

Social Software for Uncertainty Reduction in R&D Programme Planning for Custom-Built Products

Sven Schimpf¹ and Claus Lang-Koetz²

¹Sven.Schimpf@iao.fraunhofer.de

²Claus.Lang-Koetz@iao.fraunhofer.de

All at the Fraunhofer Institute for Industrial Engineering (IAO), Nobelstrasse 12, DE-70569 Stuttgart, Germany

R&D programme planning is one of the most important phases in R&D management as it highly influences the success of all later phases in R&D management. Especially for custom-built products, this is a major challenge due to the decentralised organisation and changing requirements for each single product. Social software has herein the potential to improve collaboration and information transfer in decentralised environments. This paper will present in a first part the requirements towards R&D programme planning for custom-built products at the example of the European construction sector and in a second part a concept for the use of selected social software applications for uncertainty reduction in R&D programme planning for custom-built products.

1. Introduction

R&D programme planning is an essential phase of R&D management aiming at the optimised selection and planning of R&D projects (Bürgel *et al.*, 1996a: p.102). Shortcomings in this phase cannot or only partly be adjusted in later phases (Specht *et al.*, 2002: p.203). Thereby, R&D programme planning highly influences the success of all other phases of R&D. It creates the link between strategic and operational planning and the transfer into R&D projects. Through factors like an increasing technological complexity and globalisation of markets, R&D programme planning is getting more and more important in today's economy also in sectors that are traditionally not technology oriented (Sywottek, 2006: p.62). R&D programme planning can in general be divided into the following phases (Geschka and Lenk, 1999: p.29):

1. *Strategic orientation*: Definition of the strategic orientation of the R&D programme.
2. *Generation and collection of R&D project ideas*: Identification, generation and collection of ideas for R&D projects in and outside the organisation.
3. *Evaluation and selection of R&D project ideas*:

Structured evaluation and filtering of R&D project ideas.

4. *Development of R&D project concepts*: Concept development for selected R&D project ideas to allow further evaluation based on product, technology or market information.
5. *Capacity planning for R&D projects*: Capacity planning for the R&D programme.

Especially for industries with a focus on custom-built products, the planning of the R&D programme is one of the major challenges. This is mainly due to the (1) relatively low resources spent in central R&D activities, (2) products that are individually developed to fit the specific customer needs and (3) a decentralised and project based organisational structure. Herein, technological requirements and production facilities are constantly changing (Schön, 2004: p.287). Examples for industries with a focus on custom-built products are the construction industry, the information technology industry, and the sector of mechanical and plant engineering.

There are various instruments in R&D management to support the planning of the R&D programme, however these are only rarely adapted to the use in specific

industries (Lichtenthaler, 2000: p.379). In the case of custom-built products, these instruments are too resource intensive to be applied for each single product (Wille, 2006: p.31).

In this context, the increasing importance of the Internet as a source of information on developments and trends is opening new opportunities for uncertainty reduction in R&D programme planning for custom-built products (see e.g. Springer, 2006). The availability of public scientific databases, on-line journals and articles that are available through high-speed Internet access for a relatively low cost can give access to information about developments and trends with far less costs and time than in the past (Chesbrough, 2006: p.44). However, the large amount of available sources complicates an efficient search for information satisfying the user's needs. Especially the recent emergence of social software and its widening acceptance in the Internet allows faster collection and evaluation of specific information on developments and trends. Moreover, it can be applied for the location and extraction of novel information (von Kortzfleisch *et al.*, 2008: p.75). Its application in organisations enhances the creation of clusters and communities of interest between information seekers and information providers that are geographically distributed (Millen *et al.*, 2005: p.35).

The proposed paper will present a concept for the application of selected social software applications to reduce uncertainty in R&D programme planning for custom-built products. The concept is based on requirements that have been collected in a qualitative study. The envisioned impact of this work is an advance in R&D programme planning for custom-built products through the use of social software systems.

2. Challenges of R&D programme planning for custom-built products

Custom-built products are defined by their uniqueness of each single product. In literature, this kind of production is generally described as being the contrary of mass-production. Especially from the R&D perspective, custom-built products can be differentiated from mass production through the high level of development activity that is directly linked to each individual product. Another significant difference is that most products are only produced once according to specific customer requirements. Hence, the following aspects play a key role in the definition of custom-built products in the context of R&D programme planning:

- high level of customer involvement in the specification of the product,
- high level of development activity directly bound to each single product,
- low level of repeatability of detailed product specifications.

Generally, it can be observed that organisations with a focus on custom-built products are organised in very project oriented, decentralised structure. Examples for

industries considered as custom-built product industries are the areas of software development, construction and machine and plant engineering.

This leads to notable differences of R&D in custom-built products to R&D in mass-production. Only a small part of R&D takes place on a central level. A major part of R&D for custom-built products is done in a very customer-oriented way and to a major part in operational projects based on specific customer requirements (mainly in early project phases). Therefore, the dilemma between information availability and the influence on product specifications is even more pronounced than in R&D for mass production.

In a qualitative study about technology monitoring in the construction industry that has been conducted with major European construction companies in 2007 the main requirements of the phases of R&D programme planning have been identified. These will be presented in the following chapters.

2.1 Strategic orientation for R&D programme planning

The phase of the strategic orientation for R&D process planning is one of the most important phases as it highly influences all later stages of the process. It defines the field for the generation and collection of R&D project ideas. The strategic orientation can comprise the specification of market or technology field, distribution channels or phases of new product development (Geschka and Lenk, 1999, p.32). Therefore, it has to be closely linked to strategic orientations of the organisation and of business units or specific departments. Traditional methods for the strategic orientation of R&D programme planning are scenarios or portfolio analyses to identify trends and categorise the search field.

The major challenge for custom-built products in the strategic orientation is the identification of weak-signals and the early involvement of specialised experts. Traditionally, the strategic orientation for R&D programme planning is done to a major part in a bottom-up approach based on customer requirements.

“The main point is that we are covering those fields which are defined to be important in the R&D strategy.”

2.2 Generation and collection of R&D project ideas

The generation and collection of R&D project ideas brings together input from in- and outside the organisation. This phase is responsible for filling up the opportunity funnel in a continuous way based on the general direction of the strategic orientation of R&D programme planning. In most organisations, not the generation of ideas but their collection is the critical factor for its success. Therefore, it is important to motivate all stakeholders to submit their ideas to a central idea management system. One of the major motivational instruments is a system that is easily accessible through

different communication channels. Especially in project based organisational structure, ideas for R&D projects have to be collected on a very decentralised level in the projects (Specht *et al.*, 2002: p.228). From a technological point of view, it has to be assured that a wide overview about potential technologies available exists as an input for the R&D programme. As one of the most common source of secondary information, the Internet is still gaining importance in this context.

In the generation and collection of project ideas for custom-built products, internal experts that are working in operational projects are the most important source of information. Also, the communication between projects and business units is crucial for the identification of R&D project ideas. Therefore, the integration of specialised experts working in the projects is a major challenge in the evaluation and selection of R&D project ideas.

“Experts are the most important source of information.”

2.3 Evaluation and selection of R&D project ideas

The limiting factor for the selection of R&D project ideas is the budget that is available for R&D activities. A structured and transparent process for the evaluation and selection of ideas is crucial for successful R&D programme planning. The strategic objectives of the organisation have to be the basis for a catalogue of criteria for the evaluation and selection of R&D project proposals. Organisations that aim at a strategy that is based on technological superiority have to include more technology developing projects fulfilling other criteria than organisations that aim at a price-leadership (Ulrich and Eppinger, 2004: p.43). Depending on the organisational context, this catalogue should consist of technology, client-market and context criteria (Bürgel *et al.*, 1996: p.103). Common methods for the evaluation of R&D project ideas are checklists, portfolios, relevance trees but also option pricing or cost benefit analysis. Especially the selection of a balanced portfolio of R&D projects is an essential factor in this phase. Evaluation criteria for R&D programme planning can be differentiated into four basic perspectives (Ulrich and Eppinger, 2004: p.38f): competitive strategy, market segmentation, technological trajectories, and product platforms.

The evaluation of ideas for R&D projects for custom-built products is done first on an individual level and in a later stage through business units or the central R&D department. An important requirement in this phase is the close link between projects, business unit and the central R&D department. Especially the involvement of experts with experiences from the projects is a key factor for evaluation and selection of R&D project ideas.

“You need to discuss with a specialist to evaluate if a project idea is relevant or not.”

2.4 Development of R&D project concepts

The development of R&D project concepts aims at specifying the project ideas that have passed the evaluation and selection phase. The major objective is to reduce the risk of R&D project planning and analyse in more detail the opportunities of technological or market developments (Geschka and Lenk, 1999: p.41). Also, the objectives of the project concepts are refined in this phase e.g. through the definition of the project mission which includes a brief description of the project, its key business goals, markets, stakeholders and assumptions and constraints that might influence the R&D project (Ulrich and Eppinger, 2004: p.48).

A major challenge for custom-built projects is that R&D projects from the central R&D unit have to be transferable to different products varying highly according to specific customer needs and geographical specificities. The development of concepts fulfilling this requires the involvement of experts with operational experience from different projects.

“Central R&D project concepts have to be transferable to various end-products.”

2.5 Capacity planning for the R&D programme

It can be generally assumed that an organisation cannot afford to allocate resources to all R&D project ideas in its portfolio. The challenge in capacity planning for R&D projects is to allocate the necessary resources to the most promising projects. This also includes the optimisation of project timing by means of product introduction, technology or market readiness and competitiveness (Ulrich and Eppinger, 2004: p.45). An important factor in the planning of the R&D programme is the interdependency between different project concepts or technological developments. Synergies that might result from such interdependencies should be considered in the planning process (Fahrni and Spätig, 1990: p.155).

The major challenge for capacity planning in R&D programme planning for custom-built products is the decentralised distribution of resources. Specialised experts are often not available for central R&D activities.

“Most important capacities are bound in operational projects and not available for R&D.”

3. A Conceptual framework to support R&D programme planning for custom-built products through social software

Social software systems are generally defined as web-based systems that support information-, identification- and contact-management in hypertextual and social networks (Schmid, 2006: p.38). Thereby they also support human interaction, collaboration and the personalisation of web-functionalities. An example for the advanced use of social software systems is the use of social networks for the supply of information on websurfing behaviour as a basis for innovative Internet search engines. (Mislove *et*

al., 2006: p.2). Moreover, social software allows the evaluation and classification (tagging) of information sources to enable search functionalities with improved quality (Graefe *et al.*, 2007: p. 17).

The challenge of the application of social software systems in a corporate environment is to close the gap between the unstructured mechanisms of social software in the Internet and the purposeful process of supporting information management in a corporate environment. One of the major advantages of social software systems according to traditional solutions is an increased motivation of users to participate in collaborative work through their active participation in the creation of content.

In the conceptual framework to support R&D programme planning for custom-built products through social software systems, the highest potential was seen in the phases of the generation of R&D project ideas, the evaluation and selection of R&D project ideas and on the development of R&D project concepts. Therefore, the following sections will focus on these phases.

3.1 Facilitating the generation of R&D project ideas through trend-wikis

As mentioned above, the idea phase is responsible for filling up the opportunity funnel in a continuous way. While the collection of ideas can be carried out by using a central idea management system, the generation of ideas is mostly an undefined process. It is based on the creativity of the involved persons relying on input from in- and outside the organisation. In a corporate context, creativity can be fostered in group meetings such as creativity workshops with people from management, marketing, sales, production and R&D functions. They can enhance the creative potentials by bringing people from different backgrounds together and thus help to generate, collect and evaluate new product and service ideas. Creative processes in groups rely on the following phases: 1) receiving some background on relevant trends, e. g. on developments in society, economy, politics and legal systems, energy and environment, customers and markets, technology, competitors and the value chain, 2) specification of the problems to be targeted, 3) idea generation which can be supported by creativity techniques (see e. g. De Bono, 1973; Osborn, 2001), 4) clustering and assessment of ideas. Although creative processes in groups can be seen as an effective way to generate new ideas, they have to be thoroughly prepared which requires a high amount of time and effort.

Wikis are a collection of websites in the Inter- or Intranet that can be created, edited and updated by users (Koch and Richter, 2008, p. 37). Especially the automatic versioning of contributions and a relatively simple syntax for editing the content are the strengths of wiki systems. They are one of the fastest growing applications in social software systems. Examples for the application of internal wikis are the documentation of information, project management, collection and transfer of information or personal information management. Today, many organisations have wikis running internally to support

internal communication and information transfer. In research activities, they are even applied in combination with semantic web technologies for the support of requirements engineering processes in software development (Hagen *et al.*, 2007: p.124f).

In the context of idea generation in R&D programme planning for custom-built products, a wiki can help as a collaborative platform for compiling trends on technology, market and environment. The company strategy provides the framework and defines roughly the search field for relevant trends. Trend information can come from studies, publications, visits on trade fairs or technology conferences, conversations with customers, etc. (see figure 1). However, this has to be adapted to the specific situation of the company. In a wiki, the respective information can be easily put together and edited to fit to the specific context of the company. The resulting “trend wiki” can then be used as a basis for the creative processes of users throughout the company. It can facilitate creative processes by users in a company to generate new product and service ideas. While wikis can help to facilitate the generation of new ideas, the ideas themselves have to be collected in a way that their ownership can be secured, e. g. in a central idea management system (see above). Chen *et al.* even state an increased level of creativity though increased network ties (Chen *et al.*, 2008: p. 30).

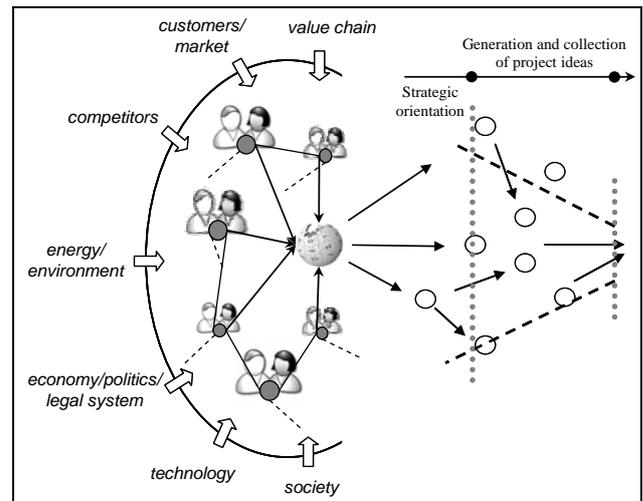


Figure 1. Using a “trend-wiki” to facilitate the generation and collection of R&D project ideas in R&D programme planning.

Major benefit of the use of trend-wikis in the generation of project ideas for R&D project planning is the high level of involvement of geographically decentralised experts from different organisational units and projects. Also it allows the early involvement of additional external stakeholders. Other benefits of the use of a trend-wiki are in the context of R&D programme planning for custom-built products are:

- The description of company specific trends from a trend-wiki can sustain novel intelligent search internet engines, which use text from documents defined as relevant by users for a refined search. This can lead to more specific search results.
- The trend-wiki can serve as an information platform,

since trend information from different sources can be used and edited by all users to form a knowledge base. Users can be kept up to date, e. g. by using technological function such as RSS feeds.

Applying Wikis in a corporate context widely differs from the “free environment” of using a Wiki on the Internet. Thus, goals, conditions of use and rules have to be made clear from the beginning with the users. Moreover, incentives have to be set in order to stimulate their use (Koch and Richter, 2008: p. 111).

3.2 Identification of experts for the evaluation of R&D project proposals through social network systems

Social network systems are communication platforms that allow users to create, edit and publish personal profiles. Thereby it creates an information base for other members of the network for interests, projects and competencies. Hereby it allows to search users according to specific profile specifications and to create connections based on weak ties or without any previously existing contacts. An important part of social networking systems are communication tools that are provided by the system such as instant messaging or integrated email applications (Koch and Richter, 2008: p.54f).

For the application of social network systems for the evaluation of R&D project ideas, they have two major advantages. First, they allow a fast identification of the appropriate expert for the evaluation process. This especially concerns the identification of experts with whom no previous contact or only weak ties are existing (Cyganski and Hass, 2008: p.107). Second, the experts do not have to work in a common project but can contribute to the evaluation process in a decentralised way. This enhances the integration of specialised experts from operational projects in the process of evaluating and selecting R&D project ideas.

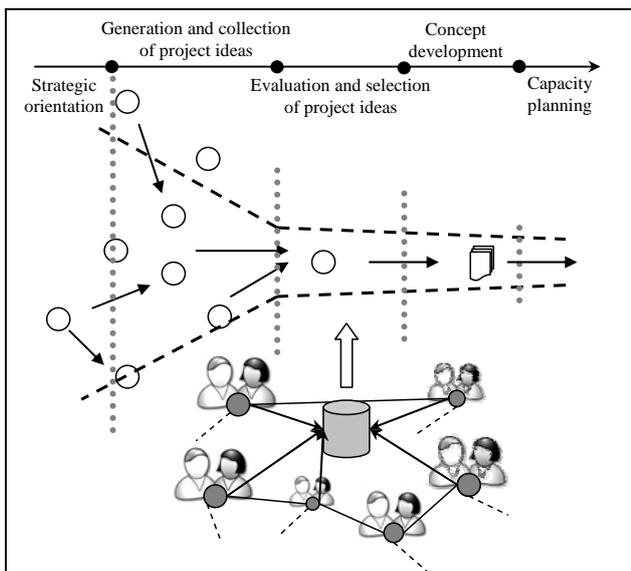


Figure 2. Social network systems in the evaluation and selection of R&D project ideas in R&D programme planning.

To allow a common understanding of the evaluation process, a multi-dimensional methodology for the evaluation of R&D project ideas as described in chapter 2.3 has to be implemented. (see also Bürgel *et al.*, 1996: p.105). This can be done through an evaluation checklist or a common scheme that supports the evaluation process.

Major benefit of the use of social network systems to support the evaluation of R&D project ideas for custom-built products is the fast identification of appropriate experts for the evaluation process. Through a user-generated profile, the selection of experts can be based on updated information and can go beyond the range of personal contacts. Through the faster involvement of appropriate experts in the evaluation, the level of uncertainty can be reduced already in early phases of the process of R&D programme planning. An important success factor for the use of social network systems in this context is the clear communication of the strategic orientation of the R&D programme and the provision of a common evaluation scheme through the system.

3.3 Weblogs: collaborative development of R&D project concepts

Weblogs (or blogs) are websites that allow users to publish or comment news in a chronological order (Schmidt, 2008: p.122). In general, a weblog is edited by a central author, giving all other users the opportunity to comment the posts and thereby contribute to the content. This comment functionality is often seen as the social aspect of the weblog systems. In corporate environments, weblogs can be used internally to document a specific project or thematic areas. Externally they can support the communication with stakeholders by means of product campaigns or customer-relationship management. In a wider range of application, they can be used for the search of experts according to specific subjects or for the documentation of organisational processes (see also Koch and Richter, 2008: p.87). Especially in decentralised structures, weblogs can avoid information overload through substituting email communication by information pull mechanisms. Also, they can create a higher level of innovation through an improved information transfer and an improved team spirit in decentralised teams through transparent communication flows (see also Koch and Richter, 2008: p. 29). Another benefit is the passive information transfer with organisational members that are not directly involved in the project team.

Through the decentralised character of organisations with a focus on custom-built products, weblogs allow the development of R&D project concepts in a geographically and timely distributed way. Concepts can be developed and published by a core team and then commented by a wider number of stakeholders. Through the early involvement of decentralised experts working in operational projects in the development of concepts for R&D projects, these can be adapted with a minimum effort to the requirements of a high number of different projects. In addition, the categorisation of project concepts in weblogs through tags allows search in previous project concepts and processes. Further all

interested employees can subscribe to their areas of interest and be informed about new concepts or comments in their area through e.g. RSS feeds. In a wider application, weblogs also allow the involvement of external experts for commenting specific concept ideas.

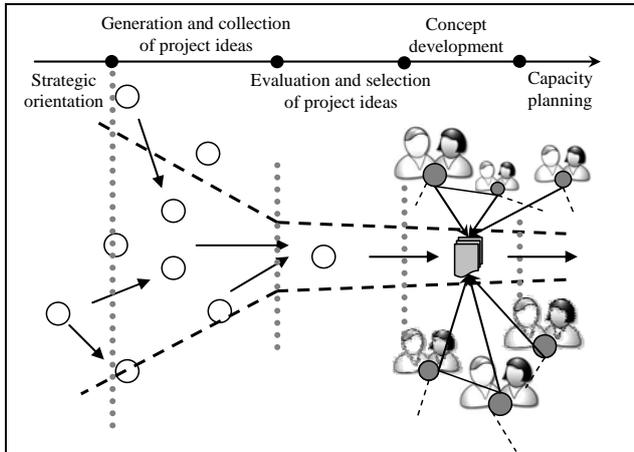


Figure 3. Concept blogs for the collaborative development of R&D project concepts in R&D programme planning.

Major benefit of the use of weblogs for the development of R&D project concepts is the enhancement of the traditional concept development process through a medium that allows the integration of decentralised experts that are working in operational projects. This allows an early discussion of the concept and thereby a reduction of uncertainty through the involvement of a high number of different experts. Thereby it supports an early identification of risks and opportunities of R&D project concepts and an improvement of further planning. Also it creates awareness of R&D activities in the operational projects which can be a key factor for the transfer of results in later R&D phases.

4. Research limitations

The limitation of the described concepts is that they represent answers towards the identified requirements from the construction industry. To be applied in a wider range, additional research has to be carried out to compare the conditions of R&D programme planning for custom-built products in different industries. Further, the concept for the use of social software systems to reduce uncertainty in R&D programme planning for custom-built products has not yet been applied and validated with industry. This validation is envisioned as a next step, also to identify future research.

The research on application of social software in corporate environments is still at its beginnings and is currently getting in the focus of many research activities. The fact that the success of social software applications depends highly on the participation and thereby on the motivation of the users is one of the key aspects that has to be further evaluated for the application of social software in corporate environments.

5. Conclusions

Social software systems in R&D programme planning for custom-built products have a high potential to facilitate the transfer of information and the communication between key stakeholders. At the example of trend-wikis, social network systems, and social bookmarking systems, it can be shown that 1) social software speeds up the process of identifying the appropriate experts for the evaluation of R&D projects, 2) it allows the involvement of experts from operational projects in the process of R&D programme planning and 3) it can facilitate the generation of R&D project ideas.

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