INTERNATIONAL CONFERENCE ON ENGINEERING DESIGN
ICED 03 STOCKHOLM, AUGUST 19-21, 2003

PRIORITIZING R&D-PROJECTS IN A STUCTURED WAY – BASED ON THE EXAMPLE OF THE AUTOMOTIVE SUPPLIER INDUSTRY

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Abstract

This paper is addressing one of the most pressing issues in R&D-management: the prioritisation of companies' research resources onto the right topics. The reasons for the ever increasing importance of research is highlighted. Research and the objectives that companies pursue by investing into it, are put into perspective. Based on industry case studies, the typical errors of research prioritisation are described. A concrete and well-proven process in order to avoid these errors is proposed and explained at a level of detail that allows the practitioner to introduce this process in the own company.

Keywords: R&D-management, innovation process, research

1 Introduction

The pace of innovation in most industries has increased dramatically. Most companies have to transform from being a good product developer to being a driver of innovation, if they want to survive the next decade. Reasons for this are in most industries: (i) the ever higher demands on the quality and functionality that the customers have on the products, (ii) the necessity to integrate more and more technologies in the products (such as the increasing share of electronic components in mechanical products), and (iii) the product cycle time that becomes shorter.

In order to face these trends companies that want to stay ahead have to focus more onto investing into research. However, research is very different from product development (product development means to develop products on the basis of an existing knowledge platform – ready for the production to take over. Research means to broaden the knowledge platform and to add new and unknown principles. Research is risky whereas product development can be better planned). Whereas product development is organised quite well in many companies, hardly any company is managing research the same well. In particular the selection and prioritisation of research projects is hardly done in a transparent and systematic manner. This paper explains how to allocate research resources appropriately.

2 Situation observed in industry

The three companies that were the sample of observation, all make their main revenues in automotive supplier industry. In this industry R&D-expenses, being typically with between 6 and 12% of the revenues, are a major cost factor. The sample companies were experienced in R&D. They differentiated clearly between research and new product development, however, none had before a transparent way to decide onto which topics to focus research - focusing

research onto specific topics is inhere understood as allocating financial and human resources: the companies did neither have an stable decision process nor clear laid out criteria.

Working with the companies, the errors of past decisions were identified. The main categories listed below:

- Research is focused on topics that were particularly important to some department of the company but not relevant to the overall success of the company. Example: The research department of one company directed up to 30% of the resources to topics that were initiated by the (well-respected) key account manager for a large customer – solving specific problems that the customer could not solve in its own research department. Although this effort was gratefully appreciated by the customer, no extra-sales could be contributed to this.
- Effort goes too long into ongoing research projects, although the success of these projects is less and less likely - as turns out during the course of these projects and the resources are needed for other topics. Reasons for this error can be (i) a lack of procedural possibility (in one company never any research project had been stopped because nobody knew who should be the one taking the responsibility for the costs incurred – leading to a situation where the large majority of projects were sometimes provided with less and less resources but still "active"), (ii) the general resistance to admit that projects that seemed very promising had turned out not to lead to usable results, (iii) a lack of overview where resources are needed most.
- The selection of research projects is biased
    - Too many projects without any focus of critical resources and no chance to be quicker than any of the competitors
    - Not enough projects, focusing on a few large ones (sometimes one) that in case of failure leave the company without any innovation in the pipeline
    - Too many "quick-hit-projects" taking the chance to reach the leading edge
    - Too many projects focussing on non-product-related, basic research that does not lead to technology that quickly can be turned into product innovation

Presumably, many companies are facing the same or similar problems that are linked to the lack of the stable process and transparent decision criteria.

3 Process Overview

The overall process that is proposed to companies - in order to decide onto which topics to focus research effort - is described in this chapter. This process consists of four main steps with one controlling step (see figure 1). The four steps are best carried out by a small team supported by the respective specialist in the area. The four steps should be conducted regularly, at least annually. The controlling step should be carried out by the controlling department of the company and is a continuous activity.

3.1 Organisational prerequisites

In order to implement the above process, it is assumed that R&D is organised and managed already in a form that fulfils the criteria:

- Separation between research and product development addressing the different nature of the activities sufficiently

- Different teams in research as there are in new product development
- Different management expectation for research and new product development i.e. research leading (with a high level of uncertainty) to a new technology that then can be integrated via new product development (with high level of certainty) into a new product
- Different ways of carrying costs for research and for new product development i.e. cost of research as general overhead costs – cost of new product development attributed to the respective products

- Organisation of research work in projects with well-defined scope, budget, and time plan
- Sufficient management understanding and acceptance of the nature of research, especially the low level of planability

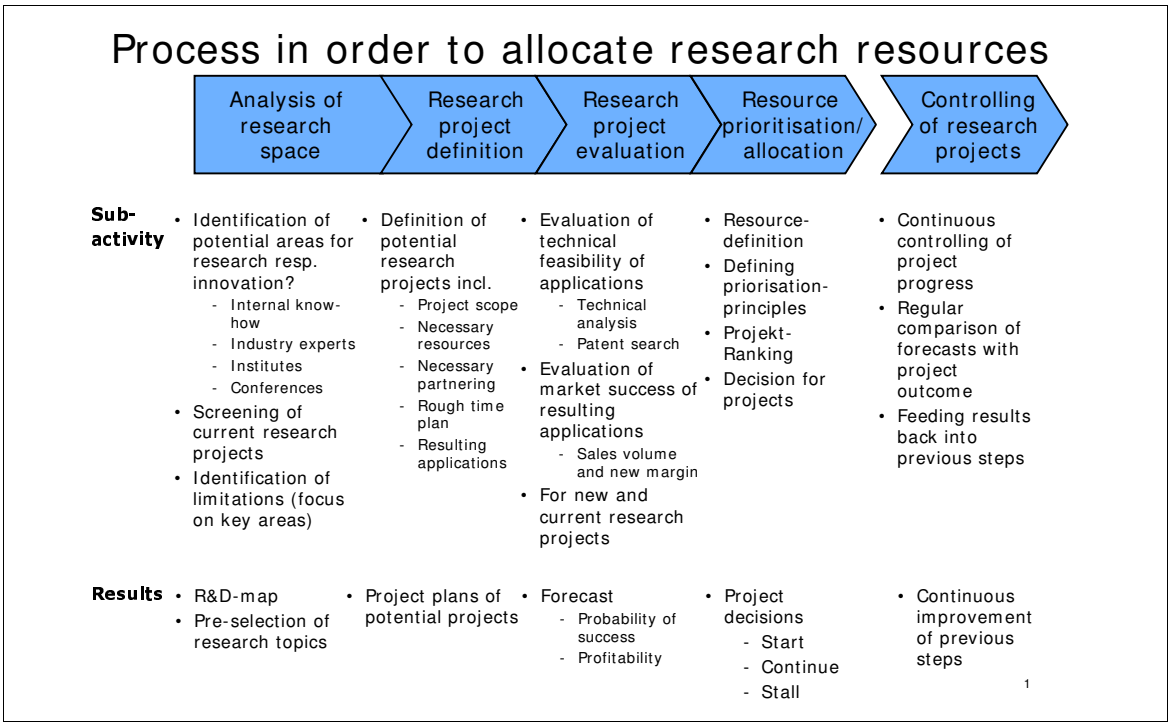

Figure 1: Process overview

4 Description of process steps

In this chapter the single steps and respective methods of the proposed process are explained in detail. Particular attention is paid to including the information that was collected when implementing the process (see especially section 4.3.6) – always adapted to the special needs of the respective company. The practitioner will appreciate this information when implementing the process in the company.

In this process should be included as well the running research projects, judging the success freshly (relating to the current state – time and investments so far should not be included because they do not count in a perspective looking forward). This helps to compare the chance of continuing current projects compared to starting new ones.

4.1 Analysis of research space

In this step the goal is to achieve an understanding of the areas onto which research could focus.

This requires to widening the perspective - often constrained by the current research topics - by identifying and listing the current and future topics of research in industry and the hot issues. Probably researchers and sales people within the company are well aware of all developments in the area, so the majority of information can be collected internally. Additional information will come from systematic screening of journals, visits of conferences, discussions with research institutes and interviews of clients, suppliers or competitors. The raw data collected will be a mixture of future applications (example: variable car head light adapting to environment) and technologies (example: different ways of how to alternate head light reflectors or light sources in order to achieve variable car head light). Often research topics will be set by the situation in which the company or industry is: such ever increasing regulatory pressure in order to reduce environmental pollution (e.g. emissions) or recycling legislation.

After this widening the perspective, the company has to focus onto the areas that are relevant. Good criteria are to compare the listed areas with (i) the own capabilities of research and production product range and (ii) the direction where the company sees its own future.

At the end of this step, there will be a list of applications and technologies and an understanding of how these relate to each other and where they are the context of technological state-of-the-art and the situation of the company.

4.2 Research Project Definition

In this step the main goal is to split up the list of research topics (which is the result of the first step) into projects with defined scope and project plan.

The projects should be covering the entire space of technology and applications and avoid any overlap of project contents. For each project, the scope has to be described as a new product or a product with additional applications through new technology. Then a rough project plan (inkl. time plan) has to be derived with necessary resources and costs attached. This will be the base of evaluating the effort respectively the investment that has to go into the different applications. Highest importance has the common definition of the level of development to which the projects shall take the technologies. Otherwise, the efforts of the projects will not be comparable. The level of product development readiness has proved to be a good definition: the level when the technology has been developed and has proved its feasibility in all aspects (as well the feasibility of production) and the researchers and engineers feel confident that the technology can be used in the next new product development cycle without carrying any risk for the development project.

4.3 Research project evaluation

In this step the main goal is to predict the success of each of the research projects in terms of (i) technical feasibility and (ii) increased margin resulting through the project, and (iii) to compare this with the necessary investment.

4.3.1 Likeliness of technical success

First a guess has to be made on the likeliness that the defined level of development can be reached within to the proposed project plan – usually this involves listing and evaluating all technical obstacles including difficult patent situations.

4.3.2 Likeliness of margin increase

Second, the potential benefit i.e. the increased overall margin has to be calculated: This can result from

- The extra margin per product (@ stable volume) that comes out when applying the research to products. Example: A product can achieve in the market through a new feature that results from innovation an increase of price from € 20 to 25 per product. The production costs increase from the € 18 to € 20. This results in a margin increase from € 2 to 5 per product. Similarly is the effect when innovations focus only the reduction of production cost and increase the margin through this.

and

- The increased margin per product line through increased sales that the product can achieve through innovation (including situations in which completely new products are introduced to the market). Example: A product increases its sales volume respectively revenue through new technology, however, with a stable margin per product (this is typical in the car industry, in which the car manufacturers have access to the suppliers calculation and accept only a set margin).

In both cases the company achieves a higher overall margin. Obviously, one project, respectively technology, can as well lead via both ways to increased margins.

For evaluating the situation of increased margins, production and sales people should be consulted – since they tend to have a better picture of the production costs and market situation.

For the increased margin estimated above a guess on the likeliness of achieving this has to be made. In many cases the increased margin through innovation is restricted to a short period. In the cases so far, one product cycle was taken as the respective period. This might be less, depending on the industry.

4.3.3 Weighting project potential with overall likeliness

In order to judging the overall likeliness of success of a project the technical and market likeliness have to multiplied – people in research know that an overall likeliness between 15% and 30% for overall success is in many areas typical – a figure that would hardly be acceptable for success of new product development in most industries.

Finally, this weighted (by likeliness of success) increased margin has to be compared with the necessary investment (see as well figure 2). In order to compare the projects with each other, ratios are of necessary. In areas were the time is long between the first research investment and the first increased margin the investment and increased margins have to be discounted by a time factor. In the automotive industry this is necessary due to long development time and model cycle of 6 years or 3 years until a facelift which is often a moment in order to introduce an innovation. The typical ratio for this purpose is the internal return of investment (IRR). Net present value should not be used since this is a indicator that will favour large projects in terms of investment and underrate small projects as profitable they may be.

4.3.4 Comparing projects

The main criteria of comparison for research projects can be

(i) The profitability measured by simple ratios or the IRR (resulting from the investment and increased margin)

(ii) The time when the increased margin resulting from the research can be realised

(iii) The extra revenue resulting from the research

(iv) The necessary resources

In figure 3 (i), (ii), and (iii) are presented – in a similar format (iv) could be represented instead of (iii).

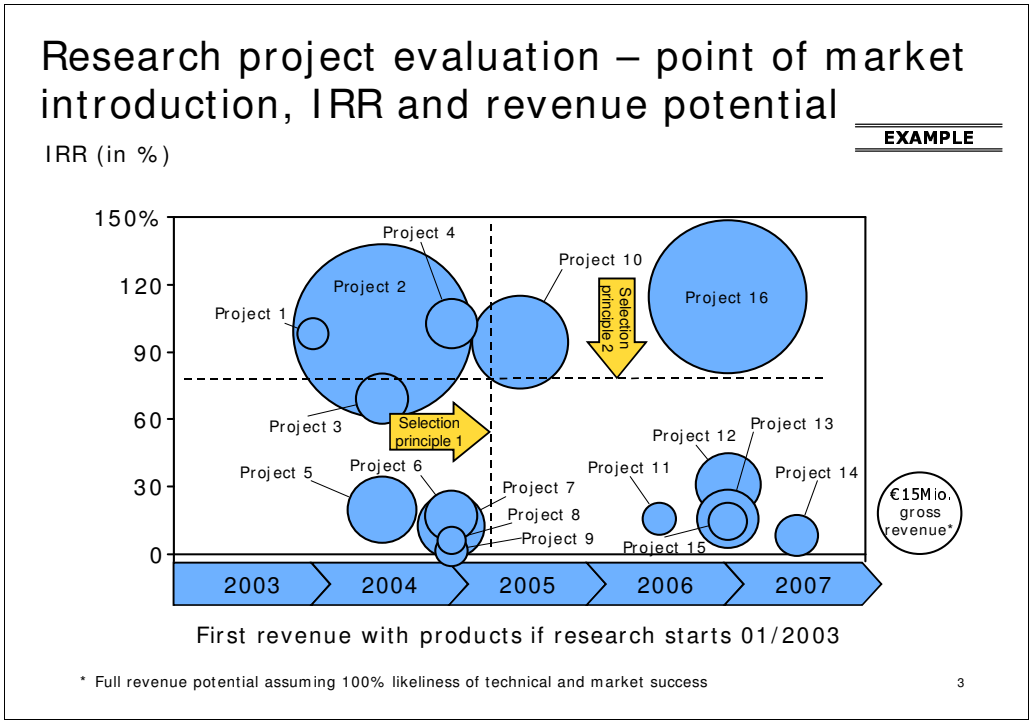

Figure 3: Presentation of comparison criteria

Judging market success or increased penetration is often difficult, even for sales people. The simplest method if no other assumption can be taken is to start with the entire market (such as ~ 15 Mio. units of produced cars in Europe per annum and to narrow down the potential market by filters such as an innovation that links to cars with leather seating will only apply to 15% of this market, etc.).

4.3.6 Additional process information for the practitioner

Below several watch-outs are highlighted: Less relevant for the pure theory but when implementing the process, this additional information will be most useful.

Investment for product development

Necessary investment into new product development should not be taken into account since the methodology uses a delta-calculation where new products with extra technology are compared to new products without this extra technology – meaning the new product development will occur in any of the cases.

Margin distribution over time

The realisation of the market success does not happen at once but is ramping-up. In the cases of car industry a ramp over three years was assumed with steps of 1/3, 2/3 and full potential in the third year. New applications are only introduced in the moment of facelifts respectively product cycles. These take place every three years – in one year, only a third of the produced cars can be addressed.

Judging likeliness

Judging the likeliness is difficult and often depends more on the mood of people involved than anything else. Whether the judgement is right can only be determined retrospectively and based on a large number of projects. This way an organisation controlling the process will learn from the previous judgment. Important, however, when judging the likeliness is that all projects are judged by the same team with the same measure (good approach: compare at the end of a team session, the guessed likeliness of projects against each other a second time and ask yourself especially about the relation between the projects).

In the sessions conducted, there was a tendency to judge research projects very positively. The discussion proved that people were excited about the chances and wanted that the projects go ahead.

Technologies without revenue but cost reduction

Special cases are projects for technologies that will only reduce cost but are not linked to any revenues (e.g. introduction of virtual reality in product development and by this reducing costs for prototypes). These reduced costs can directly be compared to increased margins since both leads directly to a higher earning.

4.4 Resource prioritisation / allocation

In this step the main goal is to take a decision how to allocate the available resources for research to the different projects based on the evaluation of the project.

Two issues have to be determined as input before the selection of projects:

- The available resources for research
- The principles to prioritise projects

The answer to the first issue will be in most of the cases either (i) that a research budget is set for a period that can be distributed to different projects or (ii) the "volume" of research is determined by the number of researchers within the company or (iii) the resources are adjusted to the opportunities respectively necessities for research, i.e. that any research project that fulfils set criteria (such as IRR of more than a set threshold) will be conducted.

In reality all three criteria will be taken into account, the one or other way, however, the available researchers will be probably the most important for most companies in Europe with the respective background of the labour market

The answer to the second issue is depending on the overall strategy of the company and how it wants to position itself on the market. Typical criteria may be:

- The time between starting the research and the first increased margin through products.
    - This can mean that the projects that result earliest in increased revenues are preferred (in figure 2 market exemplary as selection principle 1)

    Or

    - That the company wants to have a constant product pipeline, therefore, a selection of projects is preferred that will guarantee regular innovations for the market
- The profitability of projects: this means that projects that promise a higher profitability are generally preferred (in figure 2 market exemplary as selection principle 2)

- The probability of technical success and success in the market: this means that projects that are less likely to fail are generally preferred, independently from their profitability or time schedule
- In addition there may be projects that do not score in any of the ranking but are as such business critical, e.g. research in order to fulfil regulations that are simple a prerequisite in order to business in future, or research that is important to a large client on who's sympathy the company depends
- Any combination of the above criteria

With the above criteria a prioritised list of projects can be established (including all current projects) of which all projects are selected for which there are sufficient resources. This selection with its rational is a good base in order to take for current projects the decision continue or stall and for new projects the decision start or not to start.

4.5 Controlling of research projects

In this steps the main goal is to improve the above process by making forecasts more precise and hence generating a better base for decisions.

This includes a regular controlling of the project progress and comparison with the forecasts. By feeding this back into the above process adjustments and calibrations can be made. However, controlling of research projects has to understand that due to its unpredictability of research common ways of controlling evaluating research (such as a development process or production process) are in most cases not useful.

5 Conclusions

This descriptive paper has shown a method of evaluation research topics against each other and preparing a transparent base for taking decisions. The process is methodologically consistent and can be employed in most companies in which regular decisions about investment into research are necessary. The rational for decisions for research topics is easily understandable. The process should be, once introduced, carried out regularly – depending on the company: at least annually.

Within companies where this process was applied (so far only in automotive supplier industry) this proofed to well accepted amongst all parties involved and its transparency was praised.

Following the implementation of this process in several companies, it is assumed that with the process applied well, most of the errors described in the introduction can well be avoided.

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