



Organising and managing the fuzzy front end of new product development

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ORGANISING AND MANAGING THE FUZZY FRONT END OF NEW PRODUCT DEVELOPMENT

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ABSTRACT

In this article preliminary design propositions are developed to organize and manage the *fuzzy beginning* of the Front End (FE) of New Product Development (NPD). These preliminary design propositions are based on the literature and on cross-case analyses of five case-studies. They include the proposition to organize the Fuzzy Front End (FFE) around the three basic processes option generation, option development and option screening and to use clearly distinct management regimes for the various processes of the FFE, the FE and of main stream NPD itself.

Key Words: New Product Development, Fuzzy Front End, Management Regimes

1. INTRODUCTION

Large, well-managed industrial companies typically use some kind of formal base-line management system (also called a stage-gate process, Cooper, 1990) to organise and manage their main stream New Product Development (NPD). Before a formal, main stream NPD-project is started, a first base line – or gate – is passed in which a well-detailed project brief is reviewed and authorised. This project brief includes issues like product functional specifications, business plan, the resources needed for development and product launch and the project plan.

Before this gate 1 one has the so-called Front End of the NPD-process (Rubenstein, 1994; Cooper, 1997; Khurana and Rosenthal, 1998). During this Front End process the above-mentioned project brief is prepared, so it includes product and project planning and various activities to prepare and support this product and project planning, like business and innovation strategy definition (see e.g. McGrath, 1995), platform or product family planning (see e.g. Robertson and Ulrich, 1998) and technology road mapping (see e.g. Barker and Smith, 1995; Groenveld, 1997).

The Front End also comprises idea generation, idea development and idea assessment. As opposed to the planning processes of the Front End, mentioned above, these processes tend to have a more fuzzy nature, often with no clear beginning, multiple inputs, no well-defined throughput-process, creativity and serendipity playing crucial roles, participants getting involved and dropping out in unplanned ways, no clear interface with the planning part of the Front End, etc. This article deals with this *fuzzy beginning* of the Front End, the *Fuzzy Front End* (FFE).

This FFE is an important part of the overall NPD-process. As we will see, a sound FFE produces a variety of promising well-developed and well-tested options for products, product components or features and for product families or platforms as input for the subsequent product planning process (in the following these various types of options will just be called product options). By doing so the

FFE can strongly contribute to eventual product advantage and low product development costs and throughput times.

However, the nature of the FFE is still little understood and it is little researched in the context of the overall NPD-process. Nor is much known on effective management approaches to improve its performance. On the basis of the literature and on cross-case analyses of five case-studies we developed design propositions for organizing and managing this fuzzy beginning of the Front End of NPD, starting from the idea that the nature of the FFE is indeed very different from the nature of formal main stream NPD. These propositions are to be regarded as preliminary design propositions, as they have not yet been field-tested as such.

2. THE FRONT END OF NPD AND ITS FUZZY BEGINNING

The Front End of the New Product Development process comprises all activities preceding the start of formal NPD-projects (Wheelwright and Clark, 1992; Cooper, 1997; Khurana and Rosenthal, 1998). These early activities have been dubbed the *Fuzzy* Front End of the NPD-process by Smith and Reinertsen (1991), a qualifier which has been adopted by several other authors (Moenaert et al., 1995; Cooper, 1997; Khurana and Rosenthal, 1997; Rosenau, 1997; Koen et al., 2001; Buggie, 2002; Kim and Wilemon, 2002).

Already a long time it is known that the Front End of NPD is an extremely important determinant of New Product success (Maidique and Zirger, 1984; see also Thomke and Fujimoto, 2000). Cooper and Kleinschmidt (1987) found that proficiency in pre-development activities and an early, clear product definition ('protocol') were two of the three most important success factors. And their study of determinants of timeliness (Cooper and Kleinschmidt, 1994) showed that 'up-front homework' was one of the three most important timesavers, while 'product definition' was one of the four other timeliness drivers (see also Cooper, 1997, on these issues). The results from Cooper and Kleinschmidt's Canadian studies (Cooper and Kleinschmidt, 1987) were supported by Song and Parry (1996), who found that for Japanese firms development process planning and concept development and evaluation were also strongly correlated with New Product success.

The deliverables of the Front End are defined by Khurana and Rosenthal (1997) as product concept, product definition and project plan and by Cooper (1997) as the business case, a somewhat broader concept, but which includes product definition and project plan. For Khurana and Rosenthal (1998, p. 59) the Front End includes product strategy formulation and communication, opportunity identification and assessment, idea generation, product definition, project planning and executive reviews. Cooper (1997) discusses the Front End in terms of his stage-gate model. It starts with an initial screen, followed by the preliminary investigation stage and after a second screen the detailed investigation stage, which includes building the business case. This second stage may involve in-depth market analyses and also laboratory work to assess the technical aspects of the product idea. Roles in the Front End include core team, project leader, executive review committee, senior management (Khurana and Rosenthal, 1997 and 1998). Key success factors for the Front End include a clear link with strategy (McGrath, 1995), a strong market orientation (Cooper, 1997), a well-organised R&D-Marketing interface (Moenaert et al., 1995), the use of external sources of ideas and knowledge (Rubenstein, 1994) and, of course, proficiency in executing pre-development work (Cooper and Kleinschmidt, 1995; Song and Parry, 1996).

The Front End literature seems to discuss two different categories of processes. On the one hand product and project planning, including the link with business and innovation strategy and building the business case, basically through desk work and interdisciplinary discussions. And on the other hand idea generation, idea development and idea assessment, which also involves desk work and discussions, but often laboratory and market research activities as well. In this article we are

primarily interested in this second category of processes. More so than the processes of the first category, these processes may have a fuzzy nature, as discussed in the previous section. In this article we will, therefore, restrict the term Fuzzy Front End (FFE) to this fuzzy *beginning* of the Front End of the NPD-process. The mission of this FFE, then, is to provide input in the form of promising product options to the final stage of the Front End, the product and project planning. Important input for incremental main stream NPD but even more so for radical NPD and for new business development.

There is some research on this beginning of the NPD process, like the work of Rubenstein (1994) and Christiansen (2000). Among other things Rubenstein discusses the various individual and organisational roles in this process, including the role of the corporate research labs of large companies, the role of intrapreneuring and the use of external sources of knowledge and of subcontracting of development activities during these stages. There is much research on idea generation in general and also some research on idea generation in the context of NPD (Baker, Green and Bean, 1985; Conway and McGuinness, 1986; Von Hippel, 1989; Christiansen, 2000). However, the FFE, as defined here, can still be regarded as under researched, especially in the context of the overall NPD-process, i.e. the FFE as feeder of main stream NPD.

3. RESEARCH STRATEGY

This article is not, like most academic articles in Management, written on the basis of the paradigm of the *explanatory sciences*, like physics and sociology, but on the basis of the paradigm of the *design sciences*, like medicine and engineering. Following Van Aken (2004), the core mission of an explanatory science is to develop valid knowledge to describe, explain and predict. Research in an explanatory science can be seen as a quest for truth, for shared understanding of the objects of interest. The core mission of a design science, on the other hand, is to develop valid knowledge which can be used by the professionals in the field in question to *design* solutions to their field problems (hence the term “design science”). Research in a design science can be regarded as a quest for improving the human condition. The test of the knowledge of a design science is not truth but whether the solutions designed from it work, i.e. produce the intended results.

The typical product of an explanatory science is the causal model, explaining – preferably in quantitative terms – a phenomenon of interest in terms of some independent variables. The typical product of a design science is the *technological rule* (Bunge, 1967), connecting some intervention or construction with some outcome or performance (in a given application domain). More specifically, the logic of the technological rule is: if you want to achieve Y in situation Z, than do X (or something like X). The core of the rule is that X, a *general solution concept*. The rest of the rule is a kind of user instruction, connecting the solution concept with the field problem in question, including indications and contra-indications for its use.

A powerful category of the technological rule is the field-tested and grounded one. It is a rule that is tested in its intended field of application and it is known why, through what generative mechanisms, it produces its outcome.

The technological rule is general knowledge. Its application by a professional involves a translation from the general to the specific. The professional has to design a specific variant of the general solution concept, adapted to the specific conditions of his/her case. The evidence from field-testing and the knowledge of the generating mechanisms behind the rule are essential input for this translation of the general to the specific.

The empirical basis for this article consists of five, very different, case-studies on the Fuzzy Front End of New Product Development. Case-studies were chosen as a research strategy to get an in-depth understanding of the processes and problems in the FFE as well as to get an opportunity to

develop, in a kind of Action Research, approaches to deal with those problems. Each case-study was essentially a problem-solving project. These projects were subsequently used by the authors to develop general solution concepts through cross-case analyses of the problems encountered in the FFE and of the specific approaches developed to handle these problems. Through these cross-case analyses *general* solutions to management problems in the FFE are developed by “filtering out” the specifics of each case. So the cases were not used to derive true statements on how the FFE *is*, but to derive statements on how the FFE *might be* to produce intended results. No specific protocol was used for these cross-case analyses.

Technological rules can be regarded as *design propositions*, propositions with respect to the design of solutions to field problems. However, the results presented in this article should rather be regarded as *preliminary* design proposition, as they have not yet been sufficiently field-tested to be already called full design propositions.

4. FIVE CASE-STUDIES IN FFE

Every NPD-process has a Front End in which products and projects are defined, be it well organised or not. And every Front End is fed by product ideas, well developed and well tested or not. The ways in which those product ideas are generated, developed and assessed, however, varies greatly. We did five case-studies, among other things differing in industry and in company size, to get more insight in the nature of this, usually fuzzy, beginning of the Front End of NPD.

All cases are based on graduation projects of business engineering students of Eindhoven University of Technology, supervised by the authors. These projects have been executed in industrial companies (which we have given fictitious names) and were aimed at developing improvements of the FFE of the NPD-process of the company in question or of its NPD-process in general. In these projects, the students stayed six to eight months at the company, doing interviews, analyses, in cases C, D and E a survey, developing solutions for the problems specified in their assignments, and having many discussions with company staff (as well as with the university supervisors) on their analyses and proposed solutions. These projects gave the authors the opportunity to get in-depth insight in the subject matter through these students and through own contacts with company staff. The cases C, D and E started with an audit of the overall NPD-process, permitting us to put the FFE into the perspective of this overall NPD-process. Four cases concerned both incremental and radical NPD and one concerned new business development.

We will give a brief description of these cases, to provide the background for the subsequent discussion of FFE-problems and FFE-solution concepts.

Case A World Devices

World Devices is a large multinational company in the field of consumer devices. It has a well-organised NPD-process, the company’s business strategy being strongly based on creating product advantage. Recently the company had put much effort into a large, company-wide improvement project to bring down development throughput times. The core of this project consisted in defining a norm-process, in which all the company’s know-how on development management was incorporated, and in subsequently implementing this process company-wide (while allowing for some local variations). Subsequently one wanted to improve the FFE, as there were still some problems, including

- a short term orientation of mainstream development, resulting in too little product advantage
- insufficient marketing inputs to idea development
- underdeveloped screening; some ideas were incorporated in product planning but not sufficiently tested, while some other good ideas were not used for unclear reasons.

Case B Global Materials

The strategy of Global Materials, a large division of a large multinational company in the business of plastics, was to move away from low-margin bulk materials and to increase its sales in high-margin specialties. It had developed a revolutionary new material, which it sold in increasing quantities to manufacturers of end-products. It was now looking for new applications of this material, which each time involved some adaptation of its properties in order to create new business. This search was driven by a market development department, usually in projects with close collaboration with a manufacturer of end-products. The various application development projects were executed by cross-functional teams. The key problem now was a perceived underperformance of this market development department, which – being a part of the sales division – was managed as if it were a sales department and judged on the basis of tons of materials sold in initial sales of their new products. On the other hand, under the pressure of very challenging growth targets for the company as a whole, large amounts of money were invested in high-risk development projects, many of which eventually failed.

Case C Complex Mechanical Systems

Complex Mechanical Systems (CMS) is a mid-sized, well-established Dutch company, supplying complex mechanical systems in the field of warehousing and logistics to clients all over the world. Their systems consist of own modules, combined with many purchased components, usually to be assembled on-site. The competitive strategy of CMS is firmly based on product advantage, while keeping prices reasonable. CMS has a fairly large central R&D-department (some 50 people), working for the three businesses of the company. Innovation is partly project-bound, R&D-developing adaptations of existing modules to meet the specifications of a given ordered system, and partly general, aimed at developing new generations of CMS's own modules. Some 15 % of R&D-capacity is spent on 'research projects', i.e. pre-development (idea generation, idea development, often up to prototyping). Problems of CMS include cost problems (product advantage is not always a key order winning criterion), too little really new ideas (efforts to realize product advantage are too much based on the successes of a few years ago) and too little focus, partly because the link with strategy is unclear.

Case D International Imaging Systems

International Imaging Systems (IIS) is a small company in specialty TV-camera's (employing some 50 people), but on the world market a leader in its niche. Its R&D-resources are very limited, but by focussing on a few core competences it arrives at developing technologically cutting-edge products. Its customers are mostly big, sophisticated OEMs. Its product ideas are to a large extent generated by these customers – who may even pay for the innovation effort – or by their innovative suppliers of key components. The problems of IIS are its limited competences and resources: they have to be very selective in the development projects they start, but at the same time they have to fulfil the needs of their demanding customers and to stay being a market leader.

Case E WearStop

WearStop is a young micro company (10 people) in the business of overhauling engines of cross-and race motorcycles. They do so by mechanically repairing the engine-cylinders and subsequently coating the inner surface with a very hard layer through a sophisticated electrolytic process. Process development is done by one man with a small laboratory. During the first years it was aimed at getting the electrolytic process under control. Now it is aimed at broadening the product range of the company, in line with the company's strategy to diversify. New products include friction plates, coated through their special process. One of the strengths of the company is its application know-how of the motor world. Product ideas – or ideas on product enhancements – come from intense

contacts with motorcycle drivers. The problems are, of course, the limited competence base and the very limited resources.

5. PROBLEMS IN THE FFE

The cross-case analysis of the five cases, described above, created a general picture of the FFE and of the problems of organising and managing it. These problems include the following.

- Pressures on the performance of the overall NPD-process can lead to a short term orientation for the FFE, extrapolation rather than real exploration, and lack of risk-taking (case A and C).
- The participation of the key stakeholders in NPD is not well-organised, leading to a strong internal orientation, under developed communication – both with internal and external parties – and in a technology-driven company to too little marketing input into the FFE (cases A and C), or, on the other hand, difficulties of getting commitment by certain departments for uncertain projects (in case B the R&D-department was reluctant to spend its scarce resources on market development projects with low credibility).
- Idea generation as such was not so much of a problem in the large companies of case A and B, which had strong R&D-traditions: NPD in these companies seemed to operate in idea-rich environments. However, it was a serious issue for the smaller companies, the cases C, D and E.
- Underdeveloped screening and haphazard selection of ideas for product planning, which may lead to an incorporation of underdeveloped ideas in product planning (case A, E and to some extent D) and may lead to continuing investing much money in low-potential projects (case B).
- Underdeveloped resource control: for many projects in case B the huge costs became only clear after they failed; in case A there was an implicit norm for the total amount of resources to be spent on the FFE, but the allocation of those resources to the various ideas was largely left to intrapreneuring.
- Difficulties in performance control: in case B the company's traditional outcome control was used, but in view of the large uncertainties and long time horizons this was dysfunctional; this problem surfaced because a specific department had been made responsible for the FFE; in the four other cases this problem remained under the surface, because the responsibility for the outcome of the FFE was much more distributed.
- And, finally, maybe the most important issue is the managerial 'invisibility' of the FFE-process. Again in case B this was less so, but the informal nature of the FFE and the distributed responsibilities for the performance of the FFE in the four other cases made that the process of idea generation and development as such, the resources to be spent on it and the expectations on its outcomes were seldom discussed explicitly.

6. DESCRIBING THE FRONT END OF NPD

In describing the FFE we will use the concept of the *development funnel* (Hayes, Wheelwright and Clark, 1988; Wheelwright and Clark, 1992), see fig 1, because it aptly describes the process of going from a large number of immature ideas towards a limited number of promising product options, to be used in main stream NPD. The Front End (FE) is the mouth of the funnel, where new ideas enter or are created, which through a certain culling process are screened, developed – both with respect to technical and marketing aspects – and further screened, until one arrives at a more limited number of – preferably well-developed and promising – ideas, which are then the input to the product and project planning at the neck of the funnel. Product and project planning result –

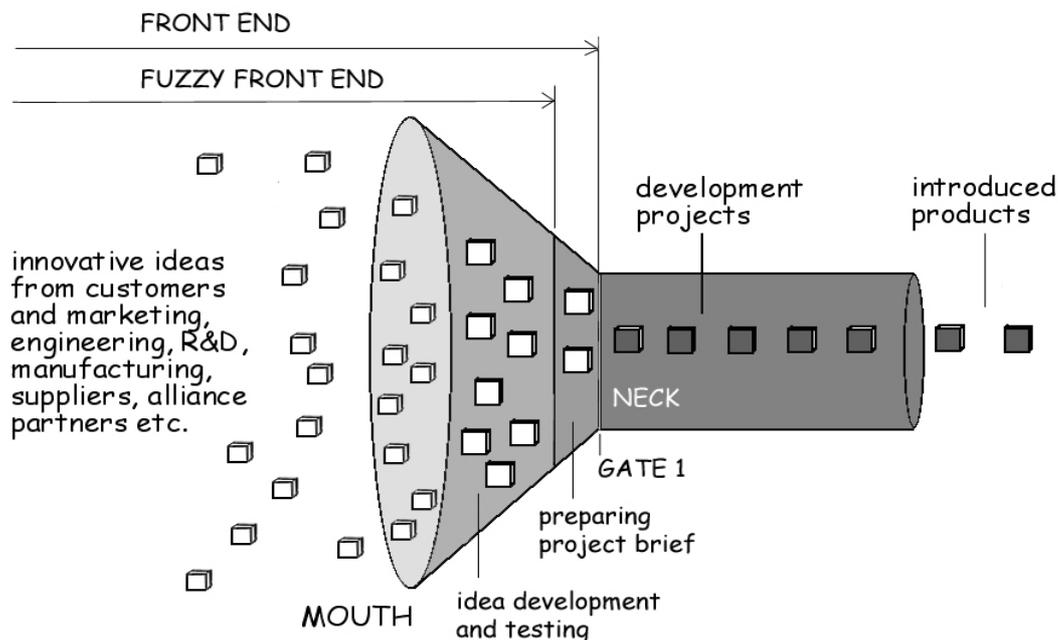


Figure 1 The Fuzzy Front End of main stream NPD (adapted from Wheelwright and Clark, 1992). Here the FFE is seen as the *beginning* of the Front End, which ends with the preparation of the project brief

among other things - in the project brief, discussed in the introduction. This project brief then is reviewed and authorized at gate 1, the entrance of the formal main stream NPD-process.

In line with the literature and our cases we see as the mission of the FFE to feed product and project planning of main stream NPD with a satisfactory number of promising product options at an acceptable price and within a competitive time span. This means that the mission of the FFE is *not* to develop product specifications and even less so prototypes, but to provide product and project planning with a satisfactory number of promising and well-developed *options*, some of which will be 'called' by these planning activities. Resource and performance control of the FFE can use real options reasoning (Mitchel, 1990; Dixit and Pindyck, 1994; Lint and Pennings, 1998, McGrath, 1999). According to this reasoning one 'buys' with a relatively limited investment in resources options on future products, options which may be exercised by formal NPD-projects beyond the neck of the development funnel. The creation of options is a high-risk activity. Its performance should, therefore, not be assessed on the basis of an individual option, but at the level of the portfolio of options. 'The key issue is not avoiding failure, but managing the cost of failure by limiting exposure to the downside while preserving access to attractive opportunities' (McGrath, 1999, p. 16).

The development funnel of fig 1 describes essentially a NPD process driven as – in terms of Chesbrough (2003) – closed innovation, i.e. innovation within the scope of a single company. The FFE of an open or networked innovation process, in which inter-company collaboration plays a major role in various stages of the innovation process, is also very interesting, but that process falls outside the scope of the present article.

6. ORGANIZING THE FRONT END OF NPD AND ITS FUZZY BEGINNING

In the following we will present a number of preliminary design propositions to organize and manage the FFE in the context of the overall NPD process. These propositions are based on the problems and solutions of the five cases. In section 8 we will give some justification of them. This may be seen as a preliminary way of grounding these propositions.

In organizing the Front End of NPD the first proposition is to make a clear distinction in organization and management between

- main stream NPD, with few (relatively) low risk, resource-intensive projects
 - the high risk, 'light' option-development projects during the fuzzy beginning of the Front End – the FFE - and
 - the more rational processes of product and project planning in the final stage of the Front End.
- The FFE itself should be organized around the three core operational processes of *option generation*, using multiple inputs from both external and internal sources, *option screening* and *option-development*, both with respect to technical aspects – possibly involving laboratory work – and with respect to marketing aspects, possibly involving some market research. The core management process in the FFE is *option portfolio management*, deciding on the amount of resources to be spent on the FFE and on the allocation of these resources to the development of the various options in the portfolio, among other things on the basis of the results from option-screening.

As said, the mission of the FFE is to provide a satisfactory number of promising product options to the product and project planning of main stream NPD. Its performance should not be judged on the average success-rate of options (a high success-rate might mean a risk-avoidance portfolio-management and hence too little real innovation), but on the results from those few options that are actually called. And a second performance indicator of options-portfolio management is its efficiency: as said, one should not spend too much resources on option-development.

Organising any process means in principle defining that process in terms of sub processes with their input and output relations *and* defining the roles of individuals and groups (on departments) in each of those (sub)processes. Given the uncertain nature of the FFE those process definitions may be fairly fuzzy and limited, even in a well-organised FFE. However, one can do much with *role definitions*, both in terms of content and contribution (like person or department x is responsible for inputs from the domain y) and in terms of type of actions: gate keeper, product champion, devils advocate, option-sponsor, review-board, etc. In repetitive, low-uncertainty processes there usually is much potential for improvement by separating planning and execution. In fuzzy processes this potential is much lower; instead one should put more effort in role definitions, leaving the actual scheduling of activities to the individuals and groups assigned to these roles themselves.

It is the responsibility of NPD-management to have an effective Front End of NPD in place to feed the resource-intensive main stream NPD with sound project briefs and to allocate sufficient resources to it, both for the planning activities for product and project planning and for the technical and market research activities for developing and testing options.

8. MANAGING THE FFE: OPERATING ON THE EDGE OF CHAOS

The very idea of organising and managing the FFE is alien to some. Ideas are emergent and their generation cannot be forced. On the other hand one may want to improve the performance of the FFE by solving some of the organisational problems discussed section 5, like the uneven participation of individuals and departments in the FFE and the problems of resource control and allocation. Some authors, therefore, propose to extend the stage-gate process of the formal, main

stream NPD-process to the FFE (Cooper, 1997; Cohen, Kamienski and Espino, 1998). However, we feel that such an approach does not match the nature of the FFE. Just like in former days children were mistakenly treated as being just small adults (and clothed as such), instead of treating them as being really different from adults in many important aspects, we feel that FFE-activities should not be treated as normal NPD-projects with just some more uncertainty. Organising and managing the FFE faces a real dilemma. In the FFE one has much risk and uncertainty, the desired results are ill defined and the roads to those results even less. Therefore, in organising the FFE one has to strike the right balance between free exploration and business-direction. Too much direction kills exploration, creativity and serendipity, while too little direction hurts FFE-performance. This dilemma has been called the *Daphne-dilemma* by Van Aken and Weggeman (see box 1).

In the Greek Daphne-myth, the sun god Apollo is enamoured of the beautiful young maiden Daphne. However, she is terrified of his advances and flees. Apollo uses various circumspect approaches, but she remains evasive. Eventually he has almost caught her, but then she turns into a Laurel-tree.

This myth symbolises the morning dew, admired by the upcoming sun but disappearing for its loving rays.

The Daphne-dilemma has to do with the problems of approaching an elusive phenomenon like literary inspiration or the recollection of a dream: one tries to catch it, but too much intent destroys it.

Box 1 The Daphne-dilemma (Van Aken and Weggeman. 2000)

One approach to handle this dilemma has been given by Quinn (1985). He describes managing product innovation as controlling chaos. This implies that chaos is not suppressed but is 'just' controlled, as many innovations don't travel along predefined paths but follow fairly chaotic processes with feed back and feed forward loops, circumvention of thorny obstacles, unanticipated breakthroughs, etc. In our opinion this approach does no longer apply to main stream NPD in large, well-managed industrial companies, and certainly not to incremental main stream NPD (where usually the bulk of the NPD-resources is spent). But it does apply to the FFE. Controlling chaos means in our opinion *operating on the edge of chaos*, i.e. on the 'dissipative equilibrium' between the chaos-trap on the one hand and the bureaucracy-trap on the other (Brown & Eisenhardt, 1998). It is a dissipative equilibrium, because it costs energy to maintain it (as opposed to a stable one - like a marble in a hollow - which doesn't cost energy to maintain). In the bureaucracy trap one has well-defined targets, processes and division of labour, good for exploitation but bad for exploration, particular in uncertain situations (or situations far-from-equilibrium-and-agreement). In the chaos-trap one has on the other hand ill-defined processes and division of labour, which can ultimately lead to an 'error-catastrophe': one is continually repairing errors so that the normal, undisturbed processes drown in repair actions and fire-fighting, causing the necessary organisational learning and improvement processes to disappear, eventually leading to a total break-down. Too much structure kills uncertain, but possibly high-potential initiatives, too little will yield unsatisfactory results.

Analysing our cases, we see that Global Materials, case B, was in fact the only case in which the company really wanted to organise and manage its FFE, i.e. its idea generation and especially its idea development. They did set up a special department to drive idea development and used the company's traditional outcome control to manage it. They ended up in managing it too tightly, which at the same time did not prevent the waste of resources on low-potential ideas. World Devices, case A, on the other hand managed their FFE too loosely. The company had a tradition of spending quite some resources on free exploration, but in the end they concluded that their

management approach led to an underperformance of their FFE. In the cases C, D and E the companies were just getting aware of the possible importance of the FFE. For International Imaging Systems (case D), however, it was still not a key issue, as they got sufficiently well-developed ideas from their powerful and sophisticated customers and suppliers. For the micro company WearStop the key issue was to get more control of their NPD as a whole; improving their FFE was compared to that of less importance. But for Complex Mechanical Systems, with a NPD-process operating in a less idea-rich environment than the multinationals A and B, improving the performance of their FFE was indeed becoming an issue.

Organising and managing the FFE does not mean that one should use the formal management systems of the stage-gate process in the FFE, but much more loose structures. In discussing and designing such management systems it is worthwhile to distinguish *type 1, type 2 and type 3 management regimes* (Van Aken and Weggeman, 2000). With the type 1 management regime we mean the formal stage-gate management processes of main stream NPD.. Here we have business plans, project plans, milestones, formal agreements on resources and especially dead lines to be met.

With the type 3 management regime - on the other hand - we mean the management of undirected research. In large corporate R&D-establishments typically some 10 to 15% of total resources is spent on such undirected research (sometimes called 'Friday-afternoon-research'). The activities of gate-keepers and boundary-spanning individuals usually are managed under a type 3 management regime. Here we have definitions of roles, of communication patterns and of roughly the resources to be spent, but very little direction of the content of the research and very few targets and milestones.

The type 2 management regime, finally, is a hybrid between type 1 and type 3: not as formal as type 1 and not as free as type 3. The typical type 2 project is the seed money project, applied for by scientists and engineers who have a good product- on technology idea and now need some resources to develop that idea further. If one wants to organise the FFE as a stage-gate process, one may want to use Cooper's ideas of flexible gates and fluid stages (Cooper, 1994), which may be too dangerous to use in a type 1 management regime, but appropriate in a type 2 management regime. Under a type 2 management regime one does not have the formal resource allocation procedures of the type 1 regime, but some very light procedure, involving only management-levels close to the innovation operations. However, one does have some idea on content and on potential interest for the business. The core idea behind type 2 resource allocation is that those resources should in principle be very limited. As said, it is easy to spend too much on low-potential options, so the type 2 management regime should have sufficient control on spending resources.

Option-generation should largely be managed under regime 3, with an emphasis on injection of variety, among other things through openness to the environment (using e.g. gatekeepers) and through (informal) collaboration with suppliers, lead customers (if any) and other potential partners. Intensive internal communication is essential.

On the other hand, option-development and option-screening should be managed under regime 2, with option-portfolio management as core management process. Typically option-development will cost more resources than option-generation, but the task of option-portfolio management is to limit spending. As said above: manage the cost of failure by limiting exposure to the downside while preserving access to attractive opportunities. By limiting spending one can take more risks in option-development than would be acceptable in resource-intensive main stream NPD

Option-development can use Boersma's (1994) approach of focusing on potential bottlenecks, not on prototypes (this is a kind of Theory-Of-Constraints for NPD). As opposed to option-generation and development, option-screening can be organised fairly crisp and clear and it can use an array of analytical checklists and techniques. One should organise it as a group process in which all major internal stakeholders are represented and with some injection of additional variety by

outsiders. Competition between ‘option-champions’ and ‘devil’s advocates’ (to avoid the trap of group think) may help and the participants should be close enough to the actual innovation activities to have a real understanding of the issues at hand.

9. JUSTIFICATION

The sections 7 and 8 gave some solution concepts for organizing and managing the FFE in the context of NPD. These solution concepts are based on the problems found in our five cases and on the approaches which have been designed to deal with them. They are proposed to handle the problems, discussed in section 5 in order to improve the performance of the FFE. In line with the mission of the FFE, given in section 6, this performance can be judged on the traditional criteria of the timeliness, costs and quality of the product options it has produced. The main idea of the sections 7 and 8 is to really organize and manage the FFE – and in doing so to make it ‘visible’ for management – without overdoing it, the management regime 2 idea. This is based on

- case C and D, which had a fairly good product and project planning process in place, but left the product option generation largely to chance resulting in a too low number of promising product options
- case A in which the FFE was under organized, resulting in a fairly haphazard option-development
- case B, the only one that really wanted to organize and manage the FFE, but used for this an inappropriate regime 1, paradoxically resulting in huge overspending.

A further proposition is to use real options reasoning in managing the FFE: limited investments in a relatively large number of high-risk product options. In case A there was a too short time horizon and a lack of risk taking, resulting in too little really innovative product options. And on the other hand in case B the risks were underestimated; on the basis of a regime 1 management philosophy the high failure-rate was attributed to poor management, rather than to the inevitable result of a high-risk project portfolio.

10. CONCLUSION

This research project was aimed at developing more understanding of the nature of the FFE and of its problems as well as at developing general solution concepts for dealing with these problems in order to improve the performance of the FFE.

We did so on the basis of the idea that the nature of the FFE is really different from mainstream, formal New Product Development. We introduced the idea of a type 2 management regime, to label approaches that try to strike a balance between free and undirected exploration of new ideas on the one hand (the type 3 management regime) and the formal, tightly managed main stream development (the type 1 management regime). Through a well-developed type 2 management regime one may adequately deal with the Daphne-dilemma. As said, these solution concepts are as yet to be regarded as preliminary design propositions, as they have to be further field-tested and refined.

Christiansen (2000) discusses how industries vary with respect to product ideas along the dimensions many/few, respectively expensive/inexpensive relative to corporate resources to develop, thus creating four types of industries. Our position is that one should not treat this aspect of corporate situation as being fully given, but that one should try to create as much as possible a many/inexpensive situation by establishing a productive FFE.

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