
Customers	yes			yes	yes
Knowledge		yes			
Staff			yes		

Table 5: Summary of method characteristics

Source: Author's illustration based on world café workshop [redacted]

The advantages and disadvantages presented for each method also add to the insights provided by prior research: [redacted] Additionally, the results indicate that a focus on individual methods might be too narrow and that combining a set of compatible methods can be more promising. Taking these implications into account, the thesis contributes to closing the practice-academia gap in research on managing the front end of innovation.[302]

7.3 Larger samples required to back up results and establish performance links

The results of this thesis are built on a strong theoretical basis, and many of the method characteristics provided by literature were confirmed by the practitioners involved. However, all data collected is based on one case only, and the method ranking as well as the arguments presented can therefore not be generalised. Although the selection of methods for assessment has been based on prior research, there are many more methods which come into question – without the chosen upfront filter, the results were even stronger. Another limitation of this work is that the implementation of the proposed set-up is still to come, so that the results cannot be measured. A longitudinal design could have evaluated the number and quality of collected ideas over time and could have drawn conclusions on the effect which the utilisation of a certain method has on these measures. Regarding the workshop results on the methods, a certain degree of bias is introduced by the fact that the lead user method was discussed more extensively than others. Additionally, the work was conducted by a researcher inexperienced in qualitative research, and the collected data was analysed by one researcher only, adding further sources of bias.

Not only these limitations call for further research: Except for the lead user method, little empirical findings on performance and innovativeness of the results are available so far. In a very comprehensive manner similar to Lilien et al. (2002), the commercial success of ideas found and the effort needed when using the different methods could be assessed;

[302] See Backman et al. (2007), p. 18; Börjesson & Elmquist (2011), p. 172.

alternatively, the number and perceived quality of ideas could be measured. Further research with larger samples could also verify the criteria found for method selection in other organisations and establish an importance ranking in order to give practitioners a more solid base for their choice. The result that a combination of methods is expected to be significantly more effective than any isolated one can as well be a fruitful hint to be picked up by future research: So far, methods have solely been discussed individually, and not in linkage with others. In the same vein, it might be a profitable endeavour to discuss the suitability of certain methods for the different front-end stages in a more structured way in order to find reasonable method combinations. [redacted] It might also be a hint that successful implementation of certain methods is dependent on the development stage and professionalism of a company's innovation management activities; a state that has been termed "maturity" in other contexts.[303] [redacted] If further research was to establish a set of maturity levels and advice for practitioners on how to classify the own organisation, suitable methods to be used might be directly deducible.

[303] See Schiele (2007), p. 274.

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Index of Annexures

Annexure 1: Full list of methods mentioned in selected articles

O'Connor (1998)	
Method	*Counted as*
Library sources	
Contact key users	(Lead user method)
Focus groups	Focus groups
Concept tests	
Revealed preference	
Futures, trend analysis	Scenario technique
Vision, imagine	Scenario technique
Direct observation	User observation / Ethnography
Engineering analyses, lab experiments	
In-house demos	
Professional conferences	(Technology scouting)
Informal internal network (SBU's)	
Rely on OEM	
Use customer as development partner	Lead user method
Use beta site to get reaction: early prototype	(Probe and learn)
Sell 'nickel bags'	
Hire MR firm, buy MR reports	
Add team member with market/sales experience	
Org. Structure: Manager, Commercial development in R&D	

Deszca, Munro and Noori (1999)	
Method	*Counted as*
Diffusion models	
Visioning techniques	(Scenario technique)
Lead user analysis	Lead user method
Empathic design	User observation / Ethnography
Experimental marketing	Probe and learn
Customer immersion sessions	(Focus groups)

Steinhoff (2006)	
Method	*Counted as*
Qualitative / explorative methods (e.g. focus groups)	Focus groups
Methods for future analysis (umbrella-method based on scenario technique)	Scenario technique
Ethnographic methods, esp. empathic design	User observation / Ethnography
Simulation techniques, esp. information acceleration	
Intensive collaboration with selected	Lead user method

customers, esp. lead users	
Iterative experimentation, esp. probe and learn	Probe and learn

Cooper and Edgett (2008)	
Method	*Counted as*
Ethnographic research	User observation / Ethnography
Customer focus groups for problem detection	Focus groups
Lead user analysis	Lead user method
Customer or user designs	
Customer brainstorming	
Customer advisory board or panel	
Community of enthusiasts	
Partners and vendors	
Soliciting the external scientific/technical community	Technology scouting
Invite external finished product designs	Technology scouting
External submission of ideas	
External idea contest	
Peripheral vision	(Scenario technique)
Disruptive technologies	
Patent mapping	
Idea capture internally	

Nicholas, Ledwith and Bessant (2013)	
Method	*Counted as*
Sending out scouts	Technology scouting
Exploring multiple futures	Scenario technique
Using the web	
Working with active users	Lead user method
Deep diving	User observation / Ethnography
Probe and learn	Probe and learn
Mobilizing the mainstream	
Corporate venturing	
Corporate intrapreneuring	
Brokers and bridges	
Deliberate diversity	
Idea generators	

A3

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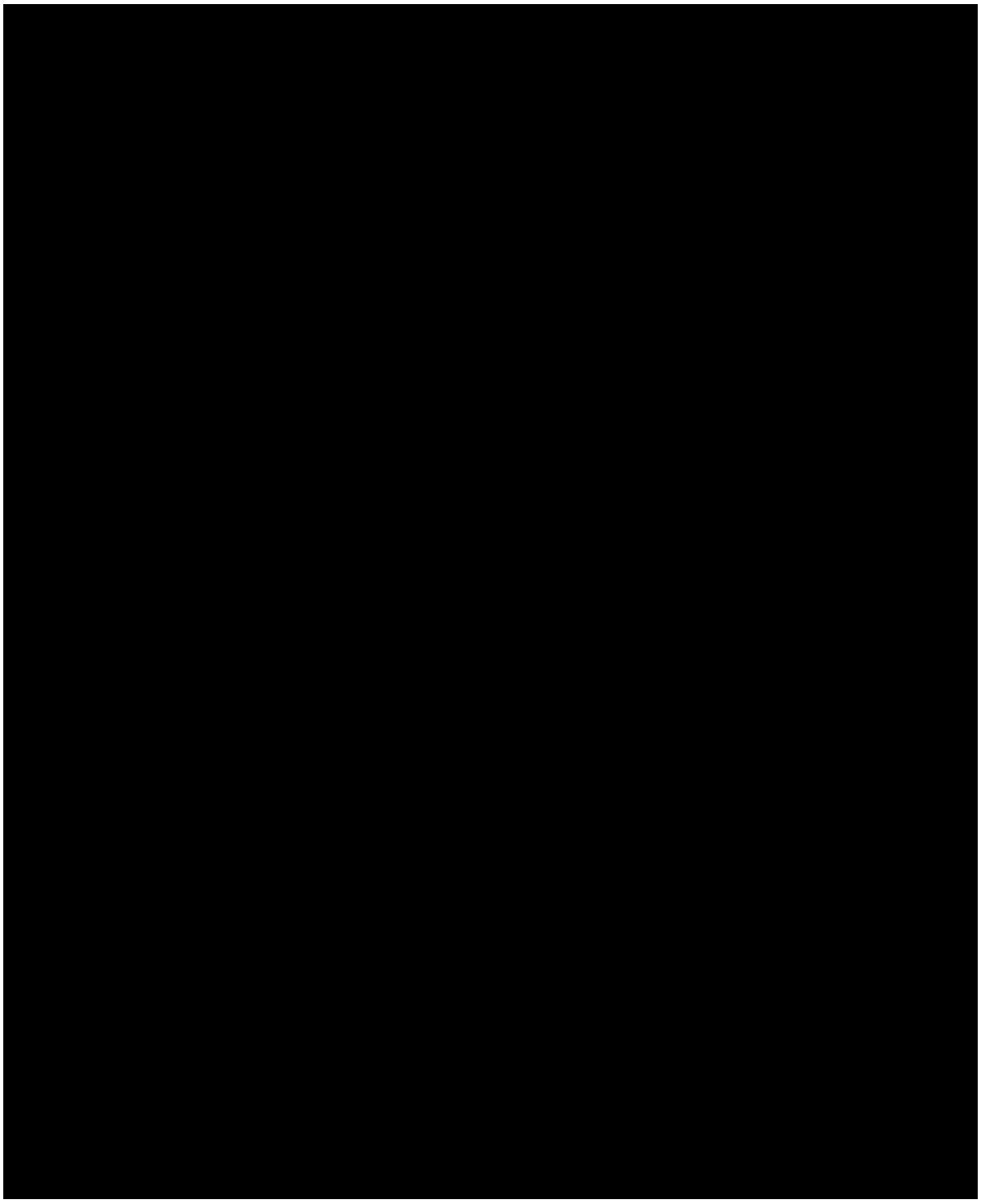

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