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The Technology Radar - an Instrument of Technology Intelligence and Innovation Strategy

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This paper analyzes the establishment of a technology intelligence tool of the Deutsche Telekom Laboratories - the Technology Radar. Goals and method are contrasted to approaches discussed in literature. After the presentation of exemplary findings of the Technology Radar, the role of the Technology Radar within the innovation and technology management of the Deutsche Telekom is being discussed. The paper closes with lessons learned, key success factors are being highlighted and recommendations for the introduction of technology intelligence systems are given.

I. Introduction

Deutsche Telekom Laboratories form part of the central unit 'Technology and Innovation' of the Deutsche Telekom Group (DTAG). Deutsche Telekom Laboratories research and develop new information and communication technologies, allowing the Group to generate new business and expand its existing operations. A key activity is to foster the knowledge transfer from research into marketable products and services. The introduction of a technology intelligence system proved to be a critical element for success.

The scope and aims of technology intelligence have been widely discussed in literature [1-4] as well as in industry. For us, technology intelligence is the provision of relevant information on technology and the evaluation of their impact on the corporation. This information is then on the one hand used for decision making in R&D and in corporate strategy; on the other hand it is used to increase the awareness of the operating units for upcoming opportunities and risks as well as prepare the receptiveness of the organization for R&D results. The process consists of gathering, assessing and communicating technological opportunities and threats.

Although technology intelligence activities are conducted in most organisations, the methods and the intensity of the activities remain diverse [5, 6]. At DTAG, technology intelligence activities are conducted on the division level as well as on group level. To channel the technology intelligence effort, the Technology Radar has been established as a central tool.

II. Goals

The Technology Radar has replaced a regular newsletter and sporadic short technology briefings written up by in-house consulting or central R&D units. The newsletters had a large group of recipients but were perceived as too generic and not DTAG specific enough with little difference to publicly available online technology newsletters. The technology briefings on the other hand covered single topics in very high quality both in terms of style and lay-out but left some gaps in topic coverage as they appeared in a frequency of several months only. The expectations to technology intelligence go beyond this, thus a much more complex tool has evolved with the creation of Deutsche Telekom Laboratories two years ago. The role of the Technology Radar in the technology and innovation management of DTAG is defined by three major contributions which have been described in literature as well.

Early identification of technologies, technological trends and technological shocks

As the telecommunication and the information technology market converge there is both an important rise of new products and services and the shortening of their development and life cycles. In consequence, the early recognition of technologies that have the potential of changing the product and service landscape is a key capability of the DTAG for maintaining and fostering its competitiveness in the market [7].

Raising the attention for the threats and opportunities of technological development

Once the technological developments have been identified, the business impact has to be assessed and brought to the attention of the decision makers within the DTAG. In addition, new technological developments value new or different capabilities in the organizations and deflate existing competencies [7]. Still, even after identifying threats and opportunities it depends on the design of an effective dissemination method for the conclusions; which is - as Vicente [8] observed - not easy to achieve.

Stimulation of innovation

The expectations towards a technology intelligence method include also facilitating the development of new products and services. The Technology Radar contributes in multiple ways.

One is increasing the level of knowledge through information transfer both through the edited version of the Technology Radar itself and through the information exchange in informal networks that are caused by the generation as well as distribution processes. In that perspective a central technology intelligence tool should also help to reduce the "Not-Invented-Here"(NIH)-syndrome first described by Katz and Allen.

Second, during the interaction with the units of DTAG during dissemination, the Radar helps to identify potential overlap on innovation activities within the group.

Third, it identifies white spots within the group and helps triggering R&D projects and other measures to close these gaps. Such needs for action from the Technology Radar can result in R&D projects at Deutsche Telekom Laboratories. The transfer of results from such an R&D project into the product development or infrastructure deployment of the operative division is comparatively easy, as the need for action was understood early on and supported by the divisions [9].

III. METHOD

The process of the Technology Radar can be divided into four stages: Technology identification, selection, assessment and dissemination of the generated information to the stakeholder inside the DTAG (see figure 1).

Identification

New technologies or technological trends are identified through an international scouting network. These scouts can be internal or external of DTAG and in this case are all part of the Deutsche Telekom Group. In addition to a strong tie to the DTAG the scouts have to be both knowledgeable in their search field and have a vivid social network which they use to get first hand information on current research projects and findings.

The main benefit of the scouting method is the reduced time lag between the initial scientific discovery and technology identification [10, 11]. This time lag can be up to 18 to 24 months in publication and patent analysis [12-14]. The time advantage is paid for by the comparatively high cost for the establishment, management and maintenance of an extensive scouting network. Another disadvantage is the lack of scalability when using the scouting method. Each scout has a limited identification and processing capacity and therefore a desired output increase can only be achieved by continuous increase of the number of scouts. A means which, in turn, increases overhead in the management of the network.

Selection

Out of a long-list of proposed technologies the editor of the Technology Radar together with an expert group select a short-list according to the degree of innovation.

For easy identification of the key innovation and its potential impact, four categories are being used: (a) technologies that are completely new, (b) state of the art technologies that have recently made an important leap in their development, (c) important changes in complementary technologies and (d) important rise in the awareness of a technology or its application.

Furthermore technologies that are already being followed-up in one or more strategic business units of DTAG are excluded from the short-list.

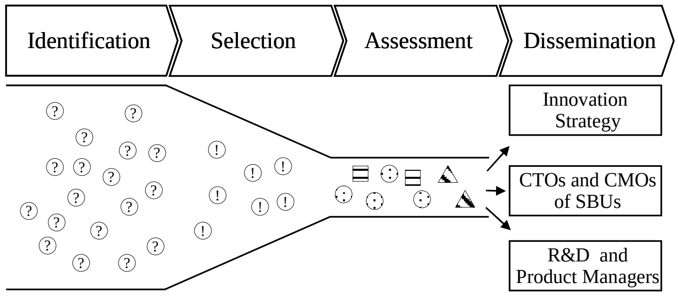

Fig. 1. Technology Radar method

In literature a variety of other innovation categorization and selection approaches can be found. An overview has been composed by Arnold [7].

Assessment

For all short-listed technologies the scouts are requested to provide a more detailed description, background information on the development stages and on remaining obstacles in the development. Also a judgement of the business potential is carried out including product and service ideas as well as ideas on business models enabled by the technology.

Based on this information, the technologies are discussed in an expert panel and rated in the two dimensions 'market impact' and 'technological realization potential'. These two dimensions form the technology matrix (see figure 2) which was derived from technology portfolio approaches [15, 16].

For each dimension, three factors have been defined, each rated on a three point scale (high, middle, low). The dimension 'market impact' consists of the factors 'potential market size', 'disruptive potential' and 'cost savings'. For the dimension 'technological realization complexity' the factors 'complexity', 'implementation risk' and 'cost' are being used. After combining the scores for the different factors, the technologies can be placed in the technology matrix. In the matrix, the area in the lower right corner is defined as low relevance for the DTAG, the middle part as medium relevance and on the top left corner the technologies are of the highest relevance to us.

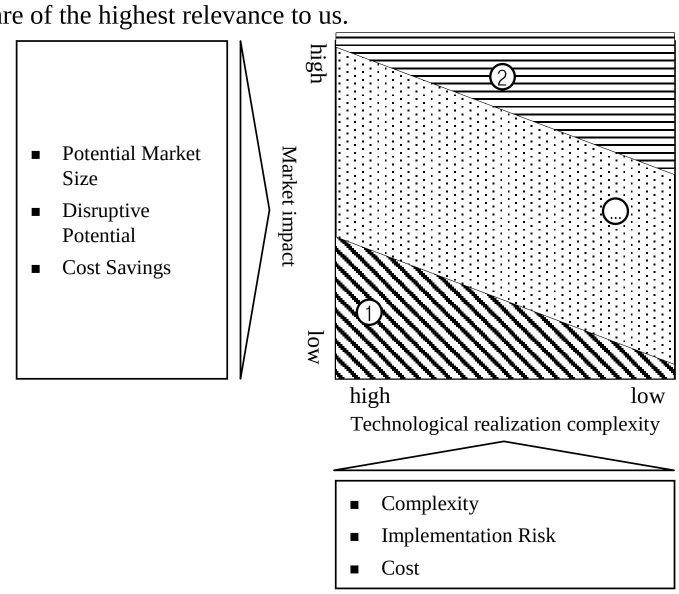

Fig. 2. DTAG Technology Ranking Framework

Another possible rating framework is the cross-impact analysis which is often preferred for the rating of emerging technologies [17, 18]. Its advantage is that it works without data from the market side, which is often difficult to gather or forecast. The portfolio approach was preferred for the intuitive usage in the initial rating and the following discussions within the DTAG in the dissemination phase.

It should be noted that the ratings only represent an evaluation from an overview point of view in the light of a complex telecommunications market. Specific aspects may well show totally different potentials in the face of a concrete market scenario. They are just one of many inputs into the formulation of the strategic direction of the corporation.

Dissemination

As the recipients of the technological information are also upper and top management, there is a need to present the findings both on a high aggregation level and with a strong focus on the business impact.

The highest aggregation level of information is the *Radar Screen* (see figure 3). It offers an overview of all covered technologies and presents at a glance the information on relevance of the technologies (as assessed through the rating framework), the development phase of the technologies and the technological field.

The development phases are divided into ‘basic research’, ‘applied research’, ‘product concept’, ‘market ready’ and ‘market presence’. They are depicted as concentric circles starting with the outside circle for basic research and moving inwards up to market presence.

Six technological fields are represented in the radar screen as segments of the circle. These segments are based on the classical value chain of the telecommunication industry so it does not need to be changed with a change in strategy.

The search fields are divided into ‘fixed & mobile devices’, ‘access network’, ‘core network’, ‘network services’, ‘end-user services’ and ‘cross-functional’.

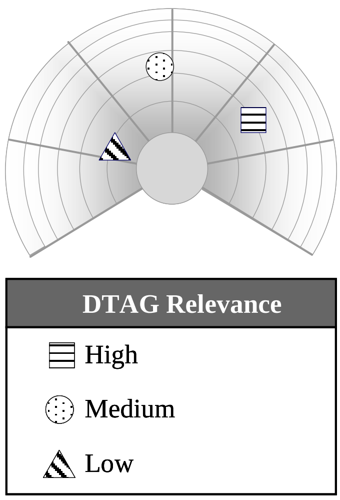

Fig. 3. Technology Radar Screen

After the overview of the covered technologies, the reader can choose between the key message, which is a brief description of the technology, and the full technology profile. The key message features an introduction to the technology and a paragraph on possible innovations, i.e. products or services enabled by the technology. The technology profile covers the technology more in detail including further technological information, research status, open questions and the business potential including products, services and business models enabled by the technology.

This structure enables the stakeholder easy access to the specific information they need and access to background information for better interaction with other departments.

Currently, the radar screen together with the key messages, the technology profiles and a number of further complements are published as a printed document three times a year. This publication is distributed to the corporate innovation management as well as to the Chief Technological Officers (CTO) and to the Chief Marketing Officers (CMO) on corporate and on business unit level. In addition, the document is distributed either as printed version or as an electronic version to more than hundred R&D and Product Managers inside the DTAG.

There are certain complements added to the descriptions of the technologies in order to show trends that can be identified from the single topics. These complements are findings from two different workshops and two paper formats.

The *‘Opinion Paper’* is written by an expert from inside the DTAG. It takes a certain, often extreme position. Also the development status for certain technologies, applications and products are given.

An external view is expressed in the *‘Feature Paper’*, which is written by a well recognized expert from the scientific community in a specific field. The scope of the field is usually about 15 to 25 separate technologies. One example of a ‘Feature Paper’ is an update view of the “Digital Home” with an overview of interdependencies of technologies, devices and services needed to enable the connected home of the future.

The *‘Innovation Panel’* is a workshop held together with other industry leaders. These companies might be direct peers, suppliers, corporate customers or other big players that play in important role in a specific technological field or market segment. In case of the “Digital Home”, the workshop was held together with companies such as Cisco, HP and Intel. The exchange on the vision level has been chosen in favour of exchange on a more detailed level.

The insights gained through the Innovation Panel are featured in the publication and are also used as input for the DTAG internal *‘Trend Workshop’*. The participants of this workshop consist of a few technology scouts, R&D managers from the divisions and managers from the corporate innovation management. For the knowledge generation in the workshop, different methods such as ‘scenario building’ [19-21] and ‘technological roadmapping’ [22-24] are used.

The two workshops are an important means to support the knowledge development within the scouting network as well as in the corporation. The findings of the workshop are also featured in the printed document as add-ons.

IV. Technological Findings

As described in the dissemination section, the information and knowledge transfer of the Technology Radar know different formats. This section shows exemplary findings generated by the approach.

Feature Paper: Virtualization

"You should virtualize away technology, so that you can really think about what customers want rather than what technology can do."

As a framework for the analysis, the impact of technology has been investigated, as well as market and social reaction to virtualization across the three major ICT infrastructure areas – (1) delivery – comprising networks and technical platforms, (2) service – encompassing specific configurations, processes and underlying IT, and (3) utilization – being made up of terminal devices and user interfaces. These three 'traditional' components of value creation at telcos were complemented with a fourth area – semantics – an emerging set of technologies and trends.

Opinion Paper: Intelligent User Interfaces

"Intelligent User Interfaces will become for telcos, what product design is for the manufacturing industry."

Today different forms of communication are defined more often by the interface that is used for establishing the communication than by the underlying transport technology. For instance, E-Mail and Instant Messaging both use the Internet for message transport but mainly vary in user interface. In future NGN dominated worlds, the major remaining form of differentiation between communication services will be the user interface. What design is for manufactured products, intelligent user interfaces will become for telco services.

Trend Workshop: Private Content Goes Public

"As the communication becomes a kind of content transfer, the consumer becomes a *prosumer*."

Communities and social software are on the rise. People always liked to show what they are doing. Now, thanks to current technological development, they can do it on a global level nearly for free. Sharing personal content in the web is becoming common place: your private photo album, your favourite playlist, your personal views, all in the internet. More and more people share their experiences and opinions using "long tail content" concepts like blogs and become content producers.

V. Value Created

After almost two years of existence, the Technology Radar is regarded widely as a success story. This is due to the appeal to its readers and that the aims of this technology intelligence tool have been achieved to a large extend.

Top management attention

The dissemination of an overview of summaries on technology key words in a hardcopy version has proven to be one of the key success factors. Especially the CTOs and CMOs have been reported to have the Technology Radar "sitting on their desks and screening through it frequently".

Stimulation of innovation

On this top management level, the linkage of R&D activities to market needs and the linkage between different business units can be achieved most effectively. In contrast to the aggregation level provided in an innovation strategy, the top management gets access to the disaggregated level, i.e. the project level. The innovation strategy is by and large concerned with the identification of general direction of the innovation policy and less in bringing together people and projects. In the entangled telecommunication product and service landscape, this contribution of the Technology Radar appears to close a gap.

In addition, the impulses from the Technology Radar have lead to the proposal of five new R&D projects at Deutsche Telekom Laboratories alone. Most of these projects have already made it through the stage-gate process of corporate R&D, which has also been facilitated by the attention raised for these specific issues.

Direct introduction of external views and impulses

Another important aspect is the insertion of external views and impulses in the company in a very direct way that matches the open innovation environment of Deutsche Telekom Laboratories. The view on technological developments, which is presented in the Technology Radar, has often only been subject to information filtering in a very limited way. Therefore the view of the scouts or the sources tapped by them has a very direct communication path to the top management of DTAG. This can to some extend break open the internal centric view which characterises large companies

Fostering the absorbtive capacity

The Technology Radar is furthermore increase the DTAGs "absorptive capacity" for innovation as it enables the organization to deal with a large quantity of topics at the same time [25]. In the quest to foster the ability to identify, assimilate and apply external know how to commercial purpose the Technology Radar assists especially in the first two.

VI. Lessons learned

Best practices

As discussed in the value creation section of this paper, the appeal of the structure and the dissemination format of the radar have been key success factors. Especially the radar screen as the highest aggregation level for the information has proven to be very powerful. It is a good starting point both for browsing the Technology Radar as well as for retrieval of specific information on a technology. This positive assessment of the dissemination format has recently been confirmed by a business unit which requested a customized edition of the Technology Radar with its own search fields but in the same structure and aggregation levels.

In the technology identification, the key success factors of the scouting activities remain the ability to leverage on the social networks of the scouts and the selection of the right person for the job. In this case and as also described by Norling [26], successful scouts have a “broad technical interest and are lateral thinkers with the ability to see beyond one product or technology to its hidden opportunities.”

To maximise the output of the scouting network, the selection of scouts with an extensive social network is the key. Without this leverage the amount and relevance of identified technologies will remain limited. A limited processing capacity, i.e. the writing of technological descriptions and the interaction with the editors of the technological information, can be enhanced with the help of support staff for the scout.

The portfolio approach for technology rating has been highly successful. There is always the temptation of using a more complex and automated rating approach. But as recently shown by Shehabuddeen [27], the higher the degree of complexity and automation the lower the identification of the stakeholder with the rating results. The portfolio approach combined with the transparency concerning the arguments considered for the ranking allows the reader to easily adapt the rating to his own perception and opinion on the underlying criteria.

Another experience confirmed by Shehabuddeen [27] was, that the rating method is influenced by “the vagueness and imprecision of language used to describe the criteria against which a decision is made”. In consequence, it is important to ensure a clear description of the factors used in the rating and a common understanding of the meaning of each factor.

Further development steps

Building on what has been achieved, some further development steps for the Technology Radar have been planned.

One of these steps is the introduction of a pull mechanism for technological information. As claimed by Patton [28], a dynamic momentum can be gained if information push and pull mechanisms are combined. For the Technology Radar this means the introduction of an online dissemination with interaction functionalities. With this step better understanding of the information needs of readers and the facilitation of networking between the readers and authors and within these two groups should be achieved.

Another goal for the Technology Radar will be enabling the access for the reader (R&D or marketing manager) to the source of information (e.g. university, industry R&D) and vice versa. This should yield two benefits: First, the R&D manager interested in starting a project building on technology covered in the Radar would be in direct contact to an expert in this field. Second, the possibility for starting joined R&D projects would foster the motivation of e.g. universities to share their knowledge with the Radar scouts.

Conclusion

In practice, establishing and improving of above mentioned processes and methods and the necessary information networks require patience. First, because in the ramp-up phase the outcome is limited and the effort usually high. Second, especially in large companies, the introduction of new methods and tools raise questions on responsibilities. For example, the approach of ‘short-circuiting’ (i.e. creating a direct channel for technology impulses to disseminate into the organization) was a clear deviation from the classical flow of information and created several challenges alongside with the benefits detailed above. The processes and results are a challenge to technological knowledge as well as journalistic skills of editorship as they need to satisfy high standards of the technology management field, as well as publication quality for widespread circulation. The benefits from the Technology Radar that support the innovation task of Deutsche Telekom Laboratories are definitely worth the effort and even with every new edition, additional positive side effects that originally had not even been expected come into place.

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