

Corporate Foresight: Its Three Roles in Enhancing the Innovation Capacity of a Firm

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Abstract – Although in the last three decades much knowledge has been produced on how best to conduct foresight exercises, but little is known on how foresight should be integrated with the innovation effort of a company. Drawing on empirical evidence from 19 case studies and 107 interviews, we identify three roles that corporate foresight should play to maximize the innovation capacity of a firm: (1) the strategist role, which explores new business fields; (2) the initiator role, which increases the number of innovation concepts and ideas; and (3) the opponent role, which challenges innovation projects to increase the quality of their output.

Keywords: corporate foresight, innovation management, technology intelligence, competitive intelligence, best practices, dynamic capabilities

1 INTRODUCTION

When asked about the direction research on foresight should follow, scholars come to different conclusions. Some argue that new tools are needed [1]. Others point to the lack of help for practitioners to find the right tools [2], concluding that education is needed to create foresight literacy [3, 4]. A third group highlights the need to develop mechanisms to allow for more participation of stakeholders [5-7] and thus increase the impact of foresight activities [8-13].

This paper agrees on the importance of these suggestions, but argues that none of them can ensure the success of foresight exercises in a corporate context. This article argues that it is important to view matters from the perspective of the users of the results of corporate foresight exercises. Only then will it be possible to create a holistic understanding of possible impacts and drive the discussion on how to use foresight to create value and increase the competitiveness of a firm.

Based on our literature review in the strategic management field, we argue that corporate foresight should be expected to support the renewal of the portfolio of strategic resources. These strategic resources have been highlighted as the basis of the competitive advantage of a firm [14]. The ability to renew the portfolio of strategic resources when faced with external (discontinuous) change has been described as 'dynamic capabilities' [15]. We therefore propose to judge corporate foresight on its contribution to this ability.

More specifically we aim to explore the ability of corporate foresight to increase the innovation capacity of a firm. We differentiate into the capacity to innovate incrementally, i.e. enhanced or new products and services within current business field and the capacity to innovate radically, i.e. creating products and services in new business fields often using new technologies.

The literature review provides guidance to observe the impact of corporate foresight on the innovation capacity of a firm.

To explore the impact of corporate foresight on the innovation capacity we collected empirical evidence from 19 multinational companies. Of a total of 107 interviews, 42 were conducted with internal stakeholders, generating insight into how foresight results are used within the company. Through cross-case analysis, we are able to create an understanding of the ways in which corporate foresight activities can contribute to the innovation capacity of a firm.

2 LITERATURE REVIEW

2.1 Creating and sustaining a competitive advantage

Research following the resource-based view has shown that companies use certain strategic resources to out-compete their rivals. To be of competitive value, these resources need to have three characteristics. They should be (1) appropriable—i.e., difficult to imitate, substitute, or transfer; (2) scarce; and (3) in demand—i.e., the resource needs to yield a competitive advantage [14].

Research on dynamic capabilities has shown that these resources lose their competitive relevance over time [16-18]. Thus, companies need to develop new resources in order to maintain their competitiveness [15, 19]. This renewal of resources needs to follow the rate of corporate change, which has been shown to occur in long periods of slow, incremental change and short periods of rapid discontinuous or radical change [20-22].

Studies have repeatedly emphasized that companies find it difficult to adapt quickly enough in times of discontinuous change and can find themselves in life-threatening situations [23-25]. One study calculated the average life expectancy of Fortune 500 companies to be less than 40 years. This high mortality rate was the result of their failure to adapt in a timely manner to discontinuous change [26].

2.2 Why firms find it difficult to renew their products and organizations

Research on innovation management, strategic management, and corporate foresight has pointed to three major reasons why companies fail to adapt to external change in an effective and

timely manner:

First, the high rate of change: In the past three decades, various empirical investigations have been conducted to prove the normative perception that the rate of change is increasing. Some evidence has been identified, for the following:

- Shortening of product life cycles [27, 28]
- Increased technological change [29]
- Increased innovation speed [30-32]
- Increased speed of the diffusion of innovations [33]

Second, ignorance: Many organizations fail to perceive discontinuous change. This ignorance has been attributed to four underlying reasons:

- *A time frame that is too short*, so that the corporate strategic-planning cycles, which are still coupled with the fiscal-year cycle, fail to produce a timely response [34].
- Announcing signals may stay undetected because they are *outside the reach of corporate sensors*. This failure has been attributed to the nature of corporate sensors, which need to focus on a search area and thus by their very nature leave spaces undetected that are at the periphery of the search focus [35-37].
- Top management suffers from an overflow of information and *lacks the capacity to assess the potential impact* of the issue at hand [38, 39].
- *Information does not reach the appropriate management level* that can understand the impact of an issue and/or that has the hierarchical power to decide on appropriate actions [40].
- *Filtering by middle management*, which may follow its own agenda, aiming, for example, to protect its own business unit [41].

Third, inertia: If a company has perceived a change in the environment with a potentially high impact, it needs to (1) define and plan appropriate actions and (2) implement them. Research has

pointed to four underlying reasons for the inertia of large companies:

- *Complexity of internal structures*. Most large companies have to deal with two types of complexity: regional reach (forcing firms to build complex multinational sales structures) and product range (forcing firms to build, for example, regionally differentiated product portfolios) [42].
- *Complexity of external structures*. In recent decades, cost pressure has forced companies to outsource parts of their production to other companies and thus forced them to build complex supply-chain networks in which they are bound to several companies [43-45]. Today, this networking with other companies has reached beyond supply chain and production to include research [46] and strategic new-product development [47].
- Large companies have built structures that protect and reinforce their successful lines of business. The downside of these protective structures is a *lack of willingness to cannibalize* that prevents the initiation of activities in new business fields [48-52].
- The current technological capabilities of companies lead to a *cognitive inertia* that inhibits them from perceiving external technological breakthroughs [53].

2.3 *What we know about the capabilities needed for managing discontinuous change*

Research on how organizations can successfully manage discontinuous change has been approached from three research perspectives: (1) strategic management, (2) innovation management, and (3) managing the future.

The *strategic management perspective* assumes that when faced with external change organizations can alter, and indeed have to alter, their strategy and organization [54, 55]. It has been shown that environmental scanning is needed to create sound, up-to-date knowledge about the direction and magnitude of emerging external change [24, 56-58]. This task is particularly challenging, because corporate change is characterized by long periods of slow, incremental change and short periods of rapid discontinuous or radical change [22, 59]. Thus, companies need two types

of capabilities:

- The ability to adapt incrementally and exploit current business in times of incremental change
- The ability to adapt radically and explore new markets and business opportunities in times of

discontinuous change

For the ability to simultaneously exercise both abilities, the term organizational ambidexterity has been proposed [60-63].

The *innovation management perspective* incorporates research streams that discuss similar concepts. Research has explored the ways in which companies can gain and maintain a competitive advantage in times of discontinuous change by

- Acquiring *new technologies* [64-66]
- *Linking emerging technologies* to new customer needs [52, 67]
- Initiating new *R & D projects* to use the window of opportunity created by the

discontinuous change [68, 69]

- Promoting specific *personal traits on radical innovation teams* [70]
- Finding and binding *promoters and champions of radical innovations* [71]
- Building *separate organizations for developing radical and incremental innovations* [72]

In addition, the concept of *absorptive capacity* enlightened companies on how they can develop their ability to acquire new capabilities and use them to create a competitive advantage [73-75]. Similar concepts such as *network competence* explain the development and exploitation of innovation networks from the perspective of a focal firm [76, 77]. More recently, the network and collaborative innovation perspective were merged under the term *open innovation*. The term has been used to express the ability of an organization to sense change and acquire needed capabilities [78-80].

The *managing the future perspective* aimed at identifying methods to systematically explore

the future. In the corporate context the assumption is that change occurs slow enough so that future researchers will detect it in time and the firm can produce adequate responses (even though the response can be expected to be slow) [81, 82]. In the 50s up to the 80s future research aimed particularly at forecasting future developments by using s-curves, mathematical modeling, and Delphi studies [83-85].

In the 1990s, the limitations of forecasting became apparent, and future research moved away from attempting to predict the future toward identifying *possible, probable, plausible, and preferable* futures [9, 86, 87]. Future research today aims more at discovering undetected currents that will influence the future and at mapping uncertainty by including potential discontinuities [88-90].

Exceptions to this rule can be found, particularly within the national foresight programs. These continue to aim at identifying the technologies that yield the greatest economic and social benefit in order to then provide additional research funding to foster their development [2, 91, 92]. But even in national foresight activities, a gradual move toward more qualitative analysis such as scenarios or visions has been reported [9, 93].

Concerning the application of future research in the corporate context, it has been emphasized that it needs to be further integrated into the company's process landscape and organizational structure to create an impact and add value [94].

The review of past research has revealed several recommendations on how to manage discontinuous change. It has also confirmed that the goal of explaining the way in which a stable, integrated, and comprehensive future-oriented management system can be built has not been reached.

One reason is that the three research perspectives have largely failed to build on one another. There remains a lack of cross-referencing among scholars of strategic management, innovation management, and managing the future. Another reason is the cross-functional nature of future orientation. In management practices, the role of scanning for external change on emerging change is

assumed by different functional units, including strategic management, R & D, corporate development, and controlling. This makes it difficult for scholars to find appropriate informants on the future-oriented management systems of a firm.

3 RESEARCH DESIGN

The objective of this research, therefore, is to help increase the implementation of corporate foresight in companies. More specifically, the aims are to broaden knowledge of (1) the impact and value creation of corporate foresight and (2) its role in enhancing the innovation capacity of a firm.

3.1 Research strategy

For research fields that are relatively new and about which the knowledge is limited, a qualitative research design is recommended [95-97]. Case studies are particularly suited to ensuring a strong qualitative base on which to produce useful and valid theory, while reducing the risk of oversimplification associated particularly with quantitative research based on statistical modeling [98, 99].

In our study, we used a multiple case-study design for its strength in developing theory which is more robust, more generalizable, and better testable than that of a single case study [100].

3.2 Sample and case selection

In case-study research, each case should be selected for a special purpose and contribute to answering the research question in different ways [95]. Case-study research follows a theoretical sampling logic. The sampling is unlike that of large-scale statistical research not driven by achieving a representation of the whole population [96, 100]. Cases are chosen and added to the sample for replication, extension, contrary replication, and elimination of alternative explanations of a phenomenon [100].

Because we aim to define a maturity model that can be applied to any organization, we aimed

for a high level of generalizability. For that reason, this study uses companies that are different from each other in *industry* and *position in the value chain* and from their primary *business driver*, which can be either *technology* or the *market*. This made it possible to discover new phenomena (extension), to search for the same phenomenon in different companies (replication), and to check the limits of application by finding cases in which the particular element of a corporate foresight system is not being used (contrary replication).

The focus of the study was on five case-study clusters (see Table 1). In these clusters, the identified phenomena have been described and compared using replication and contrary-replication logic. After studying and interpreting the cases within the five clusters, we conducted two additional cases to extend the data on particular phenomena.

Table 1: Case study sample

<i>Company</i>	<i>Industry</i>	<i>Country</i>
Deutsche Telekom	ICT (Operator)	Germany
Telekom Austria	ICT (Operator)	Austria
British Telecom	ICT (Operator)	United Kingdom
Telefonica	ICT (Operator)	Spain
Volkswagen	Automotive (OEM)	Germany
Continental	Automotive (Tier-1)	Germany
ThyssenKrupp Automotive	Automotive (Tier-2)	Germany
Philips	Electronics (Manufacturer)	The Netherlands
Osram	Electronics (Manufacturer)	Germany
Bosch Siemens Hausgeräte	Electronics (Manufacturer)	Germany
Infineon	Electronics (Manufacturer)	Germany
Vattenfall Europe	Energy (Producer)	Sweden
Endesa	Energy (Producer)	Spain
Iberola	Energy (Producer)	Spain
EDP	Energy (Producer)	Portugal
General Electric Energy	Energy (Manufacturer)	United States
MAN Turbo	Energy (Manufacturer)	Germany
Deutsche Bank Research	Finance (Service)	Germany
Hugo Boss	Fashion (Manufacturer, Retailer)	Germany

In the case of the Deutsche Bank Research (the research unit of the financial institution) the focus was on observing a specific way of using scenario analysis. At Hugo Boss, the aim was to study a specific approach of customer foresight, which has been identified in the Volkswagen case.

3.3 *Data-collection instruments*

Regarding data collection, it is important to use several sources of evidence to ensure the triangulation of information [95, 101]. For data collection, many instruments are available, among them documents, archival records, interviews, direct observation, participant observation, and physical artifacts [95].

Interviews are particularly useful when the aim is to investigate strategic phenomena, where informants need to reflect on their everyday practices [100]. In comparison to other instruments, interviews are also more flexible, allowing researchers to adapt to the context of the interviewee and the company.

The study uses four *data collection instruments*. The three major instruments are *interviews*, *internal documents*, and *external academic publications* by the foresight manager. In addition to these classic instruments, *interview templates* have been used to allow for direct validation of our interpretation of the responses during the interviews.

- The *interviews* were guided semi-structured and supported by templates that were filled in with the informant. This made it possible to structure the interview but provided enough flexibility to follow up on any new phenomenon that was brought up during the interview. In total, 107 interviews were conducted. At the start of each interview, the informant was asked for permission to record the conversation to prevent data loss and increase validity [102, 103]. This made it possible to record 80% of the interviews, all of which have been transcribed. Interviews that were not recorded were documented with the interview templates and by minutes of memory, which were cross-checked by a second researcher. Each interview lasted from one to two hours. In each interview, the research

objective, research framework, and key concepts were described in order to avoid misunderstanding. To enhance the objectivity of context analysis, a standardized questionnaire was used. This questionnaire consisted of four sections: (1) company profile, (2) nature of strategy, (3) complexity of environment, and (4) volatility of environment.

- The *templates* were used to capture information such as organizational structures, innovation processes. They are a standardized form into which the informant draws or fills-in his or her data. The templates were refined and enhanced throughout the case-study phase. The latest version consisted of seven templates: (1) goals, (2) actors, (3) process, (4) methods, (5) organizational structure, (6) information sources, and (7) value contribution.

- The *internal documents* consisted mostly of presentations on processes, results, and the working documents of foresight projects. In addition, organizational charts, annual-report presentations, and general company presentations were collected for analysis of the company's context.

- In some cases, companies provided academic *publications* on their management practices. These were primarily used for clarification and for understanding the logic behind their practices.

The amount of data collected in the case studies varied, as the research aim was not to compare the case studies but to ensure the identification of as many aspects as possible. In Table 2, an overview of the number of *data sets per case study* is given.

Table 2: Data structured by case and collection instrument

<i>Cases</i>	<i>Data collection instruments</i>			
	<i>Interviews</i>	<i>Internal Documents</i>	<i>Publications</i>	<i>Templates</i>
Deutsche Telekom	26	8	4	19
Telekom Austria	12	1	0	11
British Telecom	3	3	2	0
Telefonica	2	1	0	1
Volkswagen	9	3	2	0

<i>Cases</i>	<i>Data collection instruments</i>			
	<i>Interviews</i>	<i>Internal Documents</i>	<i>Publications</i>	<i>Templates</i>
Continental	3	2	3	2
TK Automotive	5	2	0	1
Philips	3	7	4	3
Osram	4	2	0	3
BSH	5	1	1	1
Infineon	2	1	0	0
Vattenfall Europe	10	4	0	10
Endesa	5	1	0	0
Iberola	2	0	0	0
EDP	3	0	0	0
GE Energy	6	0	0	0
MAN Turbo	2	1	0	0
Deutsche Bank Research	3	1	2	0
Hugo Boss	2	0	0	1
Total	107	38	18	51

It can be seen that a particular emphasis—in terms of amount of collected data—was put on the cases of Deutsche Telekom, Telekom Austria, Volkswagen, and Vattenfall Europe. The reason is that they were used for defining the initial version of the maturity model. The following cases were then used for validation and for identification of additional elements of foresight capabilities. Fewer data, therefore, were required.

3.4 *Key informants*

One methodological shortcoming of past research was an exclusive usage of foresighters (i.e., an employee whose job is to scan the environment for weak signals on change) as informants. This creates two concerns: First, the data could be subject to an informant bias, where the informant is overstating the impact of his work. Second, it is likely that only a limited range of foresight activities will be identified, particularly because it can be expected that in an organization several units carry out such activities and, as we have seen in our research, they are not necessarily aware of each other.

Our strategy to overcome this shortcoming was to use three informant perspectives: that of the internal customer, that of the corporate foresight activity manager, and that of the corporate foresight activity team.

- The *internal customer* is the person who uses foresight results (i.e., information on emerging change) to plan and execute actions to counter threats and seize opportunities. He is the key informant for value creation and context aspects. In addition, he can report on the capabilities from a more objective perspective, i.e., he will most likely have a reduced fake-good bias, as he is not reporting on the results of his own work.

- The *activity manager* is the person in charge of the corporate foresight activity. He is not necessarily the person who executes the activity. The activity manager is the key informant for explaining the motivation, goals, and logic of the corporate foresight activity as well as the organizational setting and characteristics of the foresighters (i.e., the activity team) on his team or in the company in general. He may also be a good informant for the capabilities if he has enough knowledge of the actual execution of the activity.

- On the *activity team*, informants were questioned who are executing corporate foresight activities. They are the key informants on information usage, methods, and networks. Their reporting on value creation may be subject to the fake-good bias and was considered with care.

Particular emphasis was put on recruiting a high number of informants with the internal-customer perspective. The number of informants per case and perspective is given in Table 3.

Table 3: Interviews structured by case and position of informant

<i>Cases</i>	<i>Position of Informant</i>		
	<i>Internal Customer</i>	<i>Activity Manager</i>	<i>Activity Team</i>
Deutsche Telekom	19	5	2
Telekom Austria	3	4	5
British Telecom	0	1	2
Telefonica	1	1	0

<i>Cases</i>	<i>Position of Informant</i>		
	<i>Internal Customer</i>	<i>Activity Manager</i>	<i>Activity Team</i>
Volkswagen	1	3	5
Continental	1	1	1
TK Automotive	2	3	0
Philips	1	1	1
Osram	2	1	1
BSH	1	2	2
Infineon	1	1	0
Vattenfall Europe	4	4	2
Endesa	1	0	4
Iberola	0	1	1
EDP	2	1	0
GE Energy	1	5	0
MAN Turbo	1	1	0
Deutsche Bank Research	0	1	2
Hugo Boss	1	1	0
Total	42	37	28

It can be seen that different emphases were made in different cases. For example, the Deutsche Telekom case was used primarily to explore the usage of foresight results and their value creation, while GE Energy, Telekom Austria, and Vattenfall Europe were used to thoroughly investigate how organizations identify and interpret weak signals on emerging change.

3.5 *Data reduction and coding*

The large amount of data gathered in a case study poses a challenge to researchers. The data need to be reduced in number in order to be crisp and to allow focused conclusions to be derived [104]. At the same time, the data need to be rich and extensive enough to allow for an adequate account of contextual information [105]. In this study, the transcripts alone run to more than 1,600 pages, and additional data from internal presentations, publications, and templates add another 500 pages. To handle so much data, electronic text-analysis software is recommended. For our research,

we used the qualitative research tool NVIVO 8. This software makes it possible to store any kind of document and organize it by information source and content.

To make sense of the data, it is recommended that one use a category system for coding them—a process that involves attaching keywords (the codes) to words, sentences, or diagrams in the documents [106]. In this study, the system of codes was created both deductively from literature and inductively from collected data (defining new codes for interesting aspects that are identified while reading the documents).

To create confidence that a phenomenon can be generalized, it should be identified and named by more than one informant. The average number of informants who have commented on the elements of the maturity model is twenty-one, and the least referenced element was identified by three informants and explained in eight sentences. As most elements are based on a high number of accounts of independent informants (i.e. different companies and different industries), we are confident to have identified elements that are relevant for both the overall ability of corporate foresight and for firms in different context.

3.6 Drawing conclusions and verifying data

In case-study research, there are three options for drawing conclusions: first, follow a theoretical framework, second, identify and test rival explanations, and third, make a case description [95, 106]. This research uses the theoretical proposition that corporate foresight can enhance the innovation capacity. In addition, inductive reasoning is applied to create a category system that makes it possible to identify the impact of corporate foresight activities on innovation management. From this process, eleven major impacts of corporate foresight have been identified. These have been clustered in the next step into three groups, which have been translated into three roles.

For confirmation of the collected evidence, the transcripts have been sent to the informants for review. For validation of the interpretation and conclusion, we organized two practitioner

conferences in which the case study participants and additional companies had the opportunity to comment on the results. This feedback was used to refine and further specify the three roles.

4 RESULTS

Through cross-case analysis, we were able to identify three generic roles that corporate foresight can play to enhance the innovation capacity of a firm (see Figure 1).

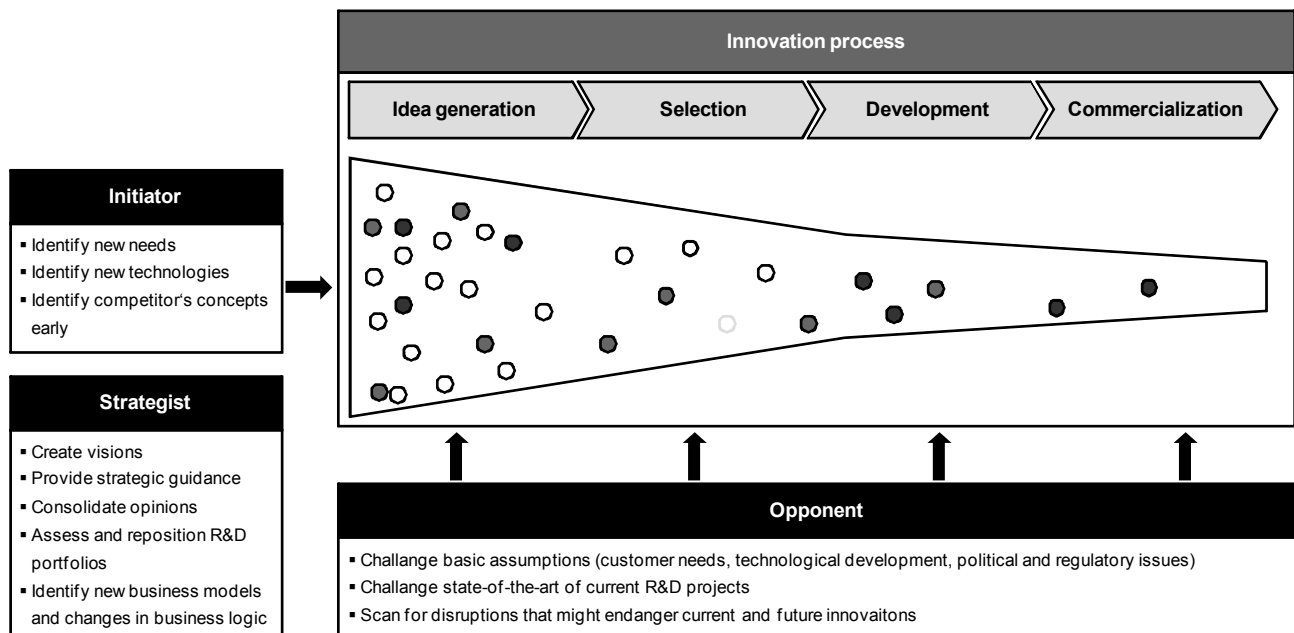


Figure 1: The three roles of corporate foresight in innovation management

Using a four-step innovation process as a frame of reference, the three roles can be positioned at the start of the innovation funnel (initiator role), outside the innovation funnel (strategist role) and along the innovation funnel (opponent role). Within these three roles, activities are conducted to boost the innovation capability of the company:

- In the *strategist* role, corporate foresight directs innovation activities by creating a vision, providing strategic guidance, consolidating opinions, assessing and repositioning innovation portfolios, and identifying the new business models of competitors.
- In the *initiator* role, corporate foresight triggers innovation initiatives by identifying new customer needs, technologies, and product concepts of competitors.

- In the *opponent* role, corporate foresight challenges the innovators to create better and more successful innovations by challenging basic assumptions, challenging the state-of-the-art of current R & D projects, and scanning for disruptions that could endanger current and future innovations.

4.1 *The initiator role*

From Figure 1, it can be seen that corporate foresight in the initiator role directly feeds into the innovation process. The *initiator* triggers new innovation initiatives, including new R & D projects and new process or business-model innovations. In so doing, he feeds the innovation funnel, which in turn is the basis for an increase in quantity and quality of innovative output.

Most companies that had a corporate foresight system with strong emphasis on the initiator role had also installed process links to the innovation process. Only two companies did not have a process link, preferring to communicate the insights through the Intranet, mailing lists, and a printed report. They aim to use corporate foresight for creating input but place the responsibility for taking action on the individual innovation managers.

Concerning the areas of foresight activity within the initiator role, three distinct input clusters have been found (see Table 4):

Table 4: Impact of initiator role

<i>Impact of Initiator Role</i>	<i>Description</i>	<i>No. of Quotes</i>	<i>Quotes</i>
Identify new needs	Socio-cultural change and/or change in customer needs generates new needs that will trigger innovation	123	<p>“In particular, I feel that we need to be dialogue-oriented. Just placing a questionnaire in front of the customer is not good enough.”</p> <p>“Today, products need not only to have a good usability; they need to be cool. I sell shampoo only through emotions; the ingredients are of no interest.”</p>
Identify emerging technologies	Scanning in science and technology enables companies to create new products and brace against disruptive and substitution technologies	84	<p>“We have ten strategic areas; in each, we define the reach, scope, and technology surveillance interest.”</p> <p>“Technology watch is a continuous process; it is used for R & D projects.”</p>

<i>Impact of Initiator Role</i>	<i>Description</i>	<i>No. of Quotes</i>	<i>Quotes</i>
Identify competitors' concepts early	Monitoring activities of competitors is the basis for anticipating their future actions and planning the company's innovation activities.	56	"We need to be alert. There are constantly new business ideas and new start-ups. Technology foresight is easy for us, but exploring future changes by competitive intelligence is much more complex and much more difficult."

The most quoted impact is the identification of new *customer requirements* through analyzing cultural shifts and collecting the needs of lead customers. An example is a large scouting project conducted by Volkswagen. Motivated by dropping sales in the U.S. market, Volkswagen decided to move a team of 23 managers to the Los Angeles area for 18 months, to live and work there. The team was recruited from all relevant functional units in Volkswagen, among them R & D, after-sales service, marketing, sales, and controlling. As part of the project, the team conducted home stays in which they lived with the families of lead customers for two or three days, interviewed community leaders, and immersed themselves in the American way of life. The goal was to understand the specific requirements of the U.S. car customer. These projects led to the discovery of new requirements and future customer needs that were fed into the innovation process.

The second impact is the identification of *emerging technologies* by scanning the science and technology environment. In our sample of 19 companies, 13 have installed a continuous technology-scanning activity. A typical activity tracks between 200 and 400 technologies and assesses their maturity. A list is then produced of technologies in which the estimated time of technological maturity and the time for deployment in products are given. This allows the companies to link the planning of new product categories to future emerging technologies. This linkage is often supported by roadmapping workshops and/or IT-based road-mapping tools.

A third cluster of impacts is the identification of new *competitor concepts* by monitoring R & D projects, patenting activities, and the new product launch announcements of the competitors. Deutsche Telekom uses a network of scouts to monitor major competitors as well as the start-up

community in relevant fields. The scouting results are consolidated and published in a “Product & Service” Radar which features:

- A radar screen on which the competitor’s concepts are positioned in a grid structured into expected time to launch and application/business field
- A one-page description of the product or service concept
- A “tracker” that reports on major changes in the application fields

Respondents have noted that the initiator role has been crucial when dealing with new business fields and in times of discontinuous technological change. When aiming for incremental innovations in existing business fields, most informants judged it sufficient to rely on intelligence by business units.

4.2 The strategist role

The *strategist* role is not directly linked to the innovation process. It provides guidance for the innovation effort and directs innovation activity toward new and promising business fields. The strategist role has been created by clustering five distinct impacts, which are described in Table 5.

Table 5: Impact of strategist role

<i>Impact of Strategist Role</i>	<i>Description</i>	<i>No. of Quotes</i>	<i>Quotes</i>
Assessing and repositioning of innovation portfolios	Corporate foresight provides the future insights to change innovation portfolios.	68	“(Our technology intelligence) supports the analysis of our project portfolio.” “We use the information (from foresighting) for our product planning for the coming years.” “(On the basis of the foresight insights) we have changed the product portfolio in China and the United States and introduced four new cars in China and three in the United States.”
Providing strategic guidance	Future insights are used to define strategic directions.	58	“Our most important goal when we do scenario analysis is that we need an overall goal and strategic guidelines.” “This (scenario technique) allows you to . . . set the ship on a long-term course.”
Identifying new business models	Foresight exercises challenge current business models and	38	“(To engage) in value creation networks has been one of the major outcomes of the scenario

<i>Impact of Strategist Role</i>	<i>Description</i>	<i>No. of Quotes</i>	<i>Quotes</i>
	provide insights into alternatives.		project.” “The BlackBerry is an example (of a latent need) that no company has expressed the need for. But it is certainly a new trend to enhance an individual’s efficiency.”
Consolidating opinions	The process of creating future insights is often used to trigger discussion and consolidate opinions throughout the company.	30	“(The goal) is primarily to form opinions. That means we throw something to the people and leave them alone with it.” “(The goal is) to consolidate an internal market view (with our market forecasts).”
Vision creation	Corporate foresight creates pictures of the future to create a common understanding of future directions.	23	“With future topics, there is no certainty. And that is why you gain safety if you stay unspecific, if you describe (the future) in a picture and not in a precise mathematical description.”

The first cluster is the impact of supporting the *strategic review of R & D portfolios*. In the foresight activity, emerging innovation opportunities are identified and compared with current R & D priorities and budgets. If realignment is needed, the foresight activity provides the needed arguments for taking the decision of re-allocating R & D investments. For example, the scouting activity of Volkswagen also revealed that the current car models in the U.S. market were mostly outside the so called “sweet spots,” with the highest demand. This foresight insight was the basis on which to introduce three new car models in the United States. In a similar project in China, Volkswagen decided to create four new car models to suit the demands of Chinese car customers.

Another function of the strategist role is *providing strategic guidance*. Siemens produced visualizations of future product-usage scenarios—so-called “pictures of the future”—that are used to direct and align the innovation effort throughout the company. The visualizations are the result of projects in which a joint team of corporate technology and a business unit explore future developments from the market and technology perspective and derive new business ideas and key technologies. The visualization, the project, the final report, and follow-on projects promote common goals and contribute to the synchronization of innovation initiatives.

In addition, corporate foresight can also help identify and assess disruptive *new business*

models and alternative business logic. One example is Deutsche Bank Research, which used scenario analysis to explore possible changes in value creation in the German economy in the next 15 years. One scenario that was judged to have the highest probability showed a market in which 15% of all value is created through networks or consortia of firms. Collaborative value creation—in which two or more firms work together to create a new market—has just a 3% share of the German economy. In consequence, the company formulated a strategic ambition to engage more in collaborations with other companies and build value-creation networks. In addition to proactive identification and development of new business models, corporate foresight was also reported to contribute by scanning for new (and rival) business models and changes in business logic that could threaten the current business activity.

Other companies explained that running foresight projects produces a benefit through the process itself. By engaging several internal stakeholders, an internal discussion is triggered that helps to *consolidate opinions*. These opinions include assessing the probability of trends, judging the size of a business opportunity, and making market forecasts. One company regularly runs a foresight activity that involves its foreign subsidiaries and local marketing staff to make predictions about emerging market segments. This activity is judged as very successful for facilitating a cross-regional discussion and for consolidating the different views on the market.

A further impact is the *vision creation*, which differs from providing strategic guidance, because it is left unspecific. Several companies reported aiming for a certain fuzziness in order to emphasize the uncertainty and ensure that the visions would inspire its employees to create the future by working in the direction of the vision, rather than discouraging them with clear long-term goals.

4.3 *The opponent role*

The *opponent* role has an impact throughout the innovation process (see Figure 1). The opponent role was derived by clustering three activities (see Table 6).

Table 6: Impact of the opponent role

<i>Impact of Opponent Role</i>	<i>Description</i>	<i>No. of Quotes</i>	<i>Quotes</i>
Challenging basic assumptions	The foresight activity makes it possible to challenge current innovation activities to adjust to external changes.	18	“(One outcome is) to wake people up and show them things outside their worldview.” “If a (scientific) study proves that mobile telephony triggers cancer, then our business model is gone forever.” “If we do not have this scenario approach, then we also will not challenge our premises.”
Scanning for disruptions that could endanger current and future innovations	Corporate foresight provides information about wild cards, i.e., potential disruptive change.	18	“There might be glowing wallpaper, or people do not have money anymore to consume energy. Such things could be disruptive.” “Environmental factors such as pollution or the drying up of all the oil wells; in such cases, we would no longer need to consider cars. Transportation, yes, but not petrol or diesel engines.”
Challenging the state-of-the-art of current R & D projects	Foresight projects show how current R & D projects need to be refocused to adapt to changes in the environment.	15	“As a consequence of the foresight activity, we changed the engine strategy and moved toward smaller, four-cylinder engines, even though everyone was saying we were crazy.”

The primary aim of the role is to *challenge the ideas and basic assumptions* of innovators. Such assumptions can be in the field of customer needs, technological developments, or regulatory issues. They are typically built on worldviews that are undisputed within the company, but which are the subject of more controversy outside the corporate environment. By making these assumptions explicit, monitoring them, and reporting expected changes, corporate foresight facilitates re-adjustments of innovation activities and triggers the cancellation of projects.

In addition, corporate foresight plays the opponent role when it identifies technologies, products, or changes in the consumer needs domain that have *disruptive potential*. Many observers reported that these changes yielded disruptive potential particularly if they came from a domain outside the current scope of the current business activity. They are often alternatives or substitution products that build on technologies that are outside the areas currently employed by the company; thus, corporate foresight is used to scan spots that would otherwise be left unobserved.

The third major impact of the opponent role is to ensure the *state-of-the-art of R & D projects*.

One company judged this to be the major aim and impact of corporate foresight. This company employs a unit of six full-time employees who scan the environment, discuss and process the collected information, and use the generated insights to challenge R & D project teams. The team's major impact is its regular participation in new project presentations, project milestone meetings, and review workshops. In these workshops, they challenge the current activities with what they have observed in the environment or what is already available in lead markets and thus increase the probability that the R & D projects will produce state-of-the-art innovations.

5 CONCLUSION

5.1 Implications for practice

Several examples—such as the failure of Kodak to respond effectively to the discontinuous change toward digital photography—highlight the need to establish effective mechanisms that allow for a timely response to disruptive change. Our assessment showed that corporate foresight can and should contribute through three roles to the ability to exploit the windows of opportunity that arise from disruptive change.

Most companies that used corporate foresight in a strategist role have a management unit dedicated to strategic innovation and strategic technology. These units are the primary internal customer for a corporate foresight unit that plays the role of the strategist. A clear recommendation from the case studies is to involve members of these units directly in foresight activities.

The opponent role has been shown to be an effective mechanism with which to challenge innovation teams and thus enhance the quality of innovation development results. Through the case studies, we have unearthed examples in which this role has been played through face-to-face workshops with new product-development teams. In these workshops, corporate foresight challenges the teams with insights on rival firms' innovation activities as well as insights into change in customer needs and on emerging technologies. The foresight manager and internal customers have

rated this practice successful. It can, therefore, be recommended that this role be established in a similar fashion.

Concerning the initiator role, it is not possible to conclusively judge whether (1) a formal link to the innovation process or (2) the dissemination of foresight insights in a broadcast fashion is more effective in triggering innovation. Even though the formal link to the innovation process ensures that the innovation opportunity will be evaluated, it does not guarantee that the decision makers within the innovation funnel's gates will be convinced that the opportunity is attractive. In companies that rely exclusively on broadcasted foresight information, it is not certain that it reaches R & D or product managers, but it reaches more internal stakeholders, thus improving the chances that the organization will be more receptive and responsive toward the innovation opportunity.

The tentative conclusion is that companies should pursue a multi-modal dissemination strategy, meaning that they should establish process links while broadcasting the foresight insights through mailing lists, the Intranet, blogs, wikis and internal document-management systems. In another article we have also shown how companies build scouting networks that integrate internal and external networks of foresighters and R & D managers. This practice of linking people to pass on foresight insights to the ones that can start new innovation initiatives has also proven to be an effective method to enhance the innovation capacity of a firm [107].

5.2 Implications for research

Earlier studies on corporate foresight have built exclusively on evidence from foresight units. In consequence, they were subject to an informant bias, by which the reported impacts could be overstated. Using respondents that inform on corporate foresight from three perspectives (that of the corporate foresight activity team, that of the corporate foresight activity manager, and in particular that of the internal stakeholder) increases the validity of the results in comparison to earlier studies and extends the knowledge about the impact of corporate foresight.

The cross-case analysis made it possible to discover eleven impacts of corporate foresight on the innovation capacity of a firm. These impacts have been described and validated by several informants, and the quotes made for a rich understanding of the potential value contribution of corporate foresight. We have thus contributed to the research on corporate foresight by extending the knowledge of value creation and providing testable items.

By clustering the individual impacts, we revealed that corporate foresight efforts can be classified into three roles. We also showed through examples and quotes that these roles are effective in creating value in terms of the enhancement of innovation capacity. By linking the roles to the innovation process, they can be used as constructs for future studies testing the theory.

By introducing and applying the resource-based view and dynamic-capabilities theory to the field of corporate foresight, we have contributed to building a theoretical base in the field. This is particularly important, as past research was primarily descriptive and explorative. To permit research on corporate foresight to move toward theory building and testing, more common theoretical frameworks are needed. The application of both the resource-based view and dynamic-capabilities theory has proven their suitability for the field. We have contributed to moving the field of corporate foresight toward using common and acknowledged theoretical foundations. This facilitates cross-fertilization with other research fields, such as innovation and strategic management.

We have contributed to research on organizational ambidexterity by confirming the importance of dedicated management systems to allow firms to move into new business fields and produce radical innovation. We also have identified examples in which corporate foresight performing the strategist role has permitted the firm to explore and plan the development of new business fields. In addition, we have shown how corporate foresight performing the initiator role increases the ability of a firm to produce incremental innovation. This leads to the conclusion that the interplay of corporate foresight and innovation management activities can contribute to organizational ambidexterity.

We hope that this article will prompt more research investigating the ways in which corporate

foresight can be integrated into innovation management, the goal being to build organizations that confront discontinuous change with flexibility and robustness.

6 REFERENCES

- [1] V. Coates, M. Farooque, R. Klavans, K. Lapid, H. A. Linstone, C. Pistorius, and A. L. Porter, "On the Future of Technological Forecasting," *Technological Forecasting and Social Change*, vol. 67, pp. 1-17, 2001.
- [2] A. L. Porter, W. B. Ashton, G. Clar, J. F. Coates, K. Cuhls, S. W. Cunningham, K. Ducatel, P. van der Duin, S. W. Cunningham, K. Ducatel, P. van der Duin, L. Georgehiou, T. Gordon, H. Linstone, V. Marchau, G. Massari, I. Miles, M. Moguee, A. Salo, F. Scapolo, R. Smits, W. Thissen, and T. F. A. M. W. Group, "Technology futures analysis: Toward integration of the field and new methods," *Technological Forecasting & Social Change*, vol. 71, pp. 287-303, Mar 2004.
- [3] R. Miller, "Futures literacy: A hybrid strategic scenario method," *Futures*, vol. 39, pp. 341-362, 2007.
- [4] T. J. Gordon, J. C. Glenn, and A. Jakil, "Frontiers of futures research: What's next?," *Technological Forecasting & Social Change*, vol. 72, pp. 1064-1069, 2005.
- [5] R. Van der Helm, "Ten insolvable dilemmas of participation and why foresight has to deal with them," *Foresight*, vol. 9, pp. 3-17, 2007.
- [6] S. Harroussi, "Système de veille stratégique basé sur un réseau d'experts: méthodes et outils," Aix-en-Provence: Université Paul Cézanne, Aix-Marseille III, 2004, p. 246.
- [7] F. Scapolo, "New horizons and challenges for future-oriented technology analysis—The 2004 EU-US seminar," *Technological Forecasting & Social Change*, vol. 72, pp. 1059-1063, 2005.
- [8] F. DenHond and P. Groenewegen, "Environmental technology foresight: New horizons for technology management," *Technology Analysis & Strategic Management*, vol. 8, pp. 33-46, Mar 1996.
- [9] K. Cuhls, "From forecasting to foresight processes - New participative foresight activities in Germany," *Journal of Forecasting*, vol. 22, pp. 93-111, Mar-Apr 2003.
- [10] A. A. Salo, "Incentives in technology foresight," *International Journal of Technology Management*, vol. 21, pp. 694-710, 2001.
- [11] T. Konnola, V. Brummer, and A. Salo, "Diversity in foresight: Insights from the fostering of innovation ideas," *Technological Forecasting and Social Change*, vol. 74, pp. 608-626, 2007.
- [12] L. A. Costanzo, "Strategic foresight in a high-speed environment," *Futures*, vol. 36, pp. 219-235, Mar 2004.
- [13] M. Oner and S. Gol, "Pitfalls in and success factors of corporate foresight projects," *International Journal of Foresight and Innovation Policy*, vol. 3, pp. 447-471, 2007.
- [14] D. Collis and C. Montgomery, "Competing on Resources: Strategy in the 1990s," *Harvard Business Review*, vol. 73, pp. 118-128, 1995.
- [15] D. J. Teece, G. Pisano, and A. Shuen, "Dynamic capabilities and strategic management," *Strategic Management Journal*, vol. 18, pp. 509-533, Aug 1997.
- [16] C. E. Helfat and M. A. Peteraf, "The dynamic resource-based view: Capability lifecycles," *Strategic Management Journal*, vol. 24, pp. 997-1010, Oct 2003.
- [17] S. Dutta, O. Narasimhan, and S. Rajiv, "Conceptualizing and measuring capabilities: Methodology and empirical application," *Strategic Management Journal*, vol. 26, pp. 277-285, Mar 2005.
- [18] V. Ambrosini and C. Bowman, "What are dynamic capabilities and are they a useful construct in strategic management?," *International Journal of Management Reviews*, vol. 11, pp. 29-49, 2009.
- [19] K. M. Eisenhardt and J. A. Martin, "Dynamic capabilities: What are they?," *Strategic Management Journal*, vol. 21, pp. 1105-1121, Oct-Nov 2000.
- [20] D. Levinthal, "Surviving Schumpeterian Environments: An Evolutionary Perspective," *Industrial and Corporate Change*, vol. 1, pp. 427-443, January 1, 1992 1992.
- [21] C. J. G. Gersick, "Revolutionary Change Theories - a Multilevel Exploration of the Punctuated Equilibrium Paradigm," *Academy of Management Review*, vol. 16, pp. 10-36, Jan 1991.
- [22] S. L. Brown and K. M. Eisenhardt, "The art of continuous change: Linking complexity theory and

- time-paced evolution in relentlessly shifting organizations," *Administrative Science Quarterly*, vol. 42, pp. 1-34, Mar 1997.
- [23] C. M. Christensen, *The innovator's dilemma : when new technologies cause great firms to fail*. Boston, Mass.: Harvard Business School Press, 1997.
- [24] G. S. Day and P. J. H. Schoemaker, "Driving Through the Fog: Managing at the Edge," *Long Range Planning*, vol. 37, pp. 127-142, 2004.
- [25] C. I. Stubbart and M. B. Knight, "The case of the disappearing firms: empirical evidence and implications," *Journal of Organizational Behavior*, vol. 27, pp. 79-100, 2006.
- [26] A. De Geus, *The living company*. Boston, Mass.: Harvard Business School Press, 1997.
- [27] W. Qualls, R. W. Olshavsky, and R. E. Michaels, "Shortening of the PIC - an Empirical Test," *Journal of Marketing*, vol. 45, pp. 76-80, 1981.
- [28] E. H. Kessler and A. K. Chakrabarti, "Innovation speed: A conceptual model of context, antecedents, and outcomes," *Academy of Management Review*, vol. 21, pp. 1143-1191, Oct 1996.
- [29] A. Sood and G. J. Tellis, "Technological Evolution and Radical Innovation," *Journal of Marketing*, vol. 69, pp. 152-168, July 2005 2005.
- [30] E. H. Kessler and P. E. Bierly, "Is Faster Really Better? An Empirical Test of the Implications of Innovation Speed," *IEEE Transactions on Engineering Management*, vol. 49, pp. 2-12, 2002.
- [31] F. Langerak and E. J. Hultink, "The impact of new product development acceleration approaches on speed and profitability: Lessons for pioneers and fast followers," *IEEE Transactions on Engineering Management*, vol. 52, pp. 30-42, Feb 2005.
- [32] M. E. Parry, M. Song, P. C. d. Weerd-Nederhof, and K. Visscher, "The Impact of NPD Strategy, Product Strategy, and NPD Processes on Perceived Cycle Time," *Journal of Product Innovation Management*, vol. 26, pp. 627-639, 2009.
- [33] H. Lee, K. G. Smith, and C. M. Grimm, "The effect of new product radicality and scope on the extent and speed of innovation diffusion," *Journal of Management*, vol. 29, pp. 753-768, 2003.
- [34] H. I. Ansoff, "Strategic Issue Management," *Strategic Management Journal*, vol. 1, pp. 131-148, 1980.
- [35] G. S. Day and P. Schoemaker, "Peripheral Vision: Sensing and Acting on Weak Signals," *Long Range Planning*, vol. 37, pp. 117-121, 2004.
- [36] S. G. Winter, "Specialised Perception, Selection, and Strategic Surprise: Learning from the Moths and Bees," *Long Range Planning*, vol. 37, pp. 163-169, 2004.
- [37] M. Pina e Cunha and R. Chia, "Using Teams to Avoid Peripheral Blindness," *Long Range Planning*, vol. 40, pp. 559-573, 2007.
- [38] H. Lesca and M.-L. Caron, "Veille stratégique : créer une intelligence collective au sein de l'entreprise," *Revue française de Gestion*, vol. 105, pp. 58-68, 1995.
- [39] M. J. Eppler and K. W. Platts, "Visual Strategizing: The Systematic Use of Visualization in the Strategic-Planning Process," *Long Range Planning*, vol. 42, pp. 42-74, 2009.
- [40] U. Krystek, "Strategische Frühaufklärung," *Zeitschrift für Controlling & Management*, vol. 2007, pp. 50-58, 2007.
- [41] H. C. Lucas and J. M. Goh, "Disruptive technology: How Kodak missed the digital photography revolution," *Journal of Strategic Information Systems*, vol. 18, pp. 46-55, 2009.
- [42] M. Godet, R. Monti, and F. Roubelat, *Manuel de prospective stratégique - 1. Une indiscipline intellectuelle*. Paris: Dunod, 2004.
- [43] M. Perona and G. Miragliotta, "Complexity management and supply chain performance assessment. A field study and a conceptual framework," *International Journal of Production Economics*, vol. 90, pp. 103-115, Jul 8 2004.
- [44] A. Kinra and H. Kotzab, "A macro-institutional perspective on supply chain environmental complexity," *International Journal of Production Economics*, vol. 115, pp. 283-295, Oct 2008.
- [45] A. Gunasekaran, K. H. Lai, and T. C. E. Cheng, "Responsive supply chain: A competitive strategy in a networked economy," *Omega-International Journal of Management Science*, vol. 36, pp. 549-564, Aug 2008.
- [46] M. von Zedtwitz and O. Gassmann, "Market versus technology drive in R&D internationalization: four different patterns of managing research and development," *Research Policy*, vol. 31, pp. 569-588,

2002.

- [47] M. Kodama, "Innovation and knowledge creation through leadership-based strategic community: Case study on high-tech company in Japan," *Technovation*, vol. 27, pp. 115-132, Mar 2007.
- [48] R. K. Chandy and G. J. Tellis, "Organizing for Radical Product Innovation: The Overlooked Role of Willingness to Cannibalize," *Journal of Marketing Research*, vol. 35, pp. 474-487, 1998.
- [49] G. J. Tellis, "Disruptive technology or visionary leadership?," *Journal of Product Innovation Management*, vol. 23, pp. 34-38, Jan 2006.
- [50] E. J. Nijssen, B. Hillebrand, and P. A. M. Vermeulen, "Unraveling willingness to cannibalize: a closer look at the barrier to radical innovation," *Technovation*, vol. 25, pp. 1400-1409, 2005.
- [51] J. Schumpeter and R. Opie, *The theory of economic development*: Springer, 1934.
- [52] A. Herrmann, O. Gassmann, and U. Eisert, "An empirical study of the antecedents for radical product innovations and capabilities for transformation," *Journal of Engineering and Technology Management*, vol. 24, pp. 92-120, 2007/6// 2007.
- [53] W. Vanhaverbeke and N. Peeters, "Embracing Innovation as Strategy: Corporate Venturing, Competence Building and Corporate Strategy Making," *Creativity and Innovation Management*, vol. 14, pp. 246-257, 2005.
- [54] D. B. Jemison, "The Importance of Boundary Spanning Roles in Strategic Decision-Making," *Journal of Management Studies*, vol. 21, pp. 131-152, 1984.
- [55] P. Shrivastava and J. H. Grant, "Empirically Derived Models of Strategic Decision-Making Processes," *Strategic Management Journal*, vol. 6, pp. 97-113, 1985.
- [56] S. C. Jain, "Environmental Scanning in United-States Corporations," *Long Range Planning*, vol. 17, pp. 117-128, 1984.
- [57] R. C. May, W. H. Stewart, and R. Sweo, "Environmental scanning behavior in a transitional economy: Evidence from Russia," *Academy of Management Journal*, vol. 43, pp. 403-427, Jun 2000.
- [58] C. S. Osborn, "Systems for sustainable organizations: Emergent strategies, interactive controls and semi-formal information," *Journal of Management Studies*, vol. 35, pp. 481-509, Jul 1998.
- [59] M. L. Tushman, B. Virany, and E. Romanelli, "Executive Succession, Strategic Reorientations, and Organization Evolution - the Minicomputer Industry as a Case in Point," *Technology in Society*, vol. 7, pp. 297-313, 1985.
- [60] C. Andriopoulos and M. W. Lewis, "Exploitation-Exploration Tensions and Organizational Ambidexterity: Managing Paradoxes of Innovation," *Organization Science*, vol. 20, pp. 696-717, 2009.
- [61] S. Raisch, J. Birkinshaw, G. Probst, and M. L. Tushman, "Organizational Ambidexterity: Balancing Exploitation and Exploration for Sustained Performance," *Organization Science*, vol. 20, pp. 685-695, 2009.
- [62] M. L. Tushman and P. Anderson, "Technological Discontinuities and Organizational Environments," *Administrative Science Quarterly*, vol. 31, pp. 439-465, Sep 1986.
- [63] M. L. Tushman and C. A. O'Reilly, "Ambidextrous organizations: Managing evolutionary and revolutionary change," *California Management Review*, vol. 38, pp. 8-30, Sum 1996.
- [64] C. J. Lambe and R. E. Spekman, "Alliances, external technology acquisition, and discontinuous technological change," *Journal of Product Innovation Management*, vol. 14, pp. 102-116, Mar 1997.
- [65] M. Nieto and P. Quevedo, "Absorptive capacity, technological opportunity, knowledge spillovers, and innovative effort," *Technovation*, vol. 25, pp. 1141-1157, Oct 2005.
- [66] G. Dushnitsky and M. J. Lenox, "When do firms undertake R&D by investing in new ventures?," *Strategic Management Journal*, vol. 26, pp. 947-965, Oct 2005.
- [67] J. Poskela and M. Martinsuo, "Management Control and Strategic Renewal in the Front End of Innovation," *Journal of Product Innovation Management*, vol. 26, pp. 671-684, 2009.
- [68] H. M. Arnold, *Technology Shocks: Origins, Management Responses and Firm Performance*. Heidelberg and New York: Physica Verlag Springer-Verlag GmbH & Co.KG, 2003.
- [69] M. P. Rice, D. Kelley, L. Peters, and G. C. O'Connor, "Radical innovation: triggering initiation of opportunity recognition and evaluation," *R & D Management*, vol. 31, pp. 409-420, Oct 2001.
- [70] G. A. Stevens and J. Burley, "Piloting the rocket of radical innovation," *Research-Technology Management*, vol. 46, pp. 16-25, Mar-Apr 2003.

- [71] H. G. Gemünden, S. Salomo, and K. Hölzle, "Role Models for Radical Innovations in Times of Open Innovation," *Creativity and Innovation Management*, vol. 16, pp. 408-421, 2007.
- [72] G. C. O'Connor and R. DeMartino, "Organizing for radical innovation: An exploratory study of the structural aspects of RI management systems in large established firms," *Journal of Product Innovation Management*, vol. 23, pp. 475-497, Nov 2006.
- [73] W. M. Cohen and D. A. Levinthal, "Absorptive-Capacity - a New Perspective on Learning and Innovation," *Administrative Science Quarterly*, vol. 35, pp. 128-152, Mar 1990.
- [74] U. Lichtenthaler, "Absorptive Capacity, Environmental Turbulence, and the Complementarity of Organizational Learning Processes," *Academy of Management Journal*, vol. 52, pp. 822-846, August 2009 2009.
- [75] S. A. Zahra and G. George, "Absorptive capacity: A review, reconceptualization, and extension," *Academy of Management Review*, vol. 27, pp. 185-203, Apr 2002.
- [76] T. Ritter and H. G. Gemünden, "Network competence: Its impact on innovation success and its antecedents," *Journal of Business Research*, vol. 56, pp. 745-755, Sep 2003.
- [77] L. Pittaway, M. Robertson, K. Munir, D. Denyer, A. Neely, and T. Street, "Networking and innovation: a systematic review of the evidence," *International Journal of Management Reviews*, vol. 5-6, pp. 137-168, 2004.
- [78] H. W. Chesbrough, "The Era of Open Innovation," *Mit Sloan Management Review*, vol. 44, pp. 35-41, 2003.
- [79] U. Lichtenthaler, "Open innovation in practice: An analysis of strategic approaches to technology transactions," *IEEE Transactions on Engineering Management*, vol. 55, pp. 148-157, Feb 2008.
- [80] R. Rohrbeck, K. Hölzle, and H. G. Gemünden, "Opening up for competitive advantage - How Deutsche Telekom creates an open innovation ecosystem," *R & D Management*, vol. 39, pp. 420-430, 2009.
- [81] J. G. Wissema, "Futures research - is it useful?," *Long Range Planning*, vol. 14, pp. 29-32, 1981.
- [82] I. H. Wilson, "Futures Forecasting for Strategic Planning at General Electric," *Long Range Planning*, vol. 6, pp. 39-42, 1973.
- [83] F. Phillips, "On S-curves and tipping points," *Technological Forecasting and Social Change*, vol. 74, pp. 715-730, 2007.
- [84] K. Cuhls, "Foresight with Delphi surveys in Japan," *Technology Analysis & Strategic Management*, vol. 13, pp. 555-569, Dec 2001.
- [85] K. Cuhls, *Methoden der Technikvorausschau - eine internationale Übersicht*. Stuttgart: IRB Verlag, 2008.
- [86] A. Gerybadze, "Technological Forecasting," in *Technologie-Management: Erfolgsfaktor mit zunehmender Bedeutung*, H. Tschirky, W. Hess, and P. Lang, Eds. Zürich: Verlag Industrielle Organisation, 1990, pp. 71-100.
- [87] M. McMaster, "Foresight: Exploring the structure of the future," *Long Range Planning*, vol. 29, pp. 149-155, Apr 1996.
- [88] P. Saffo, "Six rules for effective forecasting," *Harvard Business Review*, vol. 85, pp. 122-131, Jul-Aug 2007.
- [89] R. U. Ayres, "On forecasting discontinuities," *Technological Forecasting and Social Change*, vol. 65, pp. 81-97, Sep 2000.
- [90] W. F. Van Nottena, A. M. Slegersb, and M. B. A. Van Asselt, "The future shocks: On discontinuity and scenario development," *Technological Forecasting & Social Change*, vol. 72, pp. 175-194, 2005.
- [91] B. R. Martin, "Foresight in Science and Technology," *Technology Analysis & Strategic Management*, vol. 7, pp. 139-168, 1995.
- [92] K. Blind, K. Cuhls, and H. Grupp, "Current foresight activities in central Europe," *Technological Forecasting and Social Change*, vol. 60, pp. 15-35, Jan 1999.
- [93] H. Grupp and H. A. Linstone, "National technology foresight activities around the globe - Resurrection and new paradigms," *Technological Forecasting and Social Change*, vol. 60, pp. 85-94, Jan 1999.
- [94] A. Hines, "A practitioner's view of the future of futures studies," *Futures*, vol. 34, pp. 337-347, 2002.
- [95] R. K. Yin, *Case study research: design and methods*, 3rd ed. Thousand Oaks, Calif.: Sage

- Publications, 2003.
- [96] K. M. Eisenhardt, "Building Theories from Case-Study Research," *Academy of Management Review*, vol. 14, pp. 532-550, Oct 1989.
 - [97] C. Voss, N. Tsikriktsis, and M. Frohlich, "Case research in operations management," *International Journal of Operations & Production Management*, vol. 22, pp. 195-219, 2002.
 - [98] C. E. Helfat, "Stylized facts, empirical research and theory development in management," *Strategic Organization*, vol. 5, pp. 185-192, May 2007.
 - [99] A. Langley, "Strategies for theorizing from process data," *Academy of Management Review*, vol. 24, pp. 691-710, Oct 1999.
 - [100] K. M. Eisenhardt and M. E. Graebner, "Theory building from cases: Opportunities and challenges," *Academy of Management Journal*, vol. 50, pp. 25-32, 2007.
 - [101] H. Rubin and I. Rubin, *Qualitative interviewing: The art of hearing data*. CA: Sage 2005.
 - [102] B. Gillham, *Case study research methods*: Continuum Intl Pub Group, 2000.
 - [103] J. W. Schofield, "Increasing the Generalizability of Qualitative Research," in *The qualitative research companion*, A. M. Huberman and M. B. Miles, Eds. Thousand Oaks: Sage Publications, 2002.
 - [104] T. Lee, *Using qualitative methods in organizational research*. Thousand Oaks, CA: Sage Publications Inc., 1998.
 - [105] L. Richards, *Handling qualitative data: a practical guide*. London Thousand Oaks, CA: Sage Publications, 2005.
 - [106] M. Saunders, P. Lewis, and A. Thornhill, *Research methods for business students*, 4th ed. Harlow, England ; New York: Financial Times/Prentice Hall, 2007.
 - [107] R. Rohrbeck, "Harnessing a network of experts for competitive advantage - Technology Scouting in the ICT Industry," *R & D Management*, vol. 40, pp. 169-180, 2010.

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