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IT tools for foresight: The integrated insight and response system of Deutsche Telekom Innovation Laboratories

René Rohrbeck^{a,*}, Nico Thom^{b,1}, Heinrich Arnold^{c,2}^a Aarhus University, Business and Social Sciences, Department of Business Administration, Bartholins Allé 10, 8000, Aarhus C Denmark^b Schaltzeit, Sorauer Str 3, 10997 Berlin, Germany^c Telekom Innovation Laboratories, Ernst-Reuter-Platz 7, 10587 Berlin, Germany

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ABSTRACT

In this article we present and discuss the IT tools that Deutsche Telekom Innovation Laboratories use to support their corporate foresight activities. **These tools are integrated into an approach that encompasses the discovery of change, interpretation, and triggering managerial responses. The overall system consists of a tool for scanning for weak signals on change (PEACQ Scouting Tool), a tool for collecting internal ideas (PEACQ Gate 0.5), and a tool for triggering organizational responses** (Foresight Landing page). Particularly the link to innovation management and R&D strategy is discussed in detail. We further report on the value creation and lessons learned that have accumulated over the last eight years throughout which the tools and approach have been built gradually.

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1. Introduction

In many industries, firms are increasingly looking at corporate foresight approaches to help them increase their responsiveness towards external change [1–4]. At the same time new information technology (IT) based tools have emerged that can support corporate foresight activities and increase their productivity.

In the past years, many firms have experimented with the usage of social networks inside and outside the firm [5], with Internet-based broadcast search [6,7], and idea competitions [8]. To a lesser extend also tools such as (real-time) Delphi analysis [9,10], Wikis [11,12], and prediction markets [13].

In this article we explore how such IT-based tools are integrated in a consistent system that includes scanning for

change and triggering organizational responses. Or put differently, we aim to shed light on how IT tools need to be combined to bridge the gap between corporate foresight and follow-up functions such as innovation and strategic management.

Our discussion is based on existing literature on the topics corporate foresight, IT tools in management, and IT tools in foresight as well as on our 8 year experience of using IT tools for corporate foresight, innovation and strategic management at Telekom Innovation Laboratories (T-Labs).

T-Labs are the central research and innovation unit of the telecommunication provider Deutsche Telekom (DT). T-Labs work closely with the operative units of the corporation offering new ideas and support in the development and implementation of innovative products, services and infrastructures for DT's growth areas. T-Labs have locations in Berlin, Darmstadt, Bonn (Germany), Beer Sheva and Tel Aviv (Israel), and Mountain View (USA).

With this large geographic reach and a topic scope reaching from core network functionalities, through secure communication to IP-based end-user services, T-Labs need to build a foresight approach that is broad enough to serve all areas (and

* Corresponding author. Tel.: +45 871 64929.

E-mail addresses: rrohr@asb.dk (R. Rohrbeck), thom@schaltzeit.com (N. Thom), Heinrich.Arnold@telekom.de (H. Arnold).

¹ Tel.: +49 30 61289260.² Tel.: +49 30 835358420.

potential white spots), but which also generates insights that are concrete enough to trigger organizational responses.

In this article we conclude with lessons learned and general recommendations on how to implement IT-based foresight and innovation management systems.

2. Literature review

2.1. The corporate foresight process

The foresight process discussion has been inspired and guided particularly by the “Organizations as Interpretation Systems” model of Daft and Weick [14]. They identified three steps that lead from perceiving change to an organizational response:

- Step 1: “scanning – data collection”, where the change is perceived
- Step 2: “interpretation – data giving meaning”, where the perceived change is translated into organizational implications
- Step 3: “learning – action taken”, where the organization defines and executes a response based on their insights into their environment.

Their model has inspired many foresight activities for both public organizations [15,16] and private firms [2,17–20].

While the model of Daft and Weick is particularly useful as a mental framework it is weaker on highlighting the important aspects of implementing foresight activities. Building on an earlier multiple case study with 19 large European companies we identified 5 major barriers in translating signals on change into organizational responses [4] (see Fig. 1).

When designing a foresight process these barriers can be taken as a starting point, which allows identifying the activities that need to be implemented and the actors that would drive these activities. In Fig. 1 we distinguish between the actor responsible for the step and actors that are needed as participants. It can be seen that scouts drive the initial detection of signals in the environment. We define scouts as either internal employees or hired consultants that gather data on changes through multiple means, including expert interviews, data mining, and visiting conferences and other relevant events [21].

This first detection is particularly challenging and can be characterized as a search for a needle in a haystack in which you do not know what you are looking for [22]. Liebl and Schwarz

propose to operationalize this search by distinguishing into the novelty aspect (“invention”) and the diffusion aspect [23]. In that way the novelty filter provides a large number of candidates for important changes, and assessing for a sufficient diffusion allows identifying the changes that are on the track to become major changes. At the same time it is important to keep an open mind and not focus too much on a limited number of megatrends, which would in most cases result in additional blind spots [24].

After the initial detection most firms would employ foresighters to serve as process facilitators or brokers [25] between the scouts and internal stakeholders that trigger organizational actions. We define these foresighters as internal employees, performing the functional task of supporting the translation of change drivers into organizational responses. This functional task can be enacted through re-phrasing of change drivers, publishing trend reports, organizing workshops, creating inspiring visions and scenarios [26,27] or through any other suitable methods to increase communication and ensure a high level of participation of internal stakeholders.

These internal stakeholders include upper management decision makers (for example the executive board) and the actors responsible for planning and executing the organizational response. In the process model we mention innovation and strategy managers as two examples for the latter group, but depending on the role distribution in the respective organizations' organizational responses might also be owned by functions such as corporate development, risk management, and strategic marketing.

For innovation management, corporate foresight would be expected to first and foremost contribute by spotting innovation opportunities and initiating innovation projects [28], particularly in times when the environment is uncertain [29]. In addition, firms are also using corporate foresight to continuously monitor and challenge the state-of-the-art of on-going innovation projects and in a more strategic role, to support the identification of new promising innovation fields [30]. Thus, foresight would also be expected to contribute to the overall innovation capacity of a firm [31].

For strategic management, corporate foresight would be expected to contribute to management under uncertainty [32,33]. More specifically, corporate foresight should help informing decision makers about how to deal with state, effect, and response uncertainty [1,34]. This is particularly important

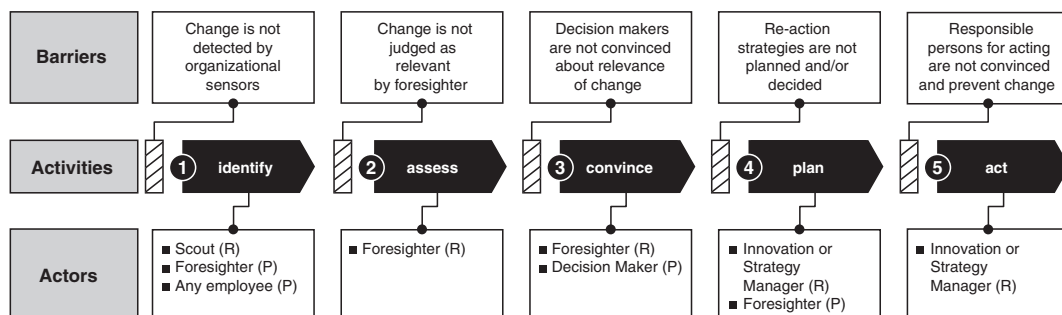


Fig. 1. Foresight process with barriers, activities and actors (based on [4]).

for decisions that need to be taken in the short-term, but which will have a strong impact on the long-term competitiveness of an organization [35]. In addition, corporate foresight might support a broader dialogue with other external stakeholders to prepare systemic change through orchestrated actions [36]. Another important role of corporate foresight might be to facilitate organizational learning and thus promoting adaptations processes [37].

In our process model we also agree with the expectation that foresight processes and indeed change processes are centered on people [38]. Thus, it is important to point out that IT tools should not replace, but rather facilitate human interaction and induce collective cognition processes.

2.2. IT tools for corporate foresight

In the last 15 years, the usage of IT tools in management has been fuelled in particular by the fast development of web-based applications. It has always been the expectation that IT tools would help to augment individual creativity, work productivity, and in particular augment the productivity of communication [39]. Here, IT support tools can be expected to reduce the effort and thus hopefully increase the direct interaction of experts, leading to an increase of opinion sharing among them [40]. It has also been shown that large, knowledge-intensive firms and firms that work under an open architecture framework are more likely to adopt Web 2.0 solutions (browser-based applications with a focus on interaction and collaboration), suggesting that IT tools create more value for these firms [41].

Much of the debate on IT tool usage is focused on their ability to enhance the capture, retrieval, combination, and usage of knowledge [12,42]. In that respect it has been shown that IT tools have a positive impact on input-based competencies, transformation-based competencies, and output-based competencies [43]. Particularly Web 2.0 technologies are expected to act as a lever for organizational learning and knowledge exchange [44]. Further, it can be expected that the degree of openness, freedom, and employee empowerment in corporate environments will have an effect on how strong the positive effect of the IT tools will be [45,46].

From the foresight perspective, Web 2.0 tools can advance foresight methodologies and increase transparency [47], leading to an increased likelihood of creating impact. They also allow integrating own employees in the insight search and in the interpretation process [25,43]. In addition, Web 2.0 has led to a faster diffusion of issues, leading to an inadequacy of existing sensors. Using Web 2.0 tools to enhance existing sensors can however open the opportunity for catching up with the increased pace of change, enabling again timely responses [42,48].

When investigating which Web 2.0 tools could be used for foresight purposes, we find many candidates, such as prediction markets [13], online idea competitions [8], social networks [5], Internet-based broadcast search tools [6,7], real-time Delphi analysis [10], and Wikis [11,12,49]. In addition to these more sophisticated special tools there are a number of universal tools that can contribute functions to a foresight support system. An overview of IT tools useful for foresight is given in Table 1.

There is however only a limited understanding about how individual IT support tools can be integrated into holistic

foresight support systems [50]. Most likely a combination of tools can help to overcome weaknesses of the individual tools [51,52]. Also, social networks can be expected to be a central part, forming an interaction and common working platform [53,54]. Further, group decision-making support through voting mechanisms can be expected to be important in most foresight support systems [55], particularly if decision under high uncertainty [56] and high impact decisions, such as mergers and acquisitions [41], need to be prepared.

It is important to also point out the disruptive character of the introduction of an IT support tool. Tools are implemented to change the way people work [57], but one should also beware of the potentially negative aspects. High-impact decisions can be expected to require the agreement of multiple decision makers, which can often be achieved only through trusted relationships and direct interaction. Therefore, it is important that the IT tools do not discourage direct face-to-face discussions.

3. IT tools supporting foresight at Deutsche Telekom

3.1. Context

With a number of roughly 230,000 employees and an innovation culture that encourages them to share their ideas and insights, Deutsche Telekom (DT) has a strong need for supportive IT tools and implemented a number of them for specific purposes. On the corporate level especially a corporate social network (Telekom Social Network), an idea management platform, as well as prediction market and (internal and external) idea competition solutions enable employees (and the outside world) to participate in developing, assessing, and implementing new ideas.

While DT is open to innovative ideas from any employee (and increasingly from outside its organization), Telekom Innovation Laboratories (T-Labs) as DT's research and innovation unit have the explicit mission to generate innovative products and services for the Deutsche Telekom Group. It is thus not surprising that innovation management at T-Labs among others relies on foresight activities, enabling the early detection of new opportunities and threats.

Given the complexity and size of the organization as well as the volatile environment of the telecommunication sector as such, T-Labs' IT tools support their foresight activities across all three foresight-process steps:

- **Data Gathering: enabling a large number of contributors from inside and outside the organization to share information (ideas, observations, insights, etc.), the IT tools being particularly useful for handling a large quantity of information**
- **Interpretation: enabling multiple stakeholders to assess and judge information from their perspectives and to participate in a dialogue with other stakeholders**
- **Organizational Response: enabling follow up activities, particularly with innovation management through a direct process link**

Thus, these tools support (1) scaling the information processing capacity of the company, (2) participation independent of geographical location, and a high reach to information users across the globe, as well as (3) more efficient

Table 1

IT tools for foresight, an overview (extended version of [4]).

Tool	Description	Used for		
		dg	in	re
News readers	Software application that extracts and aggregates information on predefined topics from a selection of sources	✓		
Internal libraries	Online libraries storing studies and reports centrally to give access to all employees	✓		
Document management platforms	Systems that store electronic documents centrally, in order to enable working on them collaboratively. Includes versioning to prevent version conflicts.	✓	✓	✓
Corporate directories	Listing of all employees, which allows searching for internal experts and stakeholders.	✓	✓	✓
Social networks	Platforms where user profiles around their identity, roles and skills are presented and interaction among users is enabled. In the foresight context they are powerful tools to share information and facilitate interaction.	✓	✓	✓
Prediction markets	(Online) game in which players bet on ideas, concepts, etc. in a stock-market-like fashion, leading to prediction of the comparative value of the respective ideas and concepts.		✓	
Instant messaging	Form of communication that allows the sending of text messages as well as other documents instantaneously and thus speeds up communication and interpretation of information		✓	✓
Tagging platforms	Systems (or functionality within a system) that assign keywords to any kind of electronic information or files. These keywords support the identification of related content and their accumulation indicates trending areas.		✓	
Real-time Delphi analysis	Software program that runs a Delphi-like analysis with multiple rounds and among a group that is connected over the Internet. Such an analysis is usually completed within one or two days.		✓	
Wikis	Web pages that can easily be edited by anyone and are used to collaboratively create knowledge. Each user can add information to complete previous entries or to correct wrong information, resulting in up-to-date peer-reviewed information.		✓	✓
Online idea competitions	Platforms for collecting (crowdsourcing) ideas, e.g. for new innovation projects in a competitive manner, providing intrinsic or extrinsic incentives. They can, however also be used as a way to scan for signals on change.	✓		✓
Internet-based broadcast search	Platforms for asking online users to suggest solutions to a given problem. Similarly to online idea competitions they can also be used to collect signals on change, particularly suited for monitoring a certain field.	✓		✓
Mailing lists	Predefined groups that are known for their common need for specific information. The list is the basis for the dissemination of information to these groups.			✓
Blogs	Web sites used to regularly post new information, commentaries, graphical elements, and videos. Particularly suited to communicate information in fast-changing domains.		✓	✓

dg = data gathering, in = interpretation, re = organizational response.

and effective means of integrating foresight activities and results with other processes.

3.2. Elements

The T-Labs foresight tool approach is built on three primary platforms. While striving for a single all-rounder platform seems natural (as handling an ever growing number of tools with different user interfaces and user accounts can be a major barrier to using these tools) it is not to be recommended and impossible in practice, where actors and processes of foresight are spread across different organizational units and IT systems. Requirements, information needs, sources of information, organizational structure, and stakeholders are changing continuously, which require flexibility in the tools' information structuring and interfaces. Currently, three integrated platforms support foresight and response systems at T-Labs and its parent company:

- A database and workflow tool for scouting and assessment of developments and trends coming from markets and technology (PEACQ Scouting Tool)
- An idea generation and management system building on impulses coming from technology and market intelligence (PEACQ Gate 0.5)
- An Intranet portal for making insights available to every DT employee and for crowdsourcing additional information and opinions (Foresight Landing Page).

Fig. 2 shows the contribution of the three platforms and how they jointly cover the whole process from data gathering

to the organizational response. Fig. 2 also shows the functional aspects of the platforms and how the platforms are integrated.

3.2.1. PEACQ Scouting Tool

The functions of an IT tool should be designed on the basis of a clear understanding of quantity and type of data that it should process. While spread sheets (e.g., Microsoft Excel) can create a quick and powerful solution, they have limits regarding the amount and types of data they can hold and the number of stakeholders with their specific information needs they can serve. Databases have proven to be more useful and flexible in this regard. The foresight and R&D strategy responsible at T-Labs explain:

"In the early days of T-Labs we started scouting for developments and trends as a mean for orientation and collecting impulses from our environment. We looked at roughly 30 such topics per quarter and discussed them with a then small group of researchers and innovation managers. Today T-Labs have grown to a unit with more than 350 researchers and experts and a large number of innovation activities, and are connected to as many stakeholders across DT's international business units and corporate departments. For foresight purposes, we are now processing more than 200 topics per month, serving various intelligence purposes (including our own R&D strategy and project definition, start-up scouting for DT's innovation hubs, corporate risk management, etc.) and feeding into multiple formats, e.g. market analysis for project proposals, regular trend reports, start-up reports, or topic-specific white papers and studies for internal and

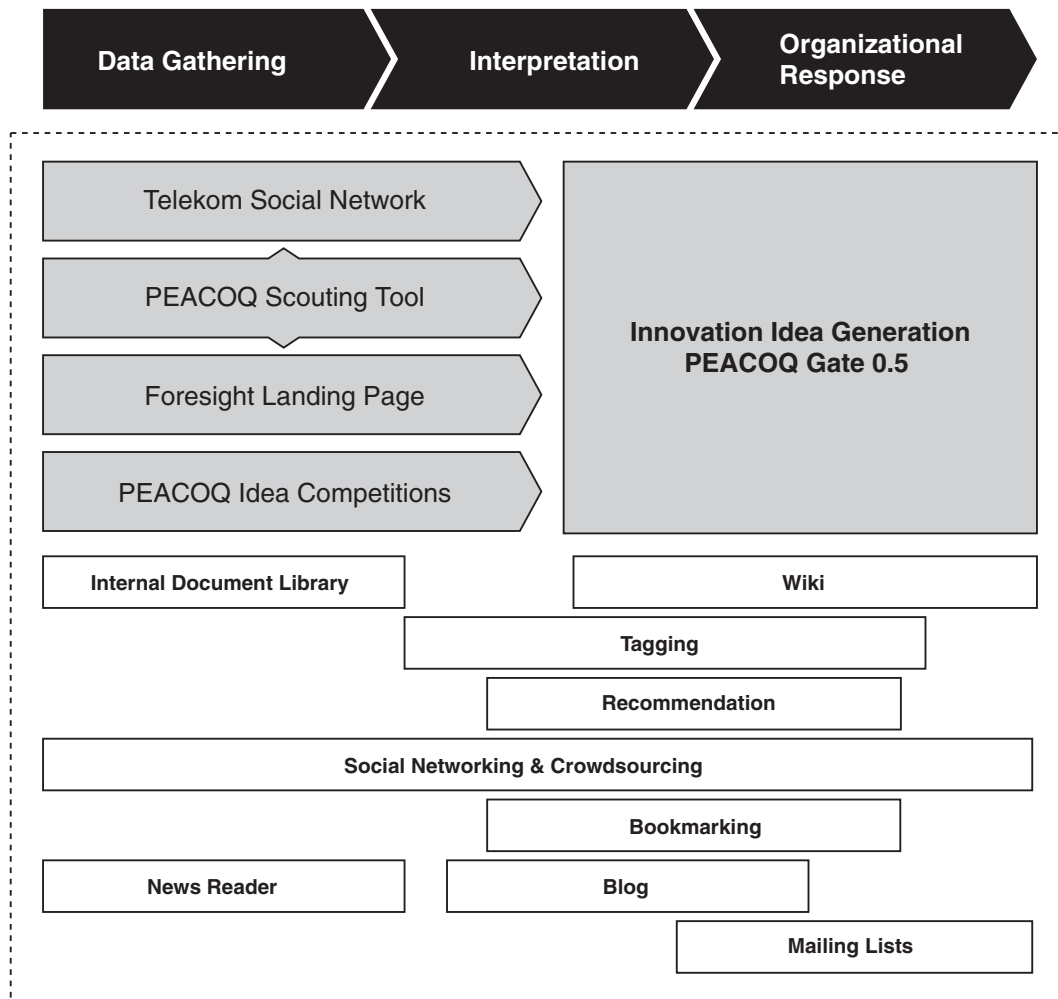


Fig. 2. IT tools for foresight at T-Labs and their combined functionalities.

external target groups. It is inevitable to have a tool that supports managing all this information and users and allowing processing and managing contents of different output formats. The tool has become a hub for interaction with many of our internal and external stakeholders."

At T-Labs, multiple sources are being used for the collection of data used for foresight purposes. **A major source is a network of internal and external scouts, who are briefed to search for developments and trends in specified areas.** They contribute their findings in the form of topics (descriptions of a development or trend and its potential relevance for DT), which are then discussed and assessed by groups of DT internal experts. Given that scouts and experts are located in different countries across the globe a virtual solution for central collection and assessment of information is needed.

Since scouts can be external professionals, this solution needs to be accessible from the Internet. And since the multiple expert groups represent different stakeholders with different information needs and criteria of assessments, a flexible user roles and

rights management as well as individual categorization of information are additional requirements. The database and workflow solution supporting these requirements was developed together with a T-Labs spin-off.

Via a secure connection scouts are able to post their topics to the browser-based platform and in addition the scout can provide references, categorization, tagging, and attach documents. Topics can either be technological developments and trends or descriptions of start-up companies and their products or services. They are structured into title, description, innovative aspects, and maturity level.

The proposal of topics is the starting point for a workflow in which topics are assessed and discussed, selected for follow-ups, or edited for internal publication. Workflow, user groups, user rights, categorization, and assessment criteria are configurable and thus adaptable to changing requirements. Throughout the workflow the status of the topic is tracked and following steps are being triggered automatically. Currently, upon adding a new topic it will first have the status of a "Draft". When being happy with their

work, scouts can publish their topics into the editorial process, starting with the status of “Topic Round”. In this round, topics are filtered regarding their quality, newness, and relevance by an editor. They are either

- rejected and moved to the status “Topic Repository” immediately,
- or a rewriting or clarification is requested sending the topic back to the scout in the status “Reply”,
- or are “Integrated” into other topics when being identical or complementing,
- or are moved to the next stage “Expert Round”.

In the expert round a group of internal experts assesses the topics, in order to discuss these and short-list them for the “Topic Selection Round”, where the decision is being taken which topics should be further analyzed. The result of such a further analysis is a “profile” (more detailed and actionable description of the selected topics). The profile writing process has its own workflow. All status changes are accompanied by optional comments and email notifications to the concerned users.

DT internal users have further personalization options, e.g. applying own categories and tags to topics or creating “containers” for topic collections (e.g., all topics relevant for a specific project). Topics can be forwarded to every DT colleague and the PEACQ Scouting Tool has interfaces to multiple systems enabling the utilization of the processed information, e.g. for idea generation (PEACQ Gate 0.5) or publication of insights (Foresight Landing Page), in order to enable access to information and strategic discussions.

3.2.2. Innovation Idea Generation tool PEACQ Gate 0.5

One overall goal of foresight is to enable early and informed decisions and triggering organizational responses. Therefore any foresight tool should have a clear interface to follow-up activities. IT tools can support foresight by making collected data available for such processes that utilize the gained insights. One area of applying foresight insights is the definition of new activities (e.g., R&D projects) through ideation and selection of best suitable alternative approaches (e.g., alternative technologies) [25].

Research and development (R&D) project management at T-Labs follows a stage gate approach, where continuation of projects requires passing the defined gates. With their so-called Gate 0.5 tool T-Labs include ideation in their gate process, ensuring evaluation and shaping of project ideas at an early stage. The online platform just like the Scouting Tool is a PEACQ implementation, but is hosted on the Intranet. Interlinking the two systems has several advantages:

- Usability: look and feel are the same, the user does not have to learn two different systems.
- Accessibility: the same credentials are being used (single-sign-on); no additional login and password are required for T-Labs employees.
- Workability: projects can be defined based on existing identified and assessed (technological) opportunities and threats, thus turning insights into action.
- Accountability: the value contribution of foresight as such can be measured easier when directly linked to follow-up activities [58].

The gate process responsible at T-Labs explains:

“T-Labs have grown bigger and are now spread across seven different locations in three different time zones. We are also linked to many stakeholders across Deutsche Telekom, which need to be involved in decision processes. Our gate process consists of three gates with different committees deciding about project proposals and projects passing each. Over time, this process has slowed down, as bringing together all required stakeholders at the same time and place at all stages has proven difficult. Decisive comments often have been made only, when much work has been already spent on shaping the project’s direction. In order to speed up the process and increase efficiency, we envisioned to bring stakeholders together at an early stage, allowing for less formal discussions and shaping of project ideas, thus creating an additional gate for more mature ideas – Gate 0.5.”

In this tool insights from foresight can serve as impulses for new innovation project ideas or for supporting or challenging existing ideas. The IT system supports the process by enabling users to (1) track topics that have been collected, assessed and discussed in the PEACQ Scouting Tool, (2) transform them into a new idea, or (3) integrating them into existing ideas on the PEACQ Gate 0.5 platform. An idea consists of a title, an idea description, a description of the technological approach, innovative aspects, and comments on its relevance. Ideas can be further categorized following current innovation fields, and tags and links can be added. Upon entering a new idea it will initially have the status of a “Draft”. Idea owners can decide to publish ideas to the status “Idea”, when they feel they would like to share it. Ideas that are no longer pursued can be moved to the status “Repository”.

After having created a new idea, based on text analysis a recommendation function suggests related project ideas (avoiding double work or enabling synergies) and related topics from the PEACQ Scouting Tool (hinting at potential enablers for an idea. These recommendations are presented as links in the meta-information section of an idea entry. As another form of recommendation, users can also forward project ideas to colleagues.

Ideas are handled like Wiki entries, allowing idea owners to invite colleagues to their ideas for collaborative idea development. The history of all changes is logged, creating versioning for the idea. Ideas can also be commented and rated according to the multiple assessment criteria of the gate process. Options for filtering and sorting lists of ideas by any criteria enable decision makers selecting candidates for new projects. Thus, the owner of the gate process can not only identify mature ideas for new projects, but also has an overview of the whole portfolio of existing ideas, which is growing by on average four ideas per week. This is especially relevant, since ad-hoc solutions to newly arising challenges are frequently in demand. The continuous dealing with environmental change and reflection of own activities – but also the preservation of resulting insights in databases – supports being prepared for such new challenges.

Overall, the introduction of the PEACQ Gate 0.5 platform achieved that new project proposals entering gate 1 have already been subject to informal processes of challenging and shaping

the original idea. This has led to less, but more mature proposals (on average two per week) in the formal gate process (which starts at gate 1), thus lowering the work load for the gate-committees members and leading to less immature proposals. At the same time it allows involving a greater number of experts in the process, leading to more participation and more promising projects. Finally, the created pool of ideas is not necessarily a “deathpool”; it is rather a knowledge pool from which ideas can re-emerge to address future challenges.

3.2.3. Foresight landing page

Foresight insights should enable decision makers to make informed thus better decisions. A major challenge lies in making information available in a suitable form to the person in need. Online solutions do not cover every user's needs and cannot replace face-to-face interaction, but allow for addressing a large user base with rich content and functionalities for search, recommendation, and interaction with this content.

Technology and start-up scouting is not the only foresight effort at T-Labs, since their user-driven innovation approach also reveals valuable consumer insights. Further, T-Labs are not the only DT unit running foresight activities. Hence, a number of results in the form of topics, articles, and reports and studies exist within the Deutsche Telekom Group covering the technology, consumer, competitor, and legal domain. A central reference platform for all these results is therefore desirable, particularly because it can be expected that looking at developments and trends from different perspectives enhances the consistency of the future outlook [21].

With their Foresight Landing Page (developed based on Drupal), T-Labs make their foresight insights available to the whole DT Group and invite other foresighters from the Group to share their results. The platform through its Intranet website allows hosting and facilitating strategic discussions around foresight topics. Users can search for information and find related content through tags and automated recommendation. Watch lists with specified keywords can be created for receiving Email notification about new content. RSS feeds enable consumption of the latest content via a newsreader.

Content is composed through full Blog-like articles, a start-up database, PDF reports and studies, as well as a user-generated chart list of currently buzzing developments and trends. This crowdsourcing approach – users of the website are encouraged to post their own topics which they consider relevant developments or trends – complements data gathering by scouting with the “wisdom of the crowds” [59], providing additional information and perspectives. All contents can be discussed, rated, bookmarked, and forwarded to colleagues and therefore receive additional interpretation from a wider range of perspectives. The PEACQ Scouting Tool serves as a content management system (CMS) for T-Labs' own Foresight Landing Page content via an interface, while additional content is added by other contributors via the platform's own CMS or as direct posts to the website. This process addresses particularly DT colleagues from outside T-Labs (the website having on average ca. 1.500 unique visitors per month) and fosters a cross-organizational discussion of developments, trends, and appropriate organizational responses.

Overall, the Foresight Landing Page is recognized as an information portal that is available to every employee. For

T-Labs as the corporate research and innovation unit though it is also an important tool for creating a dialogue with decision makers across DT. The IT tools allow thus consensus-building on which topics should get priority in the R&D pipeline. This in turn is an important input to PEACQ Gate 0.5 for supporting the gate decision, linking the foresight insights directly in the organizational response.

3.3. Use case Project X

A main driver for setting up foresight processes at T-Labs has been to define own activities and to create a basis for related discussions with internal stakeholders. While tasks such as collecting trends and opinions, communication of insights and results, or content production and management are supported by interlinked IT-based solutions (see Fig. 3: Purposes and interfaces of T-Labs foresight tools, a major element in this regard is idea management supported by PEACQ Gate 0.5), where ideas are shaped making them ready for the internal gate process. In the following we present one exemplary use case to illustrate how the three IT tools play together. The case is from a recently finalized project that we call “Project X” to ensure anonymity.

As a first step, a project team entered their new idea into the PEACQ Gate 0.5 idea management tool. Through the connection to the PEACQ Scouting Tool, the team received information about related developments and trends. This functionality uses a text analysis of their idea description to identify matches with topics and start-ups that have previously been entered in the Scouting Tool. These appear as links in the meta-information section of the idea entry, that lead to the respective entry in the Scouting Tool. The team used the information to further shape and backup their idea by discussing proactively alternative technological approaches and best practices of competitors.

Further, the text analysis matched related project ideas (*internal ideas*) that have previously been registered in the Gate 0.5 tool. Through these matches the team had been able to benefit from some of the discussions, which already took place inside these idea entries. Further, they contacted the owners of some of these ideas and invited them to comment and collaboratively edit their new idea within the tool. In that way an interest group has been formed that jointly promoted the idea and created a formal gate proposal.

Initial proposals for gate 1 require a market analysis backing up the relevance of a potential activity. With an intention not only to use existing things rather than developing everything from scratch, but also to make use of external talents in the process of development, this market research usually includes a scan of existing products, services, and start-ups. In this context, an *external scout* has been identified to support the process and to specifically scout within the area defined by the project team.

These scouting results have been collected using the PEACQ Scouting Tool. After entering the information, these specific topics have been added to a topic collection (container) in the Scouting Tool labeled “Project X”, which has been created for the purpose. While all scouted information has also entered the regular foresight workflow of assessment and selection, the separate container enabled the project team to filter topics relevant for their specific project. An additional scan of *external ideas* submitted to the Telekom Innovation Contest (running at

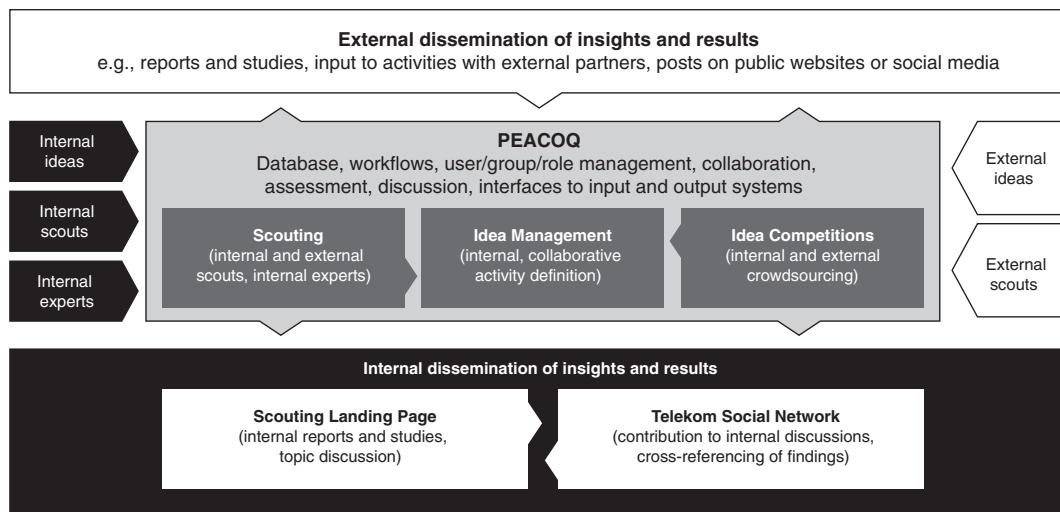


Fig. 3. Purposes and interfaces of T-Labs foresight tools.

that time using an external, Internet-based PEACOO implementation) produced no relevant match in this case.

With their idea having received a lot of feedback and input at an early stage, the project team has been able to re-define their original idea smoothing out potential showstoppers they hadn't foreseen themselves initially. Further, by identifying and involving expert colleagues in the process they managed not only to shape their idea, but also to gain support for it. Finally, having had access to intelligence results enabled them to complement their market research and their search for potential external partners. With their homework being done and being prepared for questions from the committee, the project proposal passed gate 1 in the first attempt without fundamental discussions.

3.4. Lessons learned

The process of designing and implementing IT tools starts with the expectations on positive value creation. On the downside there are however also effects such as the reduction of face-to-face communication that might reduce the overall level of interaction and potentially the level of trust.

To counterbalance the potentially negative effects of the tools we continued to use face-to-face workshops particularly for occasions where controversial discussions were expected or where commitment had to be built. It should further be mentioned that participants in the foresight activities were mostly also working in other roles that would involve meeting with other foresight participants frequently, thus the trusted relationship could be built and maintained also through interaction on these other issues.

In addition there are also barriers that are associated with IT tool introduction in general. A frequent one is the general aversion to "yet another tool", that build on both the skepticism that a tool can solve problems and the overload with IT tools, that require their own login and password, user interfaces, and incompatibilities. To lower this barrier it was aimed to integrate (e.g., with a single-sign-on and interfaces to other tools, reducing the need to create redundant entries)

where possible. A major success factor here is to respect user preferences regarding the access to tools. Recently, the wide adaptation of Internet-connected mobile devices (smartphones, tablets) changed communication and information behavior and at the same time presented new opportunities for user involvement. The development of mobile views for both, PEACOO Scouting Tool and Scouting Landing Page has resulted in an increase of interaction. The possibility to scout on-the-go and post new topics from a mobile phone has increased the contribution of topics coming from DT colleagues. The possibility to access information on the Scouting Landing Page via a page adjusted to the user interface of a mobile device has increased overall interaction on the site.

Another barrier in the implementation has been security requirement. Particularly large corporate organizations such as DT have strict requirements regarding security and compliance of IT tools accessible by a large number of corporate users. Foresight tools can contain sensitive data concerning both the corporate strategy as well as personal information of employees. Security requirements as well as regulations regarding privacy and barrier-free access (e.g., for the visually impaired) need to be considered. An early involvement of the regulating bodies (in case of T-Labs their own IT department, as well as the corporate Group Security, Group Privacy, and workers' council) is imperative for a smooth implementation and release of tools.

Concerning the use of tools another barrier is the constant change of the organization itself. While the development of a tool requires time (and financial resources), requirements and stakeholders may have changed at the time of its release. A flexible design, allowing for fast re-configuration (e.g., of information structure, categories, workflows, assessment criteria, user groups, and interfaces to other tools) can reduce the negative impact of this barrier.

Another barrier observed at DT is the general issue of different languages. As a multinational corporation, DT's corporate language is English. However, with the major part of its employees being based in Germany acceptance of information provided in English is not always given. It can discourage colleagues from participating in discussions, and

in consequence limiting their impact. Partly, this barrier can be overcome by Content Management Systems that allow for multilingual content offerings. While in our case the amounts of information prevented to provide full content in multiple languages, some elements such as teasers of selected content as well as newsletters have been provided bilingual, increasing the reach of information and inviting contributions in other languages than English. A further possibility to help surmount language barriers is the instant-translation function that is now offered by many Web browsers.

3.5. Value creation

When considering the value contributions of IT tools a first assessment can be made by judging their contribution to overcoming the barriers in a generic foresight process that we have presented in Fig. 1.

1. Detecting change: The Scouting Tool allows posting reports on change when they are still in the stage of a weak signal, as the transaction cost associated with posting topics is comparatively low. In addition, the integration of the tools allows guiding the weak signal search by feeding information about the most interesting innovation areas into the scouting process.
2. Judging change: The Scouting Tool and the Foresight Landing page facilitate participatory assessment of developments and trends and thus allow involving a wide range of expertise and perspectives. This can be expected to increase the likelihood that the relevance of change is perceived.
3. Convincing decision-makers: Bringing open expert discussions and assessments into the pre-stage of strategy processes and innovation activities create “noise” in a democratic fashion and can be expected to grab attention of decision-makers. This early exposure of decision-makers to future related information can be expected to facilitate the following decision-making process. In addition, the tools also support the formalized decision making process along the gate-process (through the Scouting Tool and the Gate 0.5 tool).
4. Planning response: The integrated tools allow maintaining the links from the final strategic or innovation-management-related decisions to the related information. That allows the person or unit responsible for the organizational response to access the rich information that has been collected through scouting, generated through the feedback processes or inserted through other units in DT.
5. Act: The integrated IT tools also support potentially bridging the gap between the planned and the enacted response. Through the invitation of a wide range of employees the likelihood is increased that employees responsible for taking action might have participated in the discussion about the future-related insight. This can then be expected to increase the feeling of ownership and thus increase the motivation and commitment.

Overall we can conclude from this assessment that IT tools can be expected to contribute to lowering all barriers associated with a generic foresight process. This contribution is however probably moderated by factors such as corporate culture and communication tradition (particularly, whether formal or informal communication channels have been dominant in the past).

In addition, the IT tools reinforce the value contributions that are associated with foresight activities in general. In the following we want to look particularly at four value creation dimensions [2,58,60,61]:

- Creating a perception and awareness of environmental change and potential disruptions coming from it, thus reducing uncertainty
- Enabling the interpretation of change and the use of gained insights for strategic and innovation management, e.g. for (re-)defining R&D projects
- Facilitating organizational learning and supporting the adaptation of the organization to external changes
- Influencing others to act and enabling response to change.

In the case of DT the major contributions lie in the tools' capabilities to involve more internal and external experts, thus increasing the breadth and depth of discussion and enhancing the organizational perception. More specifically, external scouts can share their insights into markets and technologies via the PEACQ Scouting Tool, while internal experts and stakeholders share their insights through PEACQ and the Foresight Landing page.

Interpretation is particularly enhanced through the Foresight Landing Page which serves as an additional interaction platform. The Foresight Landing Page enables engaging in open discussions and collaborative assessment of future related information. The communication capabilities via Blog-like articles, document collections, RSS feeds, mailing lists, etc. create the desired awareness of change and lay the foundation for an organizational response.

Almost as a by-product the IT tools also support the consolidation of corporate terminology, because more and more employees refer to the entries in the tools, search and retrieve information and recommend topics to their peers by using the terminology used in the tool, or insisting that the terminology should be changed. Such a consolidation of terminology is particularly valuable in new knowledge domains, where the taxonomy is not settled, yet. This can be regarded as an important aspect and starting point of organizational learning. Furthermore, the IT tools can help providing a platform for collaborative defining and sharpening of important concepts, particularly through wikis and tagging functionalities. Tagging also helps to avoid information overload by supporting filtering of relevant information for specific purposes.

Finally, integrating tools that create insight (e.g., PEACQ Scouting Tool) with tools that make use of these insights (e.g., for the purpose of idea generation PEACQ Gate 0.5) the IT platform suite ensures that foresight insights are being turned into action, i.e. an organizational response is being triggered.

In addition to supporting the overall value creation from corporate foresight there are further positive impacts from IT tools, in particular:

- enhanced knowledge management by supporting knowledge capture, creation, retrieval, combination and usage
- increased transparency, through open information sharing, connecting people to pieces of information, and storage of data
- increased work productivity for all involved actors: scouts, foresighters, and internal stakeholders

- increased communication productivity, reducing the cost, while increasing information flow between scouts, foresighters, and internal stakeholders.

The knowledge management dimension is the most difficult to assess, as it is generally difficult to assess the quality and quantity of knowledge. Tentatively however we could confirm a positive effect, particularly through the database and the social network, acting as both an always-available knowledge pool for the former and a way to connect to knowledge quickly and efficiently for the latter.

The connecting of information with the people who have supplied it also increased the transparency. Further, the life-cycle from perception, and interpretation to usage of future signals becomes increasingly traceable. This can also be expected to have a positive effect on transparency and in consequence to be positively related to the level of trust towards information.

The most clear positive impacts can be attributed to the increase in productivity both related to work and communication. For the scouts the PEACQ Scouting Tool provides a lean way of communicating their findings, discussing with their peers and drafting their topic profiles. Without the tool these tasks would have to be performed on the basis of Email communication, spread-sheet workflow tracking and documents that are drafted in word-processing software. The PEACQ Scouting Tool also supports the workflow of the foresighters who can categorize, review and select topics. Where the tool however mostly pays off is through its enhanced collaboration functions with internal stakeholders. Through the social networking, the tagging and blogging and the wikis it supports a platform for rich interaction and collaborative knowledge creation.

4. Conclusion

With this article we hope to contribute to the debate about how different IT tools can be integrated to form a powerful foresight support system. For describing and discussing the Deutsche Telekom approach we build on eight years of experience with corporate foresight and support tools. It should however also be noted that the system design, described in this article, has been built over time and thus length of the experience with the different parts varies.

Overall, we feel confident that we can confirm a positive impact from the IT tools on productivity of scouts, foresighters, and internal stakeholders, on lowering the barriers associated with a generic foresight process as well as a positive impact on the general value creation from corporate foresight.

When looking back on the successful and unsuccessful changes in the IT tools there are also four general recommendations that we can put forward for firms that aim to implement foresight support systems:

- Ensure sufficient integration of internal customers/stakeholders in the interpretation phase to lay the foundation for the organizational response
- Ensure easy access to the tools, ideally through a single-sign on through the corporate Intranet and mobile access
- Plan sufficient effort for coaching the users on tool usage and for moderating the discussion within the tool
- Supplement the tool implementation with sufficient off-line workshops and trainings to trigger early buy-in and continuously high level of trust between the contributors.

5. Future development trajectories

Finally, we would like to share some thoughts on how foresight support systems might develop in the future.

The first development trajectory relates to open innovation. In the past we have seen an increasing interest to reduce cost and increase leverage of own R&D activities through opening up the innovation process [62–67]. Likewise, the foresight activities can potentially profit from collaborating with others. In our case the collaboration with the European Institute for Innovation and Technology and its ICT division provides a platform for insight sharing and cross-validation [53].

Another trajectory rather relates to a paradigm shift in innovation management at Deutsche Telekom, but could also be representative for other firms in fast moving environments. With increasing industry clockspeed and a reduction of predetermination through shorter development cycles the payoff of R&D becomes increasingly uncertain [68–70]. This leads many firms to seek partners for risk sharing and joint investing in innovation opportunities. For that reason Deutsche Telekom is using increasingly a venturing model to drive R&D in new innovation fields [71]. Foresight insights will thus in the future not only be used and tailored to Deutsche Telekom innovation fields but also towards internal and external start-up companies.

A third trajectory relates to the development of capabilities for faster identification of innovation opportunities and their consecutive planning. The benefit of planning innovation and creating commitment through roadmapping has been known for many years [72]. However, more recently roadmapping has been discussed as a way for translating future opportunities on the market and technology side into innovation projects [73] that potentially are even developed and exploited through inter-firm collaboration.

The approach could be extended to also allow IT-based roadmapping, enhancing coordination and increasing the productivity of planning activities [74–77].

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René Rohrbeck is Associate Professor of Strategy. His research interests are corporate foresight, innovation management and organizational future orientation. His research has been published in *R&D Management*, *Technology Analysis & Strategic Management*, *Futures*, *Technological Forecasting and Social Change* and in several books, including “Corporate Foresight: Toward a Maturity Model for the Future Orientation of a Firm”. René Rohrbeck has 6 years of practical experience in the ICT and automotive industry, where he worked at Deutsche Telekom and Volkswagen on strategic management, innovation management and corporate foresight. In addition he has served as consultant for various companies in the ICT, automobile, luxury goods and energy industry.

Nico Thom is a foresight practitioner at T-Labs spin-off Schaltzeit, “empowering corporate foresight” at large and medium-sized organizations. His focus is on defining specific foresight requirements, development of suitable concepts, as well as support in implementation and operations of methods and tools of (corporate) foresight, including software solutions. Nico Thom holds a diploma degree in business administration from Technische Universität Berlin. From 2006 to 2012 he has been responsible for the foresight activities of Telekom Innovation Laboratories as well as for the setup of foresight activities at EIT ICT Labs, an innovation initiative of the European Parliament. Prior to that he worked as a consultant in the automotive and medical industry.

Dr. Heinrich Arnold heads up Innovation and Laboratories at Deutsche Telekom AG with locations in Germany, Israel, and Silicon Valley. Under his leadership, a number of significant contributions to products and infrastructures have been created. A number of businesses have their origins at the Innovation Development organization as well as start-ups, such as Zimory, Yoochoose, QiSec, Spree, Schaltzeit, and MisterX. Prior to this, he was involved in large-scale organizational and strategic projects. Dr. Arnold is a lecturer in Innovation Management, the author of the scientific book “Technology Shocks” on the management of radical technological change, and a member of the Innovation Leadership Advisory Boards of the School of Engineering at the University of Illinois Urbana-Champaign. He has been invited to the Young Global, European, and national Leader Forums of the BMW Quandt Foundation.