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Abstract: This research paper presents an early stage analysis and evaluation framework of methods used within corporate foresight activities as a means of detecting and shaping innovation opportunities. An overview of the state of the art of findings on popular methods and an adaptable framework for evaluating corporate foresight methods according to situations and aims is presented. Using findings from other fields such as psychology, the proposed framework presents a classification of methods. Thereby, biases, risks and sensible decisions in foresight processes are spotlighted. In addition, an understanding and theory building for decision making within corporate foresight activities is enhanced. For researchers, the framework is also adaptable for specific environmental and organizational situations and gives hints for further research streams, thus offering hypotheses that are yet to be tested empirically.

Keywords: corporate foresight, strategic foresight, environmental scanning, futures research, peripheral vision, foresight methods, scenario technique, Delphi method, roadmapping, decision making.

1 Introduction
This paper presents an early stage evaluation framework for corporate foresight methods suitable for innovation management based on aims and requirements of a corporate setting. First, corporate foresight is briefly introduced, as well as the design of the research; thereafter a short section will present a current understanding on the use of methods. Furthermore, the most used and preferred methods: scenario planning, Delphi technique and roadmapping (e.g. Assakul, 2003; Becker, 2002) will be briefly presented and analysed, as well as a cluster of simulation methods. The overview will be enhanced with some empirical findings. A basic evaluation framework based on derived criteria will be developed, methods exemplary evaluated and fitting use within innovation management suggested.

1 Among others, these methods are often subsumed under the terms “Future-Oriented Technology Analysis”, forecasting and foresight methods.
With an increasing globalization and the level of digital revolution, the pressure for innovation rises with time being critical (D'Aveni, 1994; Parry et al., 2009). The assessment of future technology barriers is widely applied for innovative design, technology forecasting and strategic planning (Armstrong, 1985; du Preez and Pistorius, 1999; Porter et al., 2004). (Krubasik, 1982) showed the meaning of forecasting for portfolio management, research and development and thereby innovation management. Radical innovation (Abernathy and Clark, 1985) and technological disruptions (Bower and Christensen, 1995) are special issues which are addressed by corporate foresight (CF) (Rohrbeck, 2011). Schwarz (2007) points out the growing importance of future studies in corporate contexts. Aims and impacts of CF are among other to enhance innovation capacity and technology management, as well as performance (Phaal et al., 2006 p. 336; Rohrbeck and Gemünden, 2011).

Corporate or strategic foresight systems are a credible ability, function (Slaughter, 1998) or a process (e.g. Reger, 2001) enabling companies to innovate through assessing weak signals, early changes and future developments (Ansoff, 1976). However, Foresight methods are not invented for corporate innovation management and research lacks a framework evaluating methods considering human cognition on the one hand and adaptation to innovation management stages on the other.

2 Methodology and Research Design

This paper is based on an on-going in depth analysis approach. The research aim is to develop a draft framework and criteria based on findings from literature to explore the systemic application field of methods useable for innovation management as a part of CF.

Based on this, the question how methods can be evaluated will be followed and criteria defined. The level of sensibility with which methods react to assumptions and decisions during foresight processes will be assessed exemplarily. Further questions yet to be implemented regard the biases of various categories of methods.

Furthermore, practitioners should be made aware of sensibility, power and risks certain methods have. Therewith, they will be enabled to choose methods according to their firms’ situational fits, goals and innovation management process stage, developing training to increase awareness and reducing biases.

To achieve the research goals relevant literature has been reviewed, including the field of cognitive science, using the Web of Science (WoS), Wiley Online Library (WOL) and ScienceDirect (SD) databases. These databases contain all journals in the Social Science Citation Index (WoS), thereby assuring a high level of quality and coverage. Furthermore, Glenn’s and Gordon’s ‘Futures Research Methodology Version 3.0’ (2009) was analysed as one of the largest collections of internationally peer-reviewed chapters on foresight methods. This paper focuses mainly on publications after 1980. Based on findings and analysis of literature evaluation criteria were identified, an evaluation framework developed and methods exemplarily evaluated.
3 Theoretical Background of Methods

Most methods used have been invented 30 to 60 years ago, not for corporate but for non-profit macro level means and continuously improved (Breiner et al., 1994; Grupp and Linstone, 1999; Martin, 1995 p. 143). Foresight methods are linked to the question of predictability of future developments. A shift occurred from forecasting, prediction and prognoses towards foresight as an open future approach (e.g. Gerybadze, 1994; McMaster, 1996; Miles, 2010). The prevalent opinion is that there is not one best process or method, but many. Therefore a combination of methods is often suggested (Cuhls, 2003; Porter et al., 2004 p. 291; Reger, 2001 p. 543).

The broad amount of methods being named foresight including tools like brainstorming or literature review (e.g. Becker, 2002 p. 16) is due to the lack of a consistent foresight theory and fragmented research field. Since many research fields from meteorology to CF address topics with a future perspective, the range of methods is extremely large.

However, there have been plenty of discussions about classifications and various approaches (Popper, 2008), in particular on static methods and a mechanistic use in times of change (Marris, 1954). Some general classification defines explorative methods which address technical potentials, whereas normative methods act on defined goals and needs (Steinmüller, 1995). Systematization was conducted using different criteria, e.g. the starting point of activities and type of data. These criteria refer to explorative and normative methods, and qualitative, semi-quantitative and quantitative data. Other systematization by Loveridge & van der Meulen refers to dimensions of expertise, creativity and interaction (Cameron et al., 1996). Loveridge uses the type of data, dimensions of expertise, creativity and interaction (Loveridge, 1996). Based on this systematization and the work of several other scholars, Popper uses the additional dimension of ‘evidence’ (2008). Other classifications and overviews are for instance provided by May (1996), Reger (2001), Burmeister et al. (2004), Lichtenthaler (2005; 2002), Porter et al. (2004), Armstrong (2008).

Clements and Hendry (1998) discuss such issues with regard to economic forecasting. Several methods have been tested (for instance Chermack et al., 2007, 2006) and evaluated mostly without comparison or corporate perspective. Armstrong (2008) presents an overview in the area of sales forecasting without evaluation. With a short term forecast orientation, Lawrence et al. (1986) examine the outcome of combining judgmental and statistical forecast empirically. Salo et al. (2003) consider the potential and limitations of multicriteria methods (judgemental forecasting), lacking comparison with other methods and corporate perspective. Hauss et al. (2010) present results of a survey of technology forecasting techniques applicable to military’s needs. A comparative analysis and brief evaluation of methods for horizon scanning is provided by Amanatidou et al. (2012), focusing on national foresight. Glenn and Gordon (2009) give a sophisticated overview and discussion on methods, neglecting a corporate perspective. But practical advice on how to implement CF methods has been published (Krystek and Müller-Stewens, 1993). Also, early approaches to evaluate some methods from a
corporate strategic perspective have been presented by Burmeister et al. (2002) and Schwarz (2006).

However, several empiric studies on the usage of methods (Ambacher, 2012; Becker, 2002; Burmeister et al., 2002; Cuhls, 2001; Grupp and Linstone, 1999; Jain, 1984; Kameoka et al., 2004; Popper, 2008) show that only a handful of methods, mostly qualitative ones, are used frequently as most participants and companies, in particular, lack sufficient method know-how (Meyer, 2002 p. 266). For corporate use methods like trend and environmental analysis, creativity methods, scenario planning and experts surveys such as Delphi are top ranked (Burmeister et al., 2004; Cuhls and Kuwahara, 1994; Reger et al., 1998; Schwarz, 2006). Also, patent analysis and especially literature analysis are often mentioned as most popular (Berkhout and Hertin, 2002; Godet, 1994).

Although, it is questionable, if the last mentioned are specific foresight methods. Having said this, it seems like CF methods are chosen not according to requirements, but with regards to other characteristic, such as accessibility (Andersen and Rasmussen, 2012; Popper, 2008). This issue is tightened by a slow diffusion rate of methods, leading to an unchanging portfolio of method execution (Armstrong, 2008 p. 11).

Scenario Planning

The first important fact about Scenario Planning (SP) is, there is not one scenario technique, but many different ones (Martelli, 2001; as well as a differentiation of scenario building and SP: Mietzner and Reger, 2005 p. 223). Especially the field of future research developed several SP models, evaluated by Schnaars as impractical and not tested (1987). Bradfield et al. (2005) reviewed the problematic confusion of SP and present an analysis. These authors trace SP back to generic utopic ideas such as Plato’s ‘Republic’ referring to v. Reibnitz (1988) and Wilson (1978). Therewith, they show analogies to the general evolution of futures thinking. Following this line of argumentation, SP as a strategic tool has been compiled by military in the 19th century. Nevertheless, modern basic SP has been developed after WWII in the US (Raubitschek, 1988) and France (Bradfield et al., 2005) with the RAND organization, Hermann Kahn and Hudson (founded by Kahn) being considered as the founders and experts of the method (Jefferson, 2012). SP is also linked to the French stream ‘La Prospective’ (Godet, 2001) and later became famous especially with the case of Dutch Shell (Wack, 1985).²

The assumption of SP towards future developments is that future developments are unpredictable, but certain events are predetermined (Varum and Melo, 2010). One main idea was to think about the unthinkable. Even though many definitions exist, scenarios are basically systematic, reasonable and traceable images of the future based upon the present situation. Scenarios set a framework to test different strategies and identify important influencing factors. SP is not a qualitative method per se. In fact, quantitative modelling and simulations of scenarios was very common and is linked for instance to the method system dynamics (Cavana, 2010; Visser and Chermack, 2009).

² For an historic development see e.g. Bradfield et al (2005).
Delphi Technique

The next method presented here is the Delphi survey, a participatory method which was invented by Olaf Helmer and his Associates at the RAND Corporation in cooperation with the US military during the cold war (Linstone and Turoff, 1975; Rowe and Wright, 1999). The use evolved in stages with Rieger offering one presentation of five steps (1986): secrecy and obscurity, novelty, popularity, scrutiny, and continuity.

Linstone & Turnoff discuss several areas of application.

“Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem” (Linstone and Turoff, 1975 p. 3).

The aim and procedures of Delphi are to achieve a reliable consensus of expert opinions by a series of intensive questionnaires interspersed with controlled opinion feedback (Dalkey and Helmer, 1963 p. 458). It is an iterative expert’s interview project with the additional role of a “moderator” who selects questions to be asked and modifies them in every interview round. The communication of the interviewees is limited to presented findings of prior rounds. Delphi is considered to be a semi-quantitative method using quantitative non-historic data for qualitative findings, e.g. about future technology development (Popper, 2008).

Several versions of Delphi can be differentiated: a typical laboratory version, an original concept (Rowe and Wright, 1999) and policy Delphi (Cialkowska et al., 2008). The original concept aimed at forecasting developments, also named exploratory Delphi (Dailey, 1988) or conventional Delphi (Van Dijk, 1990). In the last years, an internet-based Delphi use has been promoted (Culley, 2011). Thereby, an abundance of methodological interpretations and modification has become an issue (Powell, 2003).

Technology Roadmapping

As the foundation and development of the Scenario technique is quite clear, this is not the case with roadmapping. While the term and tool ‘roadmapping’ is now being used for other purposes (e.g. Phaal et al., 2001b), here, the proposal will concentrate on technology development aims which is technology roadmapping.

The first approaches have been developed in the US automotive industry (Probert and Radnor, 2003) and later enhanced especially by Motorola (Galvin, 1998; Willyard and McClees, 1987). Since then, roadmapping has widely been used in industry, government and academia for long-range planning and plays a vital role for technology management (Barker and Smith, 1995; Kostoff and Schaller, 2001; Phaal et al., 2004a). In his analysis, Lichtenthaler suggest the suitability of the method to be mid-term oriented (Lichtenthaler, 2005 pp. 391 ff.).
Da Costa et al. state that:

“technology roadmapping usually refers to various types of forecast or foresight studies including visions and/or detailed projections of future possible technological developments, products or environments” (da Costa et al., 2003 cited in: 2005).

While several approaches to technology roadmapping exist, Phaal et al. argue the EIRMA (European Industrial Research Management Association) proposed one to be the most common (Phaal et al., 2001a). An often cited definition for technology roadmapping is the one of Galvin:

“A roadmap is an extended look at the future for a chosen field of enquiry composed from the collective knowledge and imagination of the brightest drivers of change in that field. Roadmaps communicate visions, attract resources from business and government, stimulate investigations and monitor progress. They become the inventory of possibilities for a particular field…”

(Galvin, 1998 p. 803).

Roadmaps also play a role for the development of very specific set of technical requirements as products or product features (Strauss et al., 1998).

**Simulations**

The many methods, breadth of the fields, publications and reviews hinder a differentiated discussion here. An often used and known simulation methods is for instance system dynamics (Forrester, 1971), which is structure and feedback oriented. Another simulation method which combines and integrates other tools and methods (like Monte Carlo simulation) is agent based modelling (Axelrod, 1997; e.g. Holland, 1992), which is able to simulate individual behaviour and link micro and macro level. Such methods allow qualitative as well as quantitative modelling and analysis. Lately, hybrid simulation involving several methods has become popular (Swinder and McNaught, 2012).

The main similarity is that computers are used to process input data and information according to given specific rules and produce an interplay of forces, which exceed human processing capacity. Thereby small models of the world, which are models of the mind, are realized. Furthermore, simulations allow the integration of other tools and methods as for instance scenarios are an inherent part of system dynamics simulations.

Figure 1 shows a system dynamics process model, which can be adapted for innovation management to develop new ideas, features and products e.g. according to market developments.
Towards a Framework for Analysis and Evaluation

Corporate Foresight Methods in the Innovation Management Process

As outlined before, CF methods have a long history of use for R&D and innovation management. Even though, little literature uses the term and establishes a direct link to corporate use (e.g. Heger and Rohrbeck, 2012; Roveda and Vecchiato, 2008; H. A. von der Gracht et al., 2010). The framework presented here shall be linked to a proposed corporate foresight process based on Daft and Weick’s model of an organization as a learning system (1984 p. 286) and organizational learning processes (e.g. Argyris and Schön, 1978, 1996). In addition, these models shall be linked to a stage gate model of open innovation (Chesbrough, 2003; Cooper, 1990) as shown in figure 2. Every module has specific requirements served differently by methods.
Corporate Requirements

Even though the heritage of corporate foresight could be traced back to at least to the beginning of 20th century with overwhelming experience having been gained, dozens of founding streams challenge a convergence of aims, as well as processes and methods. The selection of the proper methods stands at the beginning of every foresight activity and is also linked to potential impacts of CF (e.g. Rohrbeck and Schwarz, 2013). The broad range of methods is due to the lack of a consistent foresight theory and fragmented research fields (Barré and Keenan, 2008; Hideg, 2007; Weber et al., 2009).

Practical advice on how to implement CF methods has been published (Krystek and Müller-Stewens, 1993). Early approaches to evaluate some methods from a corporate strategic perspective have been presented by Burmeister et al. (2002) and Schwarz (2006). Furthermore, for corporate uses Lichtenthaler (2005) and Porter et al. (2004) give recommendations which method to choose in which context.

Several authors advance the view that challenges of CF are less of methodical nature, but organizational (Burmeister et al., 2002; Gruber et al., 2003; Müller, 2008; Schwarz, 2006). However, any CF activity, results and impacts are determined by the methods applied (“we shape our tools and thereafter our tools shape us” McLuhan in: Culkin, 1967

Figure 2 corporate foresight processes within innovation management.
Source: Author's representation based on: (Daft and Weick, 1984; Leitner, 2013).
p. 52), especially from a constructivist perspective (Chermack and van der Merwe, 2003; Wright, 2005).

In addition, decision making is of special relevance for CF methods, as decisions and assumptions have to be made alongside the processes (Andersen and Rasmussen, 2012; Barker and Smith, 1995; Scapolo, 2005). With a higher participation of experts and decision makers integrated into the process, success of foresight activities rises (Schwarz, 2005), as do systemic relations such as principal-agent issues, biases and abuse possibilities. Therefore, CF activities can be abused to a) support decisions already made, or b) reproduce existing beliefs and expectations (Barend van der Meulen et al., 2003 p. 226). Hereby the question arises whether every method is prone to such abuse in the same way.

While there is much literature with researchers and consultants promoting the use of particular methods (Popper, 2008), and systematization has been done (e.g. Loveridge, 1996), little attention has been paid to a systemic evaluation of methods, especially for corporate means. A recommendation of methods to use for corporate foresight is missing so far (Gerybadze, 1994 p. 73; Lichtenhailer, 2005 p. 389; Phaal et al., 2006 p. 336).

Several differences between foresight on a macro level or for non-profit organizations and corporate foresight can be identified. A first difference is with regard to aims of CF activities. Non-profit organizations expect to gain expert knowhow and be informed about future trends and relevant developments to assess and prospect impacts as well as to generate more choices (e.g. Cuhls, 1998). Even though they could partly be involved by participative methods, they tend to have an external approach of information consumption.

Furthermore, intrinsic motivation to derive direct impacts out of foresight activities play a minor role than in corporations, since compensations are less success oriented, for instance. In a corporate environment the opposite is the case. Motivation and aims of CF activities address straighter more concrete questions, especially in the field of innovation management and R&D.

As van der Meulen et al. (2003) point out, the importance of impact and validity of foresight methods has often been rejected with regards to the importance of the process itself as one major potential impact (e.g. organizational learning). Furthermore, in line with their argumentation the author comes to the conclusion, that a shared understanding of the structure, forces and dynamics integrated in the relevant environment of the conducting organization are of relevance. In fact, this is the basis for any learning to occur and thereafter positively effecting innovation management, strategic management and planning.

With regards to an oftentimes used analogy, the following can be concluded. Whereas non-profit stakeholders have a higher expectation regarding vision and big (but cloudy) picture of the future, firms need a higher level of understanding more precise dynamic driving forces and small videos of possible developments, which can be integrated in strategy and strategic planning.

Taking up on Saritas systemic approach (Saritas, 2006), CF methods should be able integrate the interaction of a broad range of forces within relevant systems and enable
information processing and organizational learning. From this it follows that a large number of linked variables have to be taken into account, which is difficult (Nugroho and Saritas, 2009; Saritas and Nugroho, 2012). Thus, as evaluation criteria for foresight methods within innovation management, out of the mentioned argumentation and literature reviewed the following are suggested/summarized (Müller, 2008 p. 52; Reger, 2006 p. 318):

1. Creativity:
   - Fostering ideas
   - Visioning etc.

2. Information processing capability:
   - Amount of variables
   - Type of linkages etc.

3. Complexity absorption:
   - Ability for technology assessment
   - Capturing dynamics of systems etc.

4. Execution:
   - Simplicity of execution
   - Stimulation of learning
   - Tacit to explicit knowledge transformation capability etc.

5. Robustness and sensitivity:
   - Sensitivity to information input
   - Sensitivity to cognitive and group biases etc.

6. Acceptance:
   - Degree of participation
   - Communicability of results etc.

**Biases Affecting the Use of Methods**

Findings from management, psychology and neuroscience literature have to be used to evaluate the issues of decision making within corporate foresight processes. Aaltonen presented a framework and analysis of causes and complexity of phenomena under consideration of relevance for foresight activities (2005).

Dozens of psychological phenomena, effects and biases are relevant for corporate foresight activities. For instance, biases in the areas of group impression formation regard illusory correlation, group differentiation (accentuation), stereotype change (dispersed versus concentrated distribution of inconsistent information), and group homogeneity (Rooy et al., 2003). Furthermore, a great amount on research of human information

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3 Even though for the stage of monitoring and screening other criteria could be added, it is argued that information collection and filtering are basic inherent processes of all methods.
processing capability has brought insights, as the limited conscious processing capability (Barrouillet et al., 2004; Cowan, 2005, 1995; Ericsson and Kintsch, 1995; Oberauer, 2002; Towse et al., 2000).

With respects to the amount of existing research on these topics, here, only the role of hindsight bias for corporate foresight activities will be exemplified (Heuer, 1999): First, the accuracy of past judgements is overestimated; second, corporate foresight consumers underestimate learning effects from intelligence reports (Pohl, 2004).

Empirical studies show the preference of qualitative methods (Becker 2002). Methods that are primarily based on human input & processing show massive biases especially with the goal of noticing weak signals due to bounded rationality (Konrad 1991, Neumann 2004). In addition, the role of principal agent issues and different personal agendas has to be considered, as well as the role of expectations which have drawn attention regarding innovations, lately (e.g. Hekkert et al. 2007). An analysis with respect to these topics has to consider general possibilities of potential influence.

5 Discussion and findings

As is the case with many methods of CF, scenario is attached to the terms planning, thinking, forecasting, analysis and learning referring to the many related research fields (Bradfield et al., 2005). Based on the work of Schnaars (1987) and Martelli (2001), Varum & Melo (2010) outline over 30 publications regarding the use and benefits of scenario planning. For instance, it has been argued by several authors that scenario planning improves decision-making and helps dealing with uncertainty (e.g. Varum and Melo, 2007), overcoming typical errors like overconfidence and tunnel vision (Schoemaker, 1995). SP has the advantage of being easily communicable (e.g. Schoemaker, 1993). Further findings are presented by Chermack (2005), Mietzner & Reger (2005), Van der Heijden (2005) and Visser & Chermack (2009). Regarding the time horizon, scenario planning is seen to be suitable for long term analysis (E. Lichtenhaler, 2005 pp. 391 ff.)

Today, the Delphi technique is a well-established and used method in the domain for complex or ambiguous problems that exceed the capabilities of a single person (Cialkowska et al., 2008; Day and Bobeva, 2005). The method reduces group biases, gives anonymity of responses from panel experts, asynchronicity, ensures a controlled feedback and conducts a statistical description of responses (Helmer, 1983; Landeta, 2006; Linstone and Turoff, 1975; Rowe and G. Wright, 1999; Yousuf, 2007). However, group biases as e.g. confirmation biases are embedded. Other advantages, especially for tourism research are presented by Donohoe & Needham (2009).

Delphi has been reviewed several times and significant methodological weaknesses expressed (Gnatzy et al., 2011; Goodman, 1987; T.J. Gordon and Helmer, 1964; Hill and Fowles, 1975; Keeney et al., 2001; Landeta, 2006; Linstone and Turoff, 1975; Lock, 1987; Parente and Anderson-Parente, n.d.; Reid, 1988; Rowe et al., 1991; Sackman, 1975; Stewart, 1987; Weaver, 1971; Williams and Webb, 1994). Contributions to the research about the Delphi technique are provided for instance by Ament (1970), Ono &
Wedemeyer (1994), Rowe & Wright (1999) and Rowe et al. (2005) with Rowe & Wright giving an overview of empirical findings. For instance, in a review of UK Delphi use Brandes concluded “the overwhelming majority of estimates were overly optimistic” (Brandes, 2009 p. 1). Nowack et al. examine the use in combination with scenarios, recommending the integration of Delphi only in one phase of the scenario approach (2011). In his analysis, Landeta (2006) summarizes a few issues, e.g. to achieve the ‘truth’ by consensus (Weaver, 1971) or the difficulty to check the method’s reliability (Martino, 1993), just to name a few. By their most recent empirical analysis, Ecken et al. (2011) conclude one heavy issue, which is also relevant for other methods: a desirability bias.

Phaal presents success factors and barriers to an implementation of technology roadmapping (Phaal, 2004). Da Costa et al. (2005; 2003) highlight the important role that roadmapping plays on the sector level as the competitive power can be increased by sharing R&D investments and results creating common technology standards and platforms. A positive attitude of the method mentioned by literature is the excellent possibility of participation, (U. Lichtenhaller, 2008; Lischka and Gemunden, 2008; Petrick and Echols, 2004; Phaal et al., 2004b), which leads to several positive effects, as mentioned above.

A difference between the presented methods so far and simulations can be identified. As Chen et al. state in a review on technology foresight using Delphi, scenarios etc.: “Regardless of the methods employed, the main result is typically a list of desired technologies in each field, along with overall importance scores and the expected realization time of each technology” (Chen et al., 2012 p. 1255).

The use of simulations is a prevailing prejudice is, with regards to quantification. It is often argued by practitioners and researchers that with quantification a simplification of the linkages and situations come along. Furthermore, it is argued that quantitative methods do not have the ability to show the “whole picture”. Some counter arguments can be identified within the statement of Drucker, written in a letter to Ackoff (2004):

“…QUANTITATIVE ANALYSIS comes AFTER the THINKING—it validates the thinking; it shows up intellectual sloppiness and uncritical reliance on precedent, on untested assumptions and on the seemingly “obvious.”…”

Loveridge (1996) points the boundaries of foresight model building referring to the subjective implicit boundary settings. Keeping in mind that impacts of foresight lie to an major extent in the field of organizational learning, the view of the future as models of the future “is someone’s vision of the future” (1996, 2), Loveridge has to be enhanced. In contrast to other methods, formal methods like simulations express tacit knowledge and implicit models. Furthermore, the great power of simulations in comparison to other methods is that even though the modelling process might be affected by similar group and individual psychological biases, the information processing is not. In addition, whereas the conscious human information processing is very limited, this is not the case with simulations.
Figure 3 shows an exemplary evaluation based on the earlier introduced criteria and literature analysis with a scale ranging from zero to five as a representation of the potential benefits for innovation management.

![Exemplary evaluation of foresight methods based on innovation management needs.](image)

Source: own.

Summarising these findings, evaluation (figure 3) and taking an ideal corporate foresight process usable for innovation management into account (figure 2), figure 4 shows a gradual combination of methods usable for innovation management according to different stages. As indicated earlier, for the first stage of screening very specific methods as, e.g. patent analysis or bibliometrics have to be applied additionally. This is also the case for the stage of commercialisation.

![Adopting foresight methods to innovation management stages.](image)

Source: Author's representation based on: (Cooper, 1990).
Conclusion

This paper presented an early evaluation framework for method addressing the needs of a corporate foresight use within innovation management. Thereby arguments regarding psychological biases and human processing capabilities have been integrated, selected methods evaluated and adapted to innovation management processes.

The surrounding environment in which CF is applied has been classified by literature as fast, dynamic with many agents and factors playing a role, thus complex. Remarkable is the fact that most methods try to handle, or absorb such complexity by simple means.

Studies show that most publications on corporate foresight deal with methods (Thom, 2007), but only a handful of methods are used frequently as most participants and companies lack sufficient method know-how (e.g. Becker, 2002; Popper, 2008). It seems that CF methods are chosen not according to requirements, but other characteristics (Andersen and Rasmussen, 2012; Popper, 2008). The use of handful methods, that additionally are less robust to input, could be explained by other aims, as indicated before.

As it is indicated before, popular methods of corporate foresight have to be adapted to meet corporate needs and avoid biases. Models and simulations with computers processing information are used less frequently, but show more robustness against intervention, abuse and have a higher information processing and complexity absorption capacity. Findings suggest that the assessment of methods regarding certain questions of foresight in a corporate environment needs to consider the sensibility of methods towards assumptions and decisions by stakeholders of the process on the one hand and participation and communication issues on the other hand. Fitting methods to CF aims in the style of a triangulation of qualitative and quantitative information and processing methods could be a means of overcoming biases (Denzin 1970, 2009).

Summarizing the findings for innovation management, the combination of scenarios and simulation (also quantitative scenarios) seems to present a good trade-off between creative stimulation, information processing and avoiding psychological biases.

To avoid foresight activities becoming nothing more than reproducing strong ideas and legitimize actions already taken (Barend van der Meulen et al., 2003 p. 226) and to develop CF as a capability (Major et al., 2001; Rohrbeck, 2011), also the selection and use of CF methods has to be enhanced by further research.

References


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