Improving Multi-Project Management in Two Product Development Organizations

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Abstract

In this paper we describe how two product development organizations have started improving their multi-project management.

A typical problem in new product development (NPD) organizations is that too many projects are launched. NPD projects can range from advanced research to enhancements to existing product lines. Each type of project should have its own role and add its own contribution to the strategic mission and competitiveness of the company. The product strategy of a company should serve as the guideline for planning the right sequence, number, and mix of projects. Together with the product strategy, portfolio management should provide the basis for fund allocation and prioritization between the different types of projects. With a project classification system, the various needs of the different project types can be considered.

1. Introduction

In a typical product development environment, different types of projects are launched for different purposes. While one product development team is working on a break-through technology platform, other teams work on increments to existing product lines, and some teams work on new designs to cut manufacturing costs. People often work in many projects simultaneously. On top of project work, product developers can also be involved in product support. Even in small product development organizations this can result in a massive, uncontrolled workload, which makes the successful completion of a single project hard at best.

A common problem in product development is that too many projects are launched [6,7], leading to over-commitment of resources, which in turn causes projects to fall behind in their schedules, further increasing the resource overload. Another problem is the lack of strategic direction for the projects or the lack of a link between new product development (NPD) and corporate strategy [18].

Already in 1968 Howell [9] reported that the means for controlling the progress of a single project were well established. He also reported that the integration of cost, schedule, and performance control was still in a state of development, as was the management control of a number of simultaneous projects of varying value, duration, and technical complexity.

Today it seems that since Howell's report much attention has still been put on improving the management of *single* projects. In the 1980's several companies started to organize their product development according to a concurrent model [16] in order to meet the increasing demands for shorter product development cycle times. This necessitated a formal definition of the role of the different business functions across the project life cycle. For this purpose several companies adopted a StageGate™ process model [4], which has been further developed during the years, see e.g. [5].

But still, too many projects are launched, which makes the task of managing single projects harder. Too little focus has been placed on assuring the strategic fit of launched projects and multi-project management, until recent years. Cooper has been a champion for portfolio management [6], and a recent article by Englund and Graham [7] also illuminates how projects can be linked to strategy and underlines the importance of a project classification system. Wheelwright and Clark's [22] work is a classic and their project classification is perhaps the most widely used. In our own research project at the Helsinki University of Technology we are developing a framework for the controllability of product development, which addresses the same issues.

The rest of the paper is structured as follows: first we describe the emerging controllability framework in brief, followed by an introduction to multi-project management. Then we present how two product development organizations have started improving their

multi-project management. Finally, conclusions are drawn.

2. A framework for controllability

The framework for controllability combines the Balanced Scorecard [10], the Goal/Question/Metric (G/Q/M) approach [1], and participative management, e.g. [14,17]. The framework views control broadly as *"any kind of goal-directed influence"* [11]. Controllability in turn is understood as the ability to control, which is affected by several factors, e.g., the viewpoint, the object of control, and the object's environment [13].

In the framework, controllability is expressed in terms of four levels and four aspects (Figure 1). The levels are strategic, pipeline, project, and individual. At each level, the same aspects are considered: objects of control, goals, metrics, and mechanisms. The aspects at different levels should be interrelated: the corporate strategy should be communicated from the strategic level, through the pipeline and project levels, down to the individual level. Also, the metrics should be derived from specific goals. For the purpose of this paper we concentrate on the strategic and pipeline level, and focus on mechanisms to support and improve multi-project management.

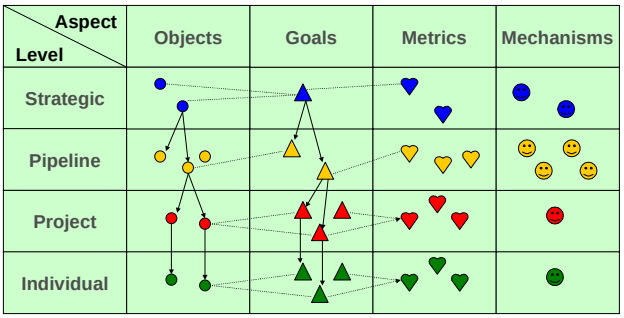

Figure 1. The Interactive Goal Panel [12]

Issues addressed at the strategic level are typically characterized by their long-term influence on the organization. At this level our interest focuses on how to control the NPD efforts of the whole company or a strategic business unit. Decisions are made concerning the mix and sequence of different projects to achieve the strategic goals of the organization. Examples of control mechanisms used on the strategic level include product strategies, roadmaps, and portfolio management.

At the pipeline level we deal with issues that are below the strategic level and above the level of a single project. Examples include process management, multi-project management, and organizational learning. Typical control mechanisms include project classification, and process models. The project classification on the pipeline level can differ slightly from the classification for portfolio management, since the level of detail typically increases when moving down the levels. Additionally, the goals of the classifications are different. For instance, in portfolio management you might consider how much should be invested in research, breakthrough products, platform products, and derivatives, thus ensuring the strategic fit to the product strategy of the organization. On the pipeline level, however, you might want to consider a more detailed classification, because different control needs exist for different types of projects, even within the above mentioned classes. Figure 2 gives a simplified example of what could be seen in and around the pipelines at any given time.

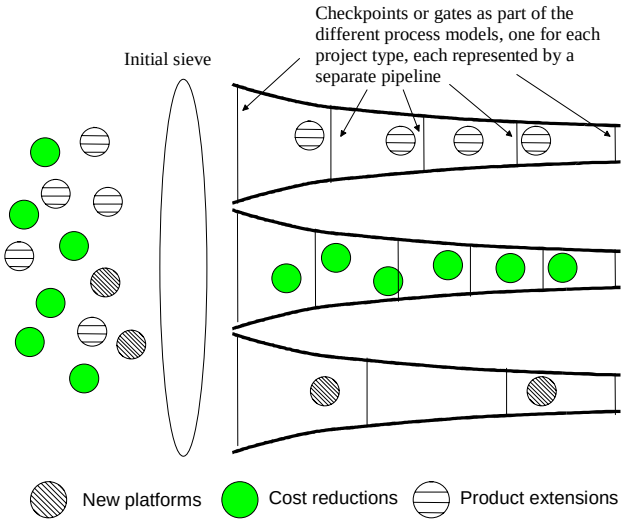

Figure 2. Snapshot of the pipelines

The vertical lines in the pipelines represent checkpoints or gates, the number of which can vary, depending on the characteristics and needs of the project type. Outside the pipelines, ideas may flow freely, but only the ideas that have a strategic fit may enter through the initial sieve. The product strategy of the company should help in deciding the mix and sequence of projects. The portfolio management efforts and the project classification system of the company should aid in determining how many projects of a certain type can be active at the same time.

3. Multi-project management

In this section we shortly present what we consider being key building blocks to successful multi-project management. Multi-project management can be understood as using the building blocks to align the NPD efforts of the organization towards a common goal. This includes resource allocation and tough go/kill decisions.

NPD projects form a system of interrelated activities that combine to achieve a common goal, which is to fulfill the overall strategy and purpose of the organization [7]. Projects can range from advanced research and breakthroughs to enhancements to existing product lines or cost reductions.

Each type of project should have its own role and add its own contribution to the strategic mission and competitiveness of the organization. Different types of projects have varying resource requirements. Since resources are scarce, it is important to use them wisely. The product strategy of a company should serve as the guideline for planning the right sequence, number, and mix of projects.

Together with the product strategy, portfolio management should provide the basis for fund allocation and prioritization between the different types of projects. A project classification system helps in considering the various needs of the different project types, e.g., concerning the management style applied, the scope and structure of the project, and the control mechanisms used.

3.1. Product strategy

One of the purposes of a product strategy is to focus efforts according to the overall strategy of the organization. Figure 3 shows an example of how a product strategy can be created.

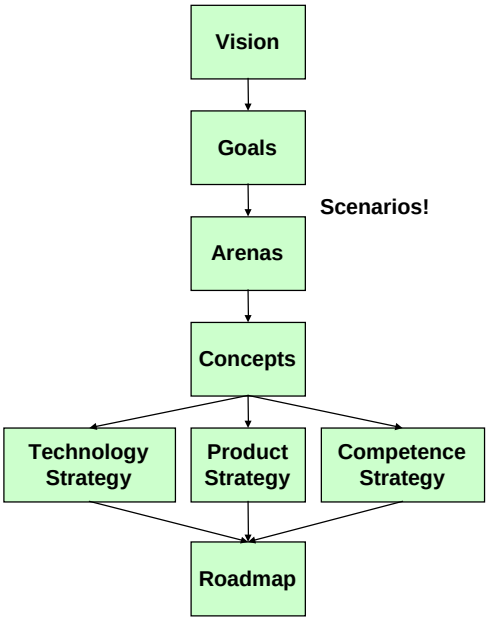

Figure 3. Example of product strategy creation

The corporate vision should pull innovation, and provide the basis for defining the goals of the organization. The choice of arenas to compete in should be based on the vision and goals. Scenario building can be an effective tool in planning for alternative futures and setting the scope and timeframe of the NPD efforts.

For each arena, an attack plan must be created. Typical issues in the plan include

- the role of the organization (e.g. innovator, follower, low-cost competitor),
- target customers (who will buy the products),
- products or concepts offered (the width and depth of the product lines offered),
- distribution channels used,
- timing or pacing of the products offered (when to introduce a new platform product, when to introduce derivatives and add-ons), and
- the business logic (why the customers buy the products).

Also, the competitive environment has to be acknowledged and considered in the plans.

Finally, the needed technologies, products, services, and competencies are identified and summarized in a roadmap, which can then be used as a basis for creating an aggregated project plan including a recruitment and training plan to acquire the necessary competencies. At this point it is important to identify which technology and product platforms can be used across the different arenas, in order to take this into account when developing the platforms.

3.2. Portfolio management

According to Cooper et al. [6], portfolio management and project prioritization is about resource allocation in the organization. It is about choosing which ideas should be developed into products to introduce to the market. It is also about building for the future, since new products are the basis of growth in organizations.

Product development is about building the organization's development capability [22]. Combined with the long-term planning on the strategic level, the use of roadmaps and portfolio management gives a way of evaluating the competencies of the organization and anticipating the future need for competencies.

The evaluation of competencies is very important for multi-project management. Different types of projects require people with different kinds of competencies and different degrees of competency. The breakthrough-project team benefits from having many innovative people in it, while a cost reduction project team benefits from other competencies. Since resources are scarce, the organization should always know what kinds of people are available, so that key people do not get overloaded, which is often the case. Or, seen from another angle, in order to be able to create a feasible and balanced portfolio of projects, the resource requirements of the different project types has to be known. The combined

knowledge can then be used for planning the future training programs and recruitment programs of the company.

One part of portfolio management is deciding what projects to launch. It is useful to create a specific project launching process, including guidelines for how decisions are made and by whom. Graham and Englund present a process for project selection in their work [7]. They also conclude that projects should not be compared to each other over the classification boundaries. Instead, portfolio management should provide the basis for fund allocation between the project types, and only projects within each type should be compared to each other for their fit to the overall plan. The product strategy should provide the key to the mix and sequence of projects and project types. In trying to do too many projects, companies end up making tradeoffs between the projects, leading to a choice between this OR that. Through the strategic focus companies can create complete solutions for their customers, which often means this AND that. This way the "tyranny of the OR" can be circumvented and companies are able to embrace the "genius of the AND" [2].

3.3. Project classification

Project classification can be based on many different dimensions, e.g., the extent of product change, the extent of target market newness, the extent of product complexity, or the extent of uncertainty of the technology used. In this section we present the classification presented by Wheelwright and Clark [22], since it has been used as a basis for project classification in one of our case example organizations.

The four development project types presented by Wheelwright and Clark are based on the degree of product change and the degree of manufacturing process change. One message is that a company should have a balanced portfolio of both of these.

The project types are research or advanced development projects, breakthrough development projects, platform or next generation development projects, and derivative development projects (Figure 4).

The four project types are defined as follows. *Research or advanced development projects* aim at inventing new science or capturing new know-how for the organization. These projects are precursors to commercial development projects. *Breakthrough or radical development projects* create the first generation of an entirely new product and involve significant change in the product and process technology. These projects are likely to create a whole new product family for the organization.

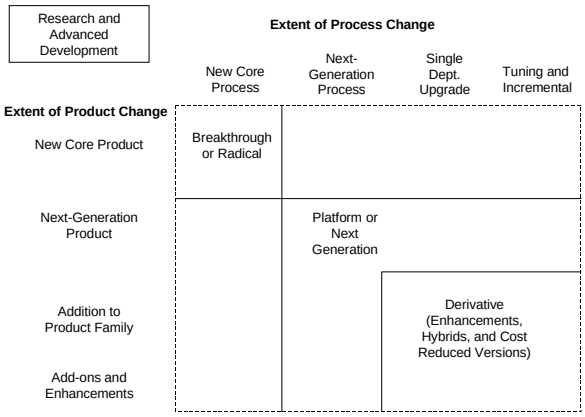

Figure 4. Types of product development projects [22]

Platform or next generation development projects provide a basis for a product and process family and thus establish the basic architecture for follow-on derivative projects. *Derivative development projects* refine and improve selected performance dimensions. These projects create for example cost-reduction versions of products and processes.

The categories in Figure 4 are generic and organizations may benefit from tailoring more specific categories for their individual needs. Good ideas for project classifications that use different dimensions can be found in literature; see for instance [8,19].

Different types of projects have various needs and requirements concerning many factors, e.g., the management style applied, the scope and structure of the project, and the control mechanisms used.

The management style. In his article [3] Constantine introduces a theoretical framework for "*making sense of the diverse possibilities in the organization of collective human effort*". The main message concerning multi-project management is that project teams are organized based on various project needs and objectives, which should be considered when choosing a management approach. A team that is assembled to invent breakthrough technology should be managed differently than a team that is working on a cost reduction project. A rigid management style, e.g., might work well in a cost reduction project, but it might seriously hinder innovativeness, which is needed in a breakthrough project. Successful leadership must match the needs of the project.

The scope and structure. If one compares a breakthrough or platform project with a cost reduction project, there are clear differences. Breakthrough projects are usually more complex, demanding more planning activities in the front-end. Platform projects contain a set

of improvements that have to be integrated into a solution to address a broader range of customer needs. The technologies developed or used in a platform project are usually more complex. Also, platform solutions have to consider future enhancements, which can influence the decisions made. Cost reduction projects, on the other hand, usually start off with most of the issues given or bounded by the previous platform solutions.

The control mechanisms. The results of Tatikonda's research [20] suggest that companies can employ a single product development management process, as long as modest customizations are made for each project type. Our idea is that a separate process model should be created for each project type, partly because it makes using the process model easier. On the other hand, maintaining separate project models is cumbersome. Tatikonda only compared platform product development projects to derivative ones. The difference between a platform and derivative project is not as great as the difference between, for instance, "pure" research and cost reduction projects. Therefore it might be advisable to have different process models, not for each project class, but for each set of "similar enough" project classes. Finding out what is similar enough is a question we leave for future research.

It might be a good idea to also have a common set of control mechanisms with variations for each project type. These control mechanisms are common to each process model, but the process model partly dictates how they are used. In the beginning of each project the project team decides which control mechanisms are used in the project, and how they are used. A template or a checklist could be used as guidance.

4. Improving multi-project management: two case examples

In this section we present two case examples from our own research. Our work with our partners is action research, constructive and iterative by nature with constant qualitative validation and feedback from the participating organizations. The researchers take an active role in helping the organizations improve themselves, for instance by conducting training sessions and workshops, and facilitating meetings. The controllability framework has been used as an improvement tool and as a way of establishing a common language. Some basic facts about the two case organizations are summarized in Table 1.

Table 1. Basic facts about the case organizations

	Organization A	Organization B
The main business(es)	access control systems, time reporting systems, security systems	Electronic ballast for the lighting industry
The characteristics of the business(es)	Few competitors, long product life-cycles, adoption to new IT solutions one key factor	Tough competition, innovation speed is essential
# of people in NPD	11	19

4.1. Organization A

Background. Organization A joined the research project with four main objectives:

1. to create and visualize metrics for project management,
2. to clarify how projects are launched (later multi-project management),
3. to improve time management in the organization, and
4. to improve the management of interfaces between the different functions in the organization

When the researchers first visited organization A, it was not clear what the biggest problem was, and what should be done first. The general feeling in the organization was that too much time was spent on other than project-related work. After a few discussions with the project development manager and other project development personnel, some conclusions could be drawn. Too many projects were launched. Project launching was not formalized, which caused some problems with unanticipated projects *"coming from nowhere, owned by nobody"*. On the strategic level there was a lack of a vision and direction for the future, and a lack of a clear, long-term product strategy. This was partly the result of how the company saw itself, as a service and sales organization, where product development was only meant to assist the sales people by providing tailoring services to the products sold. At this time the need to develop new platforms and products to

sell in the future was not recognized as crucial by most of the management team. The company, however, was making a very good financial result.

The organization had implemented time reporting, but only time spent on project work was reported. Some people felt that over half of their time was spent on other work, but there was no data to verify that feeling. At this time it was decided that the time reporting system would be redefined and rebuilt. Creating a good time reporting system was also important considering project management improvements.

In the following discussion it became apparent that managing the project load was a bigger problem than managing a single project. Single projects could have been managed better, if it were not for too many uncontrolled project launches. The lack of strategic direction was also discussed, and a mutual decision was to start structured strategy work side by side with implementing methods for multi-project management.

Methods implemented. First, a project classification was created. Several dimensions were considered, but in the end the classification was mostly based on the duration (or scope) and complexity of the projects or activities. Another consideration was the input to the project, whether it came from clients or from within the organization. Seven *activity classes* were created. The term activity class was chosen, because not all work is performed as projects, but it felt natural to classify all the different kinds of product development activities. The functionality of the classification has preliminary proven good, since it matches the competencies used in different product development activities, which was not considered during the creation process. The seven activity classes are:

1. *Systems projects* are projects in which new systems are developed. The systems project produces as its outcome a new platform or a new product.
2. *Equipment projects* develop new equipment needed in the different systems, e.g., a LON gateway.
3. *Maintenance projects* develop new product versions, mainly changing some core features in a product. The input is internal, and some bug fixes and improvements can be made in the same project.
4. *Client projects* develop new product versions, mainly tailoring some non-core features by the request of the clients.
5. *Problem solving* is a very versatile activity. The input can come on a very short notice from the clients or from the salespeople. First, the root cause of the problem has to be discovered, and then the problem is solved, which can take from an hour up to a couple of weeks. Problem solving might be the input to client projects or maintenance projects.
6. *Feasibility studies* are often made before a client project or a maintenance project. They might also include some research activities.
7. *Improvement activities* aim at improving product management activities in general. This was included in the classification since two of the people estimated that they use in average one day per week to these kinds of activities.

An Excel spreadsheet was created for each activity class. The spreadsheets contain information about each active project or activity, and on top of that work on hold and offers made are recorded. Activities are given a priority rating, which facilitates decision-making for resource allocation. It does not, however, solve the problem of too many simultaneous activities. Filling the spreadsheets the first time was a revelation even for the product development manager, whose first comment was *"I didn't know we had so many things going on, no wonder we can't get anything done."* The spreadsheets were immediately introduced at the management team meeting, and reactions were almost the same, which really served the purpose of waking up the organization.

To increase the visibility of the projects at hand, visualizations of the project load were created. Also, to increase the motivation to use the time reporting system and to support learning, individual visualizations were created to show each person how their reported hours are distributed between activities.

To solve the problem of too many simultaneous activities, a product strategy is needed to provide the direction and guidelines for portfolio management efforts. Additionally, rules about how many activities of each kind can be active simultaneously must be created and followed. For the moment, the strategy work is ongoing, with the goal to formulate a product strategy and a roadmap to facilitate the management of product development activities. Scenario building is used as a tool to create alternative pictures of the future.

Future work. Rules have to be created for the activity classification system. But before the rule set can be finalized, the company has to have a clear product strategy, otherwise the rules may point in the wrong direction. The status of product development has to be elevated, signs of which have already been seen during the strategy formulation process. The sales managers must be convinced to take responsibility for the projects they initiate, e.g., with ownership demands for every activity. A process must be created and formalized for launching projects. The process should include at least who must decide on launch, how the launching process works, and who is delegated ownership and sponsorship for the launched activity. The role of the owner/sponsor is to champion the activity in the organization. It will be a

difficult task to get the necessary commitment from the whole organization.

The existing process model has to be tailored to take into consideration the individual needs of the different activities, especially the needs of the different kinds of projects. Finally, the process models and the activity classification system should be visualized. In the visualizations the specific needs of the different stakeholders should be considered, e.g., the product development personnel should see which activities they are involved in, and the management team should see an aggregated project plan with all the activities to facilitate decision-making. Some of the visualizations have already been implemented with a tool we have developed in our research project [21]. These visualizations serve as a basis for developing suitable visualizations for supporting the organization's multi-project management efforts.

4.2. Organization B

Background. In organization B there are two objects of control at the pipeline level of the organization's product development: the new product development group, and the maintenance group. In the past three years the organization has gone through many changes, including four different NPD group leaders, which can be seen in the fact that no project management style has been established. Yet, corporate management is demanding innovativeness from the group. With no established way of doing things, too much time gets wasted on "*inventing the wheel over and over*". Time reporting had been employed on and off, so nobody really took it seriously, if it was used at all.

Organizing work into projects has been weak. Even the notion of what a project is has been vague in the organization. The NPD group has moved from platform development to developing different product versions without clearly ending the platform project, and planning and scheduling the subsequent project. Because of this it has never been clear how many projects and what kind of projects are active at any given time. The NPD group is also cooperating with a product development group in England, at another site of the company. The cooperation has been difficult at times, partly because of the problems mentioned above.

To facilitate the cooperation between the groups and to clarify project management in general, the organization decided to implement some control mechanisms for multi-project management, beginning with a project classification system. The project classification system was also expected to facilitate resource allocation according to the directives from corporate management.

Also, the project load in NPD was visualized. The main objective of the visualization was to improve the timeliness of the projects by giving information on the progress of the development projects to other departments, e.g., to sales and marketing, purchasing, and production, so that they can schedule their operations according to the current status of the projects.

Methods implemented. Wheelwright and Clark's project classification was used as a basis for the project classification system. One of the reasons for doing this was the suitability of the classification: the model takes into account not only the changes in the product but also the changes in the manufacturing process. In organization B products and manufacturing processes are developed concurrently. After many changes in the organization, it was necessary to be able to get as many people as possible to understand the classification, in order to achieve something permanent and trustworthy.

New product development projects were then classified into three types: breakthrough products, platform products, and derivative products. Maintenance remained untouched, but might later be influenced by the further improvement of the classification system. Research was also left as a separate activity from new product development.

A new product process model was developed using PACE [15] as a reference model. The phases of the process are the same as in PACE, concept evaluation, planning & specification, development, evaluation, and product release. Document templates were created in the product data management software that was already in use in the organization. Three deliverables are demanded in the concept evaluation phase:

1. A *business plan* including cost/investment analysis, market analysis, risk analysis, and an account of what product will be replaced by the new product developed.
2. A *customer requirement plan* including the different features and capabilities demanded by the customer.
3. A *project plan* including a schedule for the project, resource allocation, responsibilities, development costs, investments needed, and a technical assessment.

In the concept evaluation phase these documents are preliminary, but the information will be used in the phase review. In the planning & evaluation phase these documents must be finalized, and additionally a *product specification* document has to be written. In the past, projects have progressed without any finalized and approved documentation. By forcing the effort of writing proper documents as soon as it is possible, many costly mistakes in the form of unnecessary projects can be avoided.

Tougher go/kill decisions will be made in the reviews. In the past, almost no projects have been killed after they

have been launched, which has caused work overloads. Resources have been tied to strategically unimportant projects, instead of being allocated according to the strategy of the company. Even in this case some problems have been caused by the lack of a clearly articulated strategy.

Time reporting has been employed based on the process model. In the beginning of every project the steps and tasks of the project are chosen from a document list, and they are then included in the project plan. Templates and checklists have been prepared to facilitate the selection process. The specific needs and differences of the three project types have been considered in the templates.

Visualizations have been created to aid multi-project management. First, the NPD project load was visualized by showing how many projects are in the pipeline at a given time, and what phase they are in. Also, the time spent on project work and non-project work measured and visualized. The designers have personalized visualizations where they can see how they spend their time on the project tasks. The data is collected from the project plans and the time reporting system.

Future work. A full pilot project has been launched, in order to test, improve, and validate the implemented system. The visualizations will be refined, and more visualizations will be created, especially to accommodate the needs of multi-project management. Tailored views of the pipeline are needed. Now there is only one view of the pipeline for all the different stakeholders. In the future, the visualizations are also used to increase learning from projects, for instance to support more accurate effort estimation that facilitates resource allocation to the projects.

The linkage between product strategy and multi-project management should be made more straightforward. The activities in product development cannot be properly prioritized if the link to product strategy is not made clear.

Having a project start with the new system and following it through to the end will take a long time. The system will be refined during the duration of the pilot project(s), and will be integrated into the organization gradually.

5. Summary and conclusions

A typical problem in a product development organization is that too many projects are active simultaneously. On top of project work product development personnel are also often involved in product support, easily causing a work overload. Resources can be wasted on “unimportant” activities, instead of being used on strategically important projects. This is partly because the organizations do not have a clear product strategy, so they cannot prioritize what should be done.

Different types of projects differ from each other in many ways, e.g., regarding requirements concerning the management style applied, the scope and structure of the project, the control mechanisms used, and resource allocation. Each project type should have its own role and add its own contribution to the strategic mission of a company. Choosing the right dimensions for the classification is pivotal. They should fit the business and give a solid ground for planning the right sequence, number, and mix of projects to be launched in the pursuit of achieving the strategic goals of the company. The number of projects of each type should be limited, and comparison should be done mostly within the types. To facilitate this, a portfolio management approach is suitable.

In this paper we have reported how two product development organizations have started to improve their multi-project management. The case organizations had problems concerning launching projects. They did not have a formal launching procedure, so projects could appear from seemingly nowhere, which was a very frustrating situation for both managers and other personnel. This is also one of the reasons for too many active projects. The projects lacked strategic alignment, since the organizations did not have clearly articulated product strategies. This made it difficult to make any meaningful decisions regarding the projects. Other research has reported similar findings.

Both organizations have created a project classification system, which already has proved itself enlightening. When the classification system was created all information was gathered systematically, which showed without any doubt that too many projects were active simultaneously. In fact, the realization of how much was actually going on in the product development organization was shocking to management.

Visualizations are a powerful way of communicating the overall picture, as was the case in visualizing the project load in the organizations. The decision-making process can benefit from having the on-line status of the projects to work with, when considering what to do next. The visualizations also serve as a mechanism for inter-departmental communication.

Organizational improvement efforts take a long time, so qualification and quantification of effects beyond the immediate benefits discussed above will follow later.

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