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METHODS AND TOOLS OF CORPORATE TECHNOLOGY FORESIGHT

Key words

Technology foresight, technology scouting, innovation management.

Abstract

Technological developments can be both, opportunity or threat to businesses. While they may have disruptive character and do add to the uncertainty every company is faced with, foreseeing these developments and acting timely is crucial for success. Methods and tools of technology foresight can reduce uncertainty and prepare for future changes. Depending on characteristics such as industry, size, or internationalization different approaches make sense on the corporate level. Success of foresight activities is related to a company's capabilities in the identification of developments and trends, but also in their interpretation and the utilization of gained insights. The following article will give an overview and examples of best practices for corporate technology foresight.

1. The need for corporate foresight

The dynamics organizations are confronted with – including technological change, growing competition, changes in society and culture, and changes in legislation and regulation – forces them constantly to innovate and to adapt to their environment for success and survival [1, 9, 18, 33]. These dynamics lead to complexity and uncertainty about the future [27]. Respectively, changes in an

organization's environment need to be identified, monitored, and assessed in order to reduce this uncertainty [4, 15]. Finally, the gained insights have to be used to respond accordingly to the environmental change [37]. While potential threats coming from such changes could be turned into opportunities [2], many companies fail to do so due to a lack of foresight capabilities [7, 11].

Companies have always had ways to watch moves of competitors and were seeking opportunities from new technological developments. However, these efforts often were not coordinated [15] and the usage for strategic decision making has been low [23]. Driven by the ever growing complexity coming from dynamic environments, recently more and more companies show interest in practices of corporate foresight [13, 34]. Methods and tools of corporate foresight can support the identification and assessment of environmental changes as well as the utilization of gained insights [32].

2. Establishing corporate foresight

When introducing foresight activities on the corporate level, as a first step a company should define who will be the user of results, what are the information needs of this user and what are the areas where information has to be searched [3, 5, 10, 22, 29]. Depending on these factors different approaches should be used in the foresight process itself, which consists of three major steps: (1) collection of information, (2) interpretation, and (3) utilization [5, 12, 20, 30]. Information can be collected by scanning the environment (competitors, customers, science, etc.), internal resources and external networks. The collected data is given meaning in the step of interpretation by analyzing and assessing new technologies, new products and services, and by anticipating consumer needs. In the utilization phase finally a response to the gained insights is made, e.g. by launching new projects, developing new business fields, sourcing know-how, or making strategic decisions on activities and budget allocation (Fig. 1).

While a structured foresight approach is believed to have a positive impact on making the right decisions, there is no one-fits-all solution for designing such an approach. Choosing appropriate processes, organizational structures, and methods and tools depends on the context an organization is in, including size of the company, industry, complexity of environment, corporate culture, strategy, and source of competitive advantage (Table 1). Moreover, the financial resources of a company will have an influence on their foresight approach. Foresight activities can be costly and their budget has to be justified [14, 36]. Limited resources are the main concern of SMEs, when designing and implementing such activities [35]. This does not imply that only wealthy multinational companies could afford foresight. Rather, every company should design their foresight capabilities according to their context.

Table 1. Context factors

Context criteria	Description
Company size	Company size by revenues and number of employees; a company of large size will rather need high efforts in foresight, in order to initiate change despite complex internal structures.
Nature of strategy	The generic strategy, which can be differentiation, cost leadership, or focussing on a niche; while focusing on a niche market or cost leadership (through copying existing products and services) will only require medium foresight efforts, a differentiation strategy will require high efforts in scanning for disruptive technologies, products and services, and business models.
Corporate culture	The degree of empowering individual initiative and reaching attention of top management quickly; a high such degree would lead to faster reactions to environmental change.
Source of competitive advantage	The driver of success, which can be either technology or customer orientation; technology-oriented companies should focus foresight on competition, customers, and politics; companies whose sources are both customers and technology should focus their efforts on the use of methods integrating those perspectives.
Complexity of environment	Complexity coming from the number of interdependencies to be monitored and considered; a high complexity, e.g. from dependency on regulation, technologies, public funding, or global economy, increases uncertainty and thus requires higher efforts in foresight.
Industry clockspeed	Rate of introduction of new products, processes, and organizational structures; a high clockspeed increases uncertainty and thus requires higher efforts in foresight.

Source: Rohrbeck et. al. 2010.

While the context of an organization determines its needed efforts in foresight, these efforts can be undertaken in certain areas. For a benchmarking study comparing the foresight capabilities among multinational companies from different industries, five factors have been chosen which are believed to having an impact on the success of foresight (Table 2).

Depending on a company's context, information coming from the company's environment (competition, customers, technology, and politics) including current business, adjacent business and white spots should be identified and used. Sophisticated methods can support both, the collection of information as well as its interpretation. An own bibliographic analysis revealed that most literature related to foresight is addressing methods (Table 3).

Table 2. Success factors of foresight

Success factor	Description
Information Usage	Where and how do companies search for future-oriented information?
Method Sophistication	Which methods are applied for anticipation of future developments and how do companies choose these methods?
People & Networks	What are characteristics of foresighters and how are insights from foresight disseminated and used within companies?
Organization	How and where within companies are foresight activities started and how are these activities linked to other organizational units?
Culture	How supportive is the corporate culture towards foresight activities?

Source: Rohrbeck et. al. 2009.

Table 3. Frequency of discussed foresight methods in identified articles

Method	Micro level	Macro level	Micro & Macro level
Benchmarking			2
Bibliometrics	1	2	1
Cross-impact analysis		1	
Database search			1
Delphi method	1	22	
Devil's Advocacy	1		
Extrapolation		1	
Patent analysis	1	2	1
Roadmapping	11		4
Scenario planning	6	2	7
S-Curves		1	
SWOT analysis			1
Technology Scouting	4		
Technometrics			1
Text Mining	1		
TRIZ	2		

Source: Rohrbeck et. al. 2009.

On the micro level of companies especially roadmapping, scenario planning, and technology scouting are discussed frequently. Also roadmapping and scenario planning are considered to be a very common practice of companies [10, 19, 21, 24]. Roadmapping is considered being especially effective on a business unit level [38].

The success factor People & Networks refers to the importance of having skilled and suitable foresighters, strong external networks as a source of information and strong internal networks as a channel of foresight insights to decision makers [32]. People can be categorised into information providers and information users [5, 6]. Also people may be from within the corporation or outside. Internal experts are needed, because they understand the organization's characteristics and needs [38]. These experts can have different backgrounds at different levels of the organization, including research, marketing, or sales [5, 27]. External experts are required, because they understand customer needs, and developments and trends in markets and technologies [25]. In addition, it is believed that knowledge from external sources has a higher attention and appreciation by management [26]. External sources could include customers, suppliers, universities, consultants, etc. [5, 10, 30].

Closely linked to people and networks is the organizational structure of foresight, which defines at which level of the organization foresight responsibility is located. Corporate foresight may be executed by a central foresight unit, as an additional task by existing units (e.g. R&D), decentralized within all organizational units, or as the responsibility of every employee. While companies with a diversified product mix seem to prefer decentralized or diffused forms, companies with a non-diversified product mix rather seem to use central structures [5]. Furthermore, it is being differentiated between full-time and part-time foresighters from inside or outside the company [10, 39].

Finally, the aspect of corporate culture is believed to be crucial for the success of foresight. Depending on the attitude inside a company toward sharing of information, valuing this information and accepting the need for changes foresight results will be used – or not [15].

3. Methods and tools of technology foresight at Deutsche Telekom

Deutsche Telekom is a multinational telecommunications provider with about 258,000 employees in more than 50 countries and revenues of EUR 64.6 billion (in 2009). Hence, it can be considered a large company with a need to address all success factors of corporate foresight with highly sophisticated means. Being a network-based organization in a highly competitive sector with a high clockspeed and therefore not only dependent on technology, but also on regulation, foresight is crucial for its success and survival. Following rather a differentiation strategy it has to scan constantly for changes in its environment. It's competitive advantage being driven both by technology and customer-orientation, Deutsche Telekom has to focus foresight on all perspectives: technology, competition, customers and politics. Also, these perspectives need to be integrated into the "full picture".

At Deutsche Telekom the technology perspective of foresight is addressed by one major tool – the Technology Radar – and three major methods – technology scouting, round tables, and roadmapping (Fig. 1).

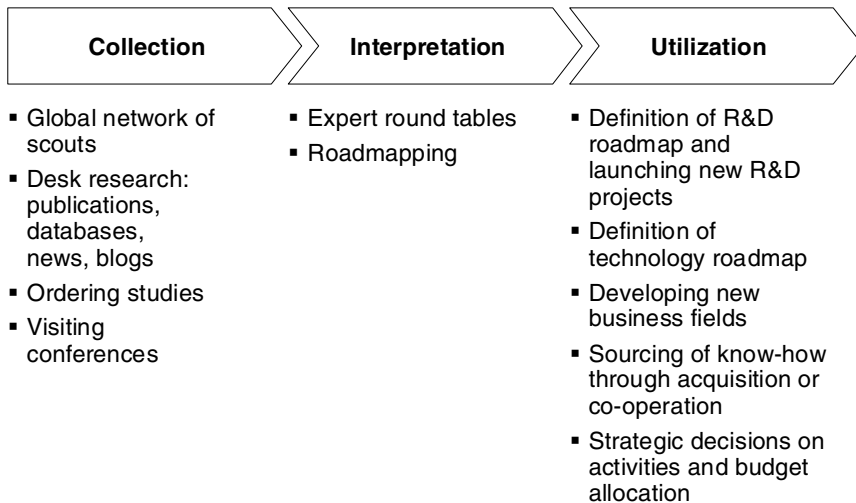


Fig. 1. Technology foresight process at Deutsche Telekom
Source: Author.

The Deutsche Telekom Technology Radar is a tool for identification, assessment, and communication of technological developments and trends. Its goal is to create awareness among innovation responsible concerning opportunities and threats coming from these developments and to initiate response. The information users are within the corporate innovation strategy, corporate R&D, as well as among product managers. Moreover, aggregated reports are made available to every employee of Deutsche Telekom in the spirit of sharing information and organizational learning. Following the identified needs of its users, the Technology Radar is scanning for developments in six technological areas (fixed & mobile devices, access network, core network, network services, end-user services, and cross-functional technologies). Moreover, it distinguishes concerning the maturity of the identified technologies (from basic research to market presence) and displays them on a radar screen for visualization and enabling filtering of information (Fig. 2).

In the process of technology foresight via the Technology Radar, technology scouting is used as a major method in the phase of collection. Technology scouts are employees of Deutsche Telekom fulfilling this role part-time, but also professional consultants who are scouting for developments and trends full-time. Using both, internal and external scouts enables a better

geographical coverage as well as internal and external perspectives. With their broad knowledge about developments outside of the company, these scouts are likely to complement corporate innovation activities [16]. In addition, the use of scouts with their personal networks in industry and academia enables better access to the identified developments, e.g. through collaboration, licensing, or buying [8, 17, 39]. Besides their personal networks, technology scouts are sourcing their information among other from journals, conferences, or databases. The identified information is regularly communicated to the Technology Radar responsible.

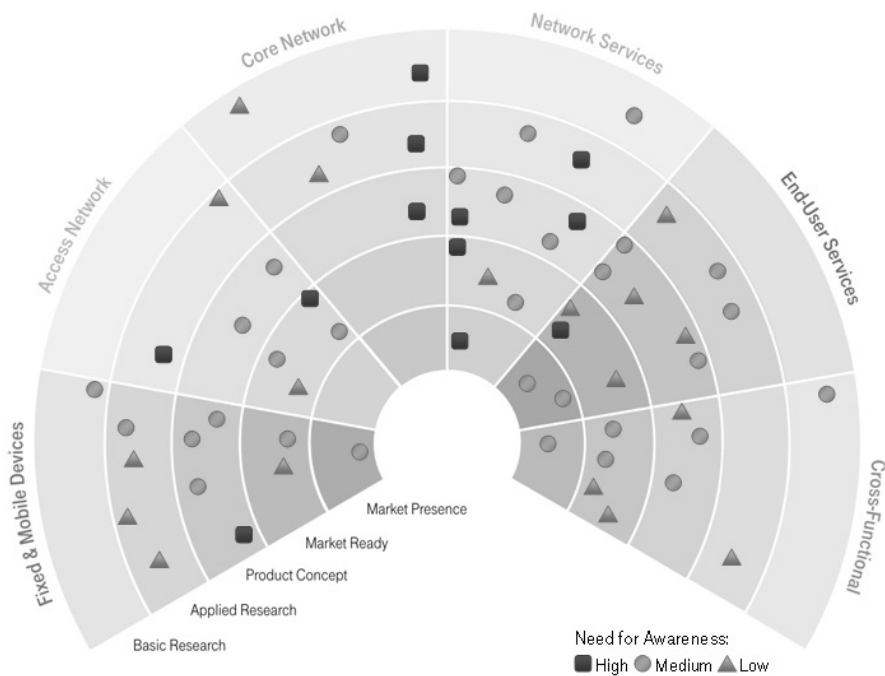


Fig. 2. Deutsche Telekom Technology Radar screen
Source: Author.

In the second phase of interpretation, the proposed technological topics are being selected and assessed by a panel of experts coming from corporate innovation strategy, different business units, as well as corporate R&D. Depending on the perceived relevance, innovativeness and existing awareness out of a long-list of topics a short list is being selected. Each short-listed topic is further assessed concerning their need for awareness (high, medium, or low) based on estimated market potential and technological realization complexity. Finally, a one-pager for each technology is created including description of

innovative aspect, technological details, research status, and business potential. While this process step aims at selecting and assessing information for later publication, the biggest value contribution is another one. Communication across different departments of the corporation is facilitated. Decision makers are forced to look into the identified subjects and to discuss them from different perspectives. Hence, it also addresses the step of utilization.

On the corporate R&D level all identified topics are being matched with existing own R&D activities. The created discussions reveal potential gaps and thus can be the starting point for new projects. Moreover, existing activities are being challenged based on new technological developments. This way the round table on the corporate R&D level ensures doing the right things and the things right. On the corporate level another round table takes place, where insights from Technology Radar are matched with insights from market research, competitor foresight, consumer foresight, and corporate strategy. This allows for a better assessment of developments as well as directly influencing the adjustment of existing corporate strategies. Finally, while strategies are mainly words, roadmapping is used as a means for turning insights into action. It is a commonly used method that allows matching consumer needs with technological capabilities in order to plan product evolution over time [28]. At Deutsche Telekom a roadmap is used to match both, user needs as well as technological alternatives to fulfil these needs, identified by the Technology Radar. The matching process has to cope with uncertainties about which technological alternative should be selected, when will it be available, and have all alternatives been identified. Via the Technology Radar these uncertainties have already been reduced. What remains is merely an exercise of integrating the insights from technology foresight with a market perspective. In a workshop R&D representatives present emerging technologies in an aggregated form of functional modules. Product managers then assess the suitability of these modules for use cases they derive from products. As a result technologies are being identified for a roadmap towards new products and services. Hence, technology foresight acts as a starting point not only for R&D, but also for product and service innovation.

Conclusion

In conclusion, corporate foresight is a relevant topic for every company. The company's context defines the degree of foresight needed as well as the areas in which foresight should take place. Many methods are known to support corporate foresight, while their applicability also depends on the context. For the market perspective other methods are proposed than for the technology perspective; for the micro level of a company other than for the macro level of an economy or industry sector. While much literature is available describing the

methods, further research is needed on how to choose the right methods in a certain situation. As for technology foresight, technology scouting has been proven successful for the collection of information, but also for its utilization. Technology scouting is not restricted to large corporations. While every employee could act as a technology scout, the additional use of external experts has the advantage of a broadened perspective and network. While technology-driven companies should follow technological developments, they also have to consider developments in competition, consumer behaviour and political environment. Roadmapping and round tables have been proven suitable methods to integrate these perspectives. While there is no one-fits-all solution, the framework suggested by Rohrbeck [32] can be a starting point for companies in a specific context to define their foresight activities. The example given on a multinational company might not scale down for an SME. But while an SME might have fewer resources, its smaller size also bears the advantage of better internal communication, reducing the cost. With an appropriate corporate culture and supporting organizational structure, every company can afford and run effective foresight.

References

1. Anderson J. (1997): Technology foresight for competitive advantage. In: *Long Range Planning* 30(5):665–677.
2. Ansoff H.I. (1980): Strategic Issue Management. *Strategic Management Journal*, 1(2), 131–148.
3. Ashton W.B. et al. (1996): Monitoring science and technology for competitive advantage. In: *Competitive Intelligence Review* 7(1), 115–126.
4. Ashton W.B. et al. (1991): A Structured Approach for Monitoring Science and Technology Developments. In: *International Journal of Technology Management* 6(1, 2):91–111.
5. Ashton W.B., Stacey G.S. (1995): Technical intelligence in business: Understanding technology threats and opportunities. In: *International Journal of Technology Management* 10(1):79–104.
6. Bergeron P., Hiller C.A. (2002): Competitive intelligence. In: *Annual Review of Information Science and Technology* 36, 353–390.
7. Bondu J. (2001): *Benchmarking des Pratiques d'Intelligence Économique Intelligence Scientifique, Technique et Economique*. Paris: ESIEE, 126.
8. Brenner M.S. (1996): Technology Intelligence and Technology Scouting. In: *Competitive Intelligence Review* 7(3):20–27.
9. Brown S.L., Eisenhardt K.M. (1995): Product Development – Past Research, Present Findings, and Future-Directions. In: *Academy of Management Review* 20(2):343–378.

10. Bürgel H.E. et al. (2005): Technologie-Früherkennung in multinationalen Unternehmen: Ergebnisse einer empirischen Untersuchung. In: Möhrle MG u. R. Isenmann (Hrsg) Technologie-Roadmapping – Zukunftsstrategien für Technologieunternehmen. Springer-Verlag, Heidelberg, New York, 27–53.
11. Christensen C.M. (1999): The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Harvard Business School Press, Cambridge.
12. Daft R.L., Weick K.E. (1984): Toward a Model of Organizations as Interpretation Systems. In: Academy of Management Review 9(2):284–295.
13. Daheim C., Uerz G. (2006): Corporate Foresight in Europe: Ready for the Next Step? Second International Seville Seminar on Future-Oriented Technology Analysis: Impact of FTA Approaches on Policy and Decision-Making. Seville, Spain, 16.
14. Davison L. (2001): Measuring Competitive Intelligence Effectiveness: Insights from the Advertising Industry. In: Competitive Intelligence Review 12(4):25.38.
15. Day G.S., Schoemaker P.J.H. (2005): Scanning the periphery. In: Harvard Business Review 83(11):135–148.
16. Dougherty E. (1989): Tech Scouts: R&D's Globetrotters. In: Research & Development 31(10):44–50.
17. Duberman J. (1996): Information to change the world-fulfilling the information needs of technology transfer. In: Database 19(5):34–45.
18. Eisenhardt K.M., Martin J.A. (2000): Dynamic capabilities: What are they? Strategic Management Journal, 21(10-11), 1105–1121.
19. Eto H. (2003): The suitability of technology forecasting/foresight methods for decision systems and strategy – A Japanese view. Technological Forecasting and Social Change, 70(3), 231–249.
20. Gregory M.J. (1995): Technology Management – a Process Approach. In: Proceedings of the Institution of Mechanical Engineers Part B-Journal of Engineering Manufacture 209(5):347–356.
21. Grupp H., Linstone H.A. (1999): National technology foresight activities around the globe – Resurrection and new paradigms. In: Technological Forecasting and Social Change 60(1):85–94.
22. Lackman C.L. et al. (2000) Organizing the Competitive Intelligence Function: A Benchmarking Study. In: Competitive Intelligence Review 11(1):17–27.
23. Lesca H., Caron M.-L. (1995): Veille stratégique: créer une intelligence collective au sein de l'entreprise. Revue française de Gestion, 10558–68.
24. Lichtenthaler E. (2005): The choice of technology intelligence methods in multinationals: towards a contingency approach. In: International Journal of Technology Management 32(3-4):388–407.

25. Lüthje C. et al. (2003): Knowledge distribution among market experts: a closer look into the efficiency of information gathering for innovation projects. In: *International Journal of Technology Management* 26(5/6):561–577.
26. Menon T., Pfeffer J. (2003): Valuing internal vs. external knowledge: Explaining the preference for outsiders. In: *Management Science* 49(4):497–513.
27. Patton K.M. (2005): The role of scanning in open intelligence systems. In: *Technological Forecasting & Social Change* 72(9):1082–1093.
28. Phaal R. et al. (2004): Technology roadmapping –A planning framework for evolution and revolution. In: *Technological Forecasting and Social Change* 71(1-2):5–26.
29. Reger G. (2001): Technology foresight in companies: From an indicator to a network and process perspective. In: *Technology Analysis & Strategic Management* 13(4):533–553.
30. Reger G. (2006): Technologie-Früherkennung: Organisation und Prozess. Quantensprünge in der Entwicklung erfolgreich managen. In: Gassmann O u. C Kobe (Hrsg) *Management von Innovation und Risiko*. Springer, Berlin, 303–330.
31. Rohrbeck R. et al. (2009): Benchmarking Report: Strategic Foresight in Multinational Companies. European Corporate Foresight Group.
32. Rohrbeck R. (2010): *Corporate Foresight: Towards a Maturity Model for the Future Orientation of a Firm*. Physica-Verlag, Springer, Heidelberg, New York.
33. Rothwell R. (1992): Successful Industrial-Innovation – Critical Factors for the 1990s. In: *R & D Management* 22(3):221–239.
34. Schwarz J.O. (2008): Assessing the future of futures studies in management. *Futures*, 40, 237–246.
35. Savioz P. (2002): *Technology Intelligence in Technology-based SMEs*. ETH Zürich, Zürich.
36. Slaughter R.A. (1996): Foresight beyond strategy: Social initiatives by business and government. In: *Long Range Planning* 29(2):156–163.
37. Slaughter R.A. (1998): Futures studies as an intellectual and applied discipline. In: *American Behavioral Scientist* 42(3):372–385.
38. Slowinski G. et al. (2000): Acquiring external technology. In: *Research Technology Management* 43(5):29–35.
39. Wolff M.F. (1992): Scouting for Technology. In: *Research Technology Management* 35(2):10–12.

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Metody i narzędzia korporacyjnego foresightu technologicznego

Słowa kluczowe

Foresight technologiczny, rozpoznawanie technologii (ang. technology scouting), zarządzanie zmianą.

Streszczenie

Rozwój technologiczny może być zarówno szansą, jak i zagrożeniem dla przedsiębiorstw. Z jednej strony jego charakter może być destrukcyjny i pogłębiać istniejącą niepewność działania, z jaką i tak borykają się przedsiębiorstwa, z drugiej zaś to właśnie przewidywanie trendów rozwoju nowych technologii i reagowanie na nie w odpowiednim czasie jest kluczowe dla osiągnięcia sukcesu.

Metody i narzędzia foresightu technologicznego mogą zmniejszyć niepewność i przygotować przedsiębiorstwo do przyszłych zmian. Na poziomie korporacyjnym zastosowanie właściwych metod identyfikuje się w zależności od sektora, w którym działa przedsiębiorstwo, wielkości przedsiębiorstwa czy też stopnia jego internacjonalizacji.

Powodzenie we wprowadzaniu foresightu technologicznego zależy nie tylko od zdolności przedsiębiorstwa do identyfikowania przyszłych trendów, ale również od umiejętności interpretacji i wykorzystania uzyskanej wiedzy. Artykuł stanowi przegląd i przykład najlepszych praktyk stosowanych w obszarze korporacyjnego foresightu technologicznego.