MODES AND MECHANISMS OF CONTROL IN MULTI-PROJECT ORGANISATIONS: THE R&D CASE

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Abstract: There is a widespread acceptance that organising by projects is on the increase. In previous research on the management of projects, the majority of studies have adopted project-centric approaches, downplaying organisation- or company-wide matters even in firms whose performance largely depends on the combined success of multiple projects. In this paper, we focus on the problem of management control and specifically the control modes and control mechanisms used by management in project-intensive R&D units. On the basis of a multiple case study of four R&D units, we suggest a typology of four different kinds of multi-project situations. The typology is based on two dimensions, dependency between projects and project uncertainty. The typology is used to explain differences in management control modes and mechanisms between the firms in our study.

Keywords: projects; project management; MPOs; multi-project organisations; management control; control mode; R&D.


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1 The consequences of projectification

Many companies in a variety of sectors and industries turn to a project-based form of organising to improve corporate efficiency, effectiveness and innovation (Whittington et al., 1999). This has important consequences for organisational structures, information systems, budget systems and the training of managers (see e.g., Winter et al., 2006). A number of studies, such as Ekstedt et al. (1999) and van der Merwe (1997), have therefore argued for the need for detailed studies of project practice and project-based forms of organising – that we need to know more about the various organisational, management and people consequences of the ‘projectification’ of firms and industries (see also Midler, 1995).

In this paper, we present a study of one important organisational system that is influenced by the projectification, namely the management control system. Simply put, management control is here defined as “the process by which managers influence other members of the organisation to implement the organisation’s strategy” (Anthony and Govindarajan, 2007, p.5). It consists of structures, systems, rules, norms and other mechanisms that managers use to influence organisational members’ behaviour so as to align it with the strategic interest of the organisation. Our focus is on the use of formal control modes, the distinct methods of control, in R&D companies with a high degree of knowledge development and engineering capacity. Such companies, we argue, could be portrayed as Multi-Project Organisations (MPOs) with a complexity that stems from many different ongoing projects and dependencies among projects in terms of knowledge, components and resources. A key managerial challenge in such firms is, therefore, to design a management control system and implement control modes that are adapted to and suited for these types of situation. This challenge is particularly important in industries where the number of projects, the pace and the complexity of R&D continuously are on the rise, making it more difficult to design management control systems that release the potentials of project-based working (Shenhar and Dvir, 2007).

The perspective adopted in the paper draws on contingency theories of management control systems (see e.g., Chenhall, 2003; Donaldson, 2001), as well as building on recent findings in project management taking a contingency perspective (Shenhar and Dvir, 1996, 2007). On the basis of a multiple case study, we outline a framework for comparing different management control situations and what control modes and mechanisms are called for in each situation. In that sense, our work aims at giving exploratory insights into the management control situations apparent in MPOs and how we are able to understand the different kinds of control modes and mechanisms applied.

The paper is structured in the following way. First, we discuss and analyse the management control issues and problematics in MPOs. After that, we present the research methodology used in the empirical studies, followed by a brief presentation of the four case studies. In the analysis section, the cases are discussed in further detail and
a typology is suggested based on the mechanisms of control used in the companies. The paper ends with the main findings of our study and a few suggestions for future research.

2 Management control in MPOs

Generally speaking, every organisation faces three fundamental challenges – to determine the organisation’s mission, the division of labour between units and managers and the concomitant need to coordinate departments and activities. The first challenge is the focus for the strategic planning process and the other two are of critical importance for management control. Management control is then very much seen as an attempt to realise strategy by linking the behaviour in the organisation to an overarching organisational interest. Projects represent, in this sense, structural elements, which, for reasons of efficiency and effectiveness, need to be coordinated so that the organisation attains its strategic goals. The importance of this coordination aspect of control is directly related to the degree of dependency between the projects.

Previous research on the management of projects has covered several aspects of projects but, so far, the principal thrust has been focused on the individual project, its characteristics and its management and organisation (Engwall, 2003; Davila, 2000; Lindkvist et al., 1998). Fricke and Shenhar (2000, p.258) even argued that “most of the current literature on project management is still focused on the study of a single project in isolation, assuming limited interactions among projects”. On the basis of this awareness of the importance of looking upon the firm as MPOs, several researchers have called for studies of management control and company-wide aspects of project-based companies (e.g., Hobday, 2000; Lindkvist, 2004; Midler, 1995). Despite this call, research on multi-project settings has, however, been limited to situations characterised by non-operational dependencies between projects, where the problem is how to select a set of projects in line with financial and strategic considerations. As a consequence, a project is, to a large extent, regarded by Engwall (2003) as an ‘island’ without more than geographical relations with other projects. This is the common line of reasoning in the portfolio approach (Cooper et al., 2001), and in recent work on the links between corporate strategy and projects (Artto et al., 2001; Morris and Jamieson, 2005; Künz, 2007). Research that has focused on relationships between projects has been limited to issues such as organisational structure (Hobday, 2000; Midler, 1995) and knowledge management (Lindkvist, 2004; Prencipe and Tell, 2001). A few empirical studies have analysed the management problems experienced in project-intensive firms (e.g., Anell, 2000; Engwall and Jerbrant, 2003, see also Söderlund, 2004 for a review), and although these studies provide us with an empirical understanding of the operations of multi-project firms, they do not explain the differences in control modes and mechanisms needed for the integration of activities across projects.

Cusumano and Nobeoka (1998) stress that multi-project settings require different modes and mechanisms for control. Similarly, writing about product development, De Maio et al. claim that

“input/output interdependencies acquire fundamental importance as they induce deep strategic – and not only operative – links between projects that must be managed by a special [Multi-project Management] System.” (De Maio et al., 1994, p.181)
However, when firms develop into MPOs with inter-project dependencies, the control situation becomes much more complex and problematic. The variety of mechanisms to bring about mutual adjustment increases, and other supporting control mechanisms are necessary.

3 Aim and research questions

This paper concentrates on how problems related to coordination among several projects in an environment characterised by varying levels of uncertainty can be solved. The previous sections have stressed, first, the need for better knowledge of control in MPOs, and, second, the importance of analysing the control modes and mechanisms used in different settings. Our argument is that to increase our understanding of different types of multi-project contexts, both conceptual development and additional empirical research are needed. Following this, two research questions are addressed in this study:

1. What control modes and control mechanisms are used by MPOs to achieve integration and resolve dependencies?
2. How and why do modes and mechanisms of control vary between different multi-project contexts?

4 Research methodology

The methodology applied for the studies reported here could best be described as a multiple case study. We argue that such an approach is applicable when both in-depth analyses and comparisons between cases are called for. The basic idea behind our choice of a multiple case study is that we expect variations between companies and that the use of multiple cases makes it possible to develop typologies that could guide practice and future research within this area of study (Normann, 1970).

In this study, the cases have been chosen so that we include different industrial settings, specifically, R&D companies/units within large corporate groups. We also wanted to cover settings that varied along the following lines: number of projects, linkage between projects (e.g., dependency on the same resources, engineers) and organisational structure. In many ways, we thus followed the advice of Eisenhardt (1989) in looking both at similarities and at differences between the companies. The cases were chosen primarily on the basis that the companies had multi-project R&D activities, they had a long experience working in such settings, and finally, they had made recent efforts to develop management control systems.

The following four companies participated in the study: Saab Future Products, Ericsson BSC, Ericsson SRF and Telia Mobile. All companies are heavily project-dependent and have spent considerable resources on developing project capabilities (cf. Davies and Brady, 2000). Moreover, they more or less rely on a project-based structure where the line organisation supplies resources and knowledge and the project managers are responsible for the implementation of projects. All companies have also experienced difficulties with handling the management control related to multi-project operations. In several ways, the study reported here is both a study in how...
The study started with a number of interviews at each company to get a ‘first understanding’ of the context, strategy and overall organisation structure for each of the firms. After that, we made a preliminary analysis and tried to categorise the companies included in our study. Subsequently, we did four interviews with senior project managers or project directors to focus on the control mechanisms applied in each of the firms and get a better understanding of the various types of projects in the firms. From these interviews, we produced a preliminary case report with background information and a series of selected quotes from the interviews (all information and names of the companies are from the time when we carried out the empirical studies). This first draft report was distributed to one or two key managers in each firm, and from their reading, we received comments and additional required information. After consideration of these factors, we produced the case descriptions presented in this paper.

Although case studies are an excellent vehicle for producing ‘rich stories’, it is not the specifics of the cases that are generalised, but rather “the general in the specific” (Baxter and Chua, 1998, p.80). Our purpose is thus to theorise about “chronic behavioural and social issues that are exemplified in and by our case studies” (Baxter and Chua, 1998, p.80). As mentioned, the cases in our study come from different industries. Three come from the telecom industry and one from the aerospace industry. In the aerospace industry, the R&D is close to basic research, whereas the other three can be characterised as applied research or development. The question might then be asked whether the similarity is sufficient to allow for generalisations. Since all projects in the companies participating in the study are ‘development projects’ (new in terms of knowledge, technology, services, and products and systems), only a limited comparison can be made with other project types, e.g., construction projects or ‘business projects’ (cf. Söderlund, 2005). One must also keep in mind that our intention is not to generalise and apply one concept or one model to all types of organisations. On the contrary, we are looking for variations between the firms to map that variation in our model. The variations are, so to speak, a basic, explorative platform for us, not something that impedes or threatens generalisations.

5 Case studies

Here, we present the four case studies in which we give an overall contextual description of each of the companies. A summary of the cases and some additional data are given in Tables 1 and 2.

5.1 Case 1: Saab Aerospace Future Products

Saab Aerospace develops aircraft systems and subsystems primarily for military markets. The company also works as a subsupplier and manufacturer for large civilian aircrafts. The focus of our study is the Future Products Division, which is one of three business areas within Saab Aerospace. Within this division, most work is oriented towards developing defence technology for the future. It is thus a high-technology environment and the level of engineering skills in the division is well known and recognised.
Alongside the long-term development work, the division also develops systems and products that support the current operations of the Saab Group – from manufacturing processes to customer support. The business has a clear orientation towards ‘network defence’ in the sense that it develops defence systems that integrate management, information and operations to function powerfully in a network. The division works not only with other parts of the Saab Group but also with a number of international partners and in various types of consortia.

The number of employees is just above 300. The development activities of the division are organised into four departments, namely Product Development, Systems Technology, Operations Analysis and Advanced Design. The development of the products and systems is carried out in these departments. In total, more than 80% of the employees work on different types of development projects. The division has more than 50 ongoing projects at various stages of the project-life cycle.

Future Products are organised as a matrix organisation. The four departments make up the knowledge resource dimension whereas five different so-called ‘programme areas’ make up the project dimension. The departments supply knowledge and resources to the programme areas. The programme areas are responsible for getting and completing contracts. A programme director with senior manager authority is in charge of each programme giving five programme directors in total. Each of the departments consists of a department head and a number of project managers. The project manager is responsible for scheduling what should be done and when; the line manager is responsible for appointing the right person for the job, for determining how the job should be done and what methods and technologies are most appropriate for the job at hand. The project managers report both to the department head and to the programme director.

“The programme directors have a very important role in our organisation. They are in charge of our projects and have the overall responsibility for the things we do in the firm. The programme directors work together with a number of project leaders that are placed in the departmental organisation. The project managers are responsible for handling the interface between the departments and the programmes.” (Programme Director)

The development cycles for Future Products is very long, which is typical for the industry as a whole. The development lead time is often more than five years, from project start to project completion.

“It is possible to look at the replacement need for our main customer. It is thus possible to estimate what is needed and required in the future and when new products will be needed … it is fairly uncomplicated to give a prognosis on the replacement need.” (Director of Technology)

The difficulty is, however, to decide on when to start development work to reach the market in time. Furthermore, consideration has to be given to the changing environment, such as political conflicts and new defence alliances. Therefore, according to the management team, the fundamental way of controlling projects lies in choosing the right projects. The first phase of each project is a market analysis so that the correct target for each of the projects can be set. In the second phase, focus is placed on potential business and time estimates for the various opportunities. The resource estimates are made at a fairly comprehensive level and are based on standardised areas of competence. Suggestions for projects come from several sources – clients, internal project
stakeholders, or engineers in the company. This process is considered to be critical for the management control of the Future Products Division.

“There are different sources that we try to assemble a few times each year. We evaluate each of the suggestions and let a group of people take a closer look at each suggestion. It is also this group who is responsible for prioritising the projects and suggesting which project we should launch in the immediate future.”

The company recognises that this process is a key for competition, which has led management to devise more clearly developed processes and routines for handling the suggestions. However, they also recognise that the process cannot, and should not be, overly standardised.

“This process is very much about integrating knowledge from various sources. We have experts in a number of areas but we also have very good clients that know about future needs. To get the right projects and have a fairly good view about what the important aspects are, we must be very good at organising this early process.” (Director of Technology)

The evaluation of the projects is based not only on the product level, but also on other aspects related to the business plan. The strategies are developed based on five focus areas that make up a type of balanced scorecard. The five focus areas are profit, customer, cooperation, operations and co-workers.

In the Saab Future Products Division, a project is always initiated by a project owner, even though the original suggestion might come from other parts of the organisation. It is also the project owner who appoints the project manager. The unit applies Saab’s general project model, Project Steering Model (PSM), and the project process is relatively standardised. At certain tollgates (decision points) and intervals, the progress of each of the projects is evaluated. This is done in accordance with the balanced scorecard model and the five earlier-mentioned focus areas. From the management team’s perspective, the control system is primarily based on the early process described earlier and handing the responsibility for multi-project issues to the programme directors. The programme directors also assume much of the responsibility for prioritising projects during project implementation and for resolving dependency problems between projects. The various progress meetings with senior management are primarily for identifying basic problems or errors during project implementation and for improving cooperation within the company.

5.2 Case 2: Ericsson BSC

Ericsson BSC (henceforth BSC) is a unit within the telecom multinational Ericsson Group. BSC is responsible for developing products and services within the area of radio base station control. The unit has a strong line organisation and a number of projects that cut across the organisation. Most projects are organised and managed by a project manager and an assistant project manager. The rest of the people in a project are recruited from the line organisation. Within BSC, there are four different departments. The responsibility for establishing priorities and determining which projects are to be launched falls on the Systems Department unit. The Integration and Verification Department is responsible for verifying that the developed products work according to
the specifications and quality standards. In addition to these two departments, two project offices comprise the rest of the organisation.

“The project offices are very important for the control of our projects. We have strengthened their role during the last few years to improve the performance of our projects.” (Project Manager)

One of the project offices has the main responsibility for developing the product from idea to delivery. The second office is responsible for product improvements and maintenance. Both project offices utilise resources from the line organisation and from other design and support units around the world. The design units within the BSC organisation are geographically dispersed to Ireland, UK, USA and Sweden.

The steering committee. Every senior manager is a member of this committee and the local design units’ managers are also represented. The committee makes decisions on the projects’ strategies, directives and changes.

“The steering committee is a permanent organisation. The committee is very important for handling the overall project portfolio of BSC and for supporting the project managers in their work.” (Manager, BSC)

The BSC unit has three, parallel main projects that are concerned primarily with software. The three projects are in different phases of the project-life cycle: one is in the pre-study phase, one in implementation and the last is in the conclusion phase. In addition to these three main projects, approximately ten smaller projects are carried out in parallel. These projects are normally concerned with minor changes of and adjustments to the current platform or the provision of additional services, which are generally separated from the three main projects and do not fit the overall time plan of the main projects. They also follow a more simplified process compared with the main projects. Management has tried to change the portfolio of projects to be able to speed up development work.

“A few years ago we designed whole packages, an entire release with design, testing and verification. That could take up to three or four years. Now we try to divide the package into smaller parts which makes it possible to release the first package after, for instance, one year.” (Assistant Project Manager)

Still, the main projects are the principal agenda setters for the management team.

“You can look upon the main projects as ‘software trains’ – when the first train is fully loaded with the right functionality, you can release it.” (Manager, BSC)

The trend is, however, towards smaller projects. The creation of smaller projects is also an important step in reducing uncertainty. Smaller and shorter projects are considered to be easier to manage and implement. The direct relationship between projects during implementation is also simplified. This has, however, increased the number of projects, which has led to some new challenges and difficulties in handling the entire project portfolio. Additionally, it makes coordination between the projects necessary and extensive.

One important role in controlling the portfolio is played by the people working in the two project offices. Each project office has a manager and a controller in charge of managing and reporting on the progress of the projects. The controller also works closely with the assistant project manager to measure the progress of each of the projects. Their reports are presented at the steering committee meetings following the guidelines stated in the project management model. The controller also makes use of various types
of ‘planning constants’ to implement a similar control system for all projects. The planning constants create somewhat of a routine that guides project control and the follow-up procedures.

The core for control of the projects is considered to be the general project model PROPS; however, this model primarily establishes a foundation for the work of the steering committee. Decision and evaluation points are set; project managers are asked to report on the progress of the projects and discussions about how to establish priorities between the projects are often brought up during these meetings. The steering committee meets at least once a month, sometimes more frequently, to review the project portfolio and make decisions to support the implementation of the projects.

5.3 Case 3: Ericsson SRF

Ericsson SRF (henceforth SRF) is a unit within Ericsson Radio Systems, a subsidiary of the Ericsson Group. The unit works on the development of radio base stations and, at the time of our study, was one of the most important and profitable units within the Ericsson Group. SRF has a Strategic Product Management unit with responsibility for the entire product range. Within SRF, the Strategic Product Management unit is also responsible for the initiation of the projects, which are primarily software projects.

In SRF, the project management model PROPS is applied throughout its operations. The model focuses on the tollgates decisions. A centralised forum called the Radio Development Board makes all the tollgate decisions for the new development projects within the entire unit. It is thus within this board that all the business decisions concerning the projects are made. Moreover, the project management office has the important role of project planning in the management control of the project portfolio whereas the manager for the office is responsible for all the project managers within SRF. The manager also appoints project managers to the projects within SRF, is responsible for coordination among the various projects, and is in charge of the unit’s project portfolio.

SRF operates, on average, four, full-scale, large development projects. Every project employs between 50 and 100 people. Each of the projects is divided into sub-projects for easier management. The sub-projects are frequently geographically dispersed to different parts of Sweden and to design units in other parts of Europe. Each project lasts for approximately three years and the projects are partly overlapping. In addition to major projects, approximately five to ten smaller projects (in terms of longevity, man-hours and people) are carried out.

The dependencies between projects are relatively small. The prioritisation is normally based on time considerations. The project that is closest to deadline is generally the one with the highest priority. A great deal of the responsibility of the project management office has to do with sorting dependencies through the use of planning expertise. Moreover, the role of the planning function is to analyse the capacity of the development organisation. A new project might create interdependencies between two (or more) projects that are not considered to be efficient from an organisational perspective. This is especially troublesome since the complexity of the product portfolio of SRF has increased in recent years.
"A few years ago, we only had one large project that we focused on. Today, when we have an established product portfolio, we have a completely different situation. This puts greater pressure on the multi-project management. Today, we must be able to handle a variety of products and a multitude of projects." (Manager, Strategic Product Management)

According to the same manager, the unit has a number of projects that they would like to start or continue. The limits for this are primarily set by the planning unit in cooperation with Strategic Product Management. The responsibility of the latter is to define products and thus also to define the requirements of the projects so that they meet the technology and market needs. The Strategic Product Management unit is responsible for setting the requirements agenda and collecting information from customers and other development units within the worldwide Ericsson Group. Profitability is always a major factor in the discussion when it comes to establishing priorities among projects. The Strategic Product Management should also make a general prioritisation among the projects within SRF. The planning function should give expert advice in terms of the resource and knowledge capacity in SRF, and assure that projects are efficiently defined from a project perspective. This process is generally conducted in the early stages of the projects before the top management team has decided on full-scale implementation of the project. Therefore, the setting of the project scope is also a very important part of the work done by the Strategic Product Management unit and the planning function at the project management office.

"It is normally a matter of man hours. We have a certain budget and we cannot hire 1000 engineers more if we would like. We have a limited pool of resources." (Manager, Strategic Product Management)

After the planning function and the Strategic Product Management has decided which projects to start and how the implementation of each project can be accomplished, the final decision to proceed is made by the Radio Development Board. After such a decision, the responsibility of the project is handed over to the various local management teams within SRF. The remaining overall tollgate decisions are made by the local management teams.

Normally, SRF has one large project that has the highest priority. It is this project that sets many of the constraints for the other projects when it comes to resources and attention. Also of great importance is whether a project is in line with the unit’s strategy and operative targets. The Strategic Product Management thus has to present a general business case for the project before top management decision is made. However, once in a while, a project that is outside the main strategy is given priority to develop new markets or new technologies. Still, every project has to be based on a clear-cut business decision.

"The critical issue is to understand the dependency that exists between the different projects and before we start a new project be able to make an estimation on how that project will affect the other ongoing projects. What are the critical resources in the project and how will the resources be affected by the new project?" (Manager, Strategic Product Management)

From a project point of view, critical resources very much set the agenda for management control within SRF. The project management office has the responsibility for examining the state of each project in terms of critical resources.
“The best way is to talk to the project managers about the critical resources in the projects. However, we are currently looking at a new methodology to handle this more formally. I hope that this will improve the management of multiple projects.” (Manager, Project Management Office)

As it seems, the Strategic Product Management unit and the project management office have key roles in the management control of the projects within SRF. Moreover, the Radio Development Board has the strategic responsibility and a final say in the initiation and termination of the projects carried out. During project implementation, the Radio Development Board has a limited control of the project operations. Most of its decisions are based on analyses developed by Strategic Product Management and the project management office. The planning function within the project management office also has an important role in solving the dependency problems between projects during project implementation. Even though the objective is that most dependencies are resolved before project implementation, problems owing to dependencies can occur in this phase. The planning function has here a critical role in determining priorities among projects and handling the use of critical resources.

5.4 Case 4: Telia Mobile

Telia Mobile is a company within the Telia Group, a Scandinavian telecom operator. Telia Mobile was founded in 1997 as a pure technology company with responsibility for the development and maintenance of the mobile telephone infrastructure. The line organisation of Telia Mobile consists of two business units – the Net Business and the Final Customer Business. Under each unit, four departments contain the resources that work on the projects. Additionally, the development department, R&D, organises 16 project managers in a project management pool. Sometimes, the need for project managers exceeds the available number. In these cases, consultants are recruited to assume the responsibility of managing the project. A great deal of resources has been invested in improving the skills of the project managers and in designing a support system to improve the work of the project managers. Moreover, project managers play a key role in the project operations of Telia Mobile.

Telia Mobile has a number of staff functions, among which one is the project management office. This office is responsible for supporting the project management model and for project coaching. Telia Mobile has three permanent steering committees, one for each of the business units and one that is responsible for the common projects. The common projects involve both the Net and the Customer organisations. In each of the business units’ steering committee, a project coordinator has the role as contact person for the project managers and the rest of the organisation. The project coordinator is also the connecting link between the projects and is the one who suggests priorities to the steering committee.

The projects in Telia Mobile are quite diverse: new platforms on which to build services, new platforms for making maintenance more efficient and regulatory projects, i.e., projects that have to be carried out due to legal requirements. The variety of projects in the portfolio has created some problems. For example, it is not clear in the organisation as to what really constitutes a project.
“When you live in an organisation like this, with many projects, it is very hard to determine how many projects you have going on at the same time. We have initiated a process to clarify this and hope that it will improve the project implementation within the company.” (Project Manager)

The projects carried out differ in size, both in terms of time and in terms of the number of people employed. Many of the service development projects have a lifetime between three and 15 months, with the average length of a project being ten months. The project teams vary between five and 30 engineers (ten persons on average). The net development projects have a lifetime between seven months and two years (on average 14 months). At Telia Mobile, a large number of projects are carried out at the same time. The project list covers more than 50 projects, many of which are in the pre-study phase.

Every project is put on the project web, which looks very much like a structured website. The project web is also used for project control and follow-up purposes. The web gives information about progress, project staff, project manager, deadline, etc. The situation where too many projects are going on at the same time remains a problem despite the efforts of the management to resolve it.

“We have too many projects at the moment. If we would be able to take a few of them away, things would be much better. We have a problem today.” (Manager, Project Office)

However, the company has worked intensively to improve the project selection process to decrease the number of projects. Managers at the top level have launched initiatives to improve the hit rate of projects – to know which project to implement. Priorities between projects have been assigned to a group called NASA (an abbreviation based on the Swedish words for Net and Customer Businesses) to improve the project selection process. This group has made a priority list divided into four levels. The time factor and delivery dates are normally the ones driving the prioritisation process.

“We have this type of funnel where we initially have somewhat of a wide and open idea generation phase. After that we have decision points where we screen the projects and determine which of the various ideas should move on to the pre-study phase. Following that, we have a decision phase where we decide on which of the projects should enter the project implementation phase. However, it requires tough management to tell committed individuals to terminate a project that they have been working on for a number of months. I still believe we could do better on the entire funnel process.” (Project Manager).

Several measures have been taken to decrease the dependency among the projects. Management has tried to improve the project efficiency by delimiting the scope of the project and shortening the lead time of the projects. A consequence of these changes has been that projects are implemented with fixed deadlines, normally around 12 months. Functionalities that were not possible to include in projects are handed over to other projects that have not reached the design freeze stage. The scope of the projects is changed on a relatively frequent basis. Primarily, these changes are made to meet the requirements of customer needs and technological possibilities or requirements. The project uncertainty is not necessarily about deep technological problems, but more of meeting constantly changing customer needs. The management control of the project operations within Telia Mobile has been directed towards the selection process, training of project managers and of allowing project flexibility. Moreover, the dependency among
projects has been kept to a minimum to facilitate project managers focusing on meeting the requirements of individual projects.

## 6 Empirical analysis

Some of the characteristics of the cases described in the previous sections are summarised in the following two tables. Table 1 gives the contextual information about each of the companies and an introduction to the control problems facing the firms. Table 2 presents information about how the firms have solved their control problems.

### Table 1 A cross-case comparison: organisation and control

<table>
<thead>
<tr>
<th></th>
<th>Saab Future Products</th>
<th>Ericsson BSC</th>
<th>Ericsson SRF</th>
<th>Telia Mobile</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Typical project duration</strong></td>
<td>5 years</td>
<td>1–2 years</td>
<td>3 years</td>
<td>1 year</td>
</tr>
<tr>
<td><strong>Project portfolio</strong></td>
<td>Stand-alone projects grouped in five programmes, knowledge dependencies. More than 50 projects going on.</td>
<td>Integrated projects, knowledge dependencies between projects. Three large development projects. Ten smaller projects.</td>
<td>Integrated projects, knowledge dependencies. Four large main projects and ten smaller projects.</td>
<td>50 projects of different nature. Many short projects with fixed deadlines.</td>
</tr>
<tr>
<td><strong>Organisational structure</strong></td>
<td>Four departments and five programme areas. Programme directors with senior management authority. Each department has a line manager and a number of project managers in charge of the projects. Project owner plays a key role. Progress meetings with top management</td>
<td>Two project management offices with separate responsibility. Steering committee decides on project strategy and directives. Project management office responsible for the control function of the portfolio.</td>
<td>Strategic Product Development responsible for project generation. Centralised forum, Radio Development Board, makes tollgate decisions.</td>
<td>Many projects of different types. 16 project managers grouped in a project management pool. Project management office, one of several staff functions. Each business unit has a steering committee.</td>
</tr>
<tr>
<td><strong>Control challenges</strong></td>
<td>High-technology environment creates difficulties for management control. Project uncertainty puts challenges on the control system. Setting limits for the project operations to decrease the dependency among projects. Close cooperation between systems department and project controller.</td>
<td>Partly overlapping projects requires cooperation among projects during implementation. Planning function at the project management office plays a key role in resolving dependencies among projects.</td>
<td>Customer needs change on a frequent basis that leads to high project uncertainty and requires a flexibility within the projects.</td>
<td></td>
</tr>
</tbody>
</table>
Table 2  A cross-case comparison: control mechanisms and control logics

<table>
<thead>
<tr>
<th>Primary control mechanisms</th>
<th>Saab Future Products</th>
<th>Ericsson BSC</th>
<th>Ericsson SRF</th>
<th>Telia Mobile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selecting the right projects</td>
<td>Systems department in charge of launching projects in cooperation with project management office</td>
<td>One steering committee in charge of the project portfolio</td>
<td>Strategic Product Management responsible for product range</td>
<td>Steering committee at business unit level</td>
</tr>
<tr>
<td>Prognosis of technological possibilities and market needs</td>
<td>Radio Development Board, centralised forum, making all major decisions on projects</td>
<td>Project management office at decentralised level</td>
<td>NASA: a group for deciding priorities among projects</td>
<td>Priority list divided into four levels</td>
</tr>
<tr>
<td>Resource estimation is based on standardised areas</td>
<td>One steering committee with members from the line organisation</td>
<td>Project management office at decentralised level</td>
<td>Operative planning resides at the project management office</td>
<td>Project web used for control and follow-up purposes</td>
</tr>
<tr>
<td>Balanced scorecard has been implemented</td>
<td>Project management model important, lays the foundation for the control activities</td>
<td>Project controller important in checking the progress according to the project management model</td>
<td>Project management office</td>
<td>Project web used for control and follow-up purposes</td>
</tr>
<tr>
<td>The standardised project management model PSM is implemented and used in most cases</td>
<td>Project controller in charge of the project portfolio</td>
<td>Program controllers support project managers</td>
<td>Project controllers support project managers</td>
<td>Project controllers support project managers</td>
</tr>
<tr>
<td>Main logic of control and key functions</td>
<td>Selection team</td>
<td>Project management model</td>
<td>Project management office</td>
<td>Selection process</td>
</tr>
<tr>
<td>Programme directors</td>
<td>Planning constants</td>
<td>Planning function</td>
<td>Priority list</td>
<td>Short projects</td>
</tr>
<tr>
<td>Resource estimates</td>
<td>Project management office</td>
<td>Profitability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balanced scorecard</td>
<td>Project controller</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As is seen from the case descriptions, the companies in our study are development-intensive, and rely heavily on the success of their projects for the overall success of the organisation. All firms have also invested considerable time and money on improving the selection process of the projects. As shown in the case studies, the selection of projects is the first and core issue of management control in this type of MPOs. There are also a few other evident similarities between the firms. Much of the basic dependency seems to be handled by standardisation. In all of our case companies,
we, for instance, find the use of standardised project models. By requiring the use of such models, the management of the organisation is able to standardise behaviour in otherwise decentralised operations. In Ericsson BSC, this standardisation is further emphasised by the use of ‘planning constants’. The use of devices such as this is, of course, tied to the similarity between projects in time and space. On the other hand, projects within Saab Future Products Division are relatively different and have project durations and technological uncertainties for which planning constants might not be relevant.

As for dependencies between projects, these seem to be strongest in Ericsson SRF and Saab Future Products. Mutual dependencies are best handled by creating arenas where key actors in the projects can meet. In Ericsson SRF, some projects draw on similar solutions and share information about the progress in other projects. The project management office, the centralised Radio Development Board and the unit for Strategic Product Development play key roles in handling such interdependencies between projects. In the Saab Future Products Division, another type of dependency occurs. Here, dependencies are mostly related to the use of key engineers and joint platforms for future products and services. These dependencies are sometimes solved by project managers in the line organisation, but most frequently by the programme managers. The project owners also have an important role in establishing arenas between different projects to stimulate cooperation and coordination between the development projects.

Another important feature has to do with the measures taken to reduce project uncertainty and handle project interdependence. Several interviewees, for instance, state that reduced lead times and a limited project scope are important ways of reducing project uncertainty. Additionally, project interdependency has been considered to be troublesome. In Ericsson BSC, for example, the management has tried to decrease project interdependency during implementation to improve the efficiency of the company’s project operations. As evident, project uncertainty and interdependency between projects are critical for the understanding of management control in MPOs. It is also difficult to separate the selection and portfolio management of projects from the control activities of a firm’s project operations during project implementation.

7 Control modes in MPOs

On the basis of empirical studies and analysis, we suggest a typology of control situations in MPOs. The typology uses two fundamental dimensions – dependency between projects and project uncertainty. Dependency is here taken to denote the extent to which the success of one project is contingent upon the result of activities in other projects (interdependency). This dependency could be either high or low. In a situation of low dependency, no direct transactions occur between projects. Here, each project is basically independent. Still, if one project fails, it can affect the customers’ valuation of other projects or lead to financial burdens for them. A high degree of dependency occurs, for instance, when one project’s output is input for another project during project implementation. In our case, this happens with projects in Saab Future Products and Ericsson SRF when projects are coordinated during project implementation. Examples of this are found in shared knowledge resources, engineering capacity and systems/products used in multiple projects. High dependency thus means that projects are involved in an inter-project exchange. An example of this would be the relationship between development projects within Saab Future Products, where technical know-how
and design in one area have to be adapted to knowledge and design in other areas and vice versa. In sum, all projects within an MPO are interdependent, but different contexts produce different degrees of dependency. The distinction between high and low dependency in this context has to be viewed relative to the type of R&D activity under study.

As is clear from the case studies, the uncertainty of projects is important for the analysis of management control. Project uncertainty could here be defined as the degree of precision with which the variation in outcome, resources and work process of projects can be forecasted (Pich et al., 2002). Every project, as seen in our interviews, carries with it a certain, but varying, degree of uncertainty. In development projects close to basic research, such as within the Saab Future Products Division, the uncertainty is so great that it must include the question of whether a project will lead to any outcome whatsoever. A different type of project uncertainty is found in Telia Mobile where known software solutions are adapted and changed to meet customer requirements and changing customer needs. In Ericsson BSC and Ericsson SRF, project uncertainty has been kept to a minimum. This has primarily been done by delimiting the scope and time of projects and by using planning constants and standardised routines.

In summary, we believe that the two dimensions of project uncertainty and dependency between projects must be put at the forefront in the analysis of the modes of management control in MPOs. As stated earlier, a number of similarities have been found in the firms, but equally important are the major differences identified in our study. Building on the suggested two dimensions, we offer a matrix identifying four situations of management control in MPOs (see Figure 1).

Given the characteristics of each situation, we can now link each such situation to an appropriate control mode. Since the four firms in our study are thought to contain dependencies and uncertainty, the control modes presented are what appear to dominate in each of the case-study firms. Here, we describe the four situations in further detail.

**Figure 1** Four control settings: dependency and uncertainty

In situation I, we find a situation where projects show a low degree of interdependence and low uncertainty. In many ways, this presents a relatively simple case of management control. Empirically, we find these MPOs involved in rather standardised and repetitive projects with little resource sharing or exchange of services. To say that the projects are standardised does not, however, necessarily mean that each project needs to be identical to other projects. In our empirical study, the firm that most resembles this situation is Ericsson BSC. Here, project uncertainty has been reduced and project dependencies have been sorted out by creating an overall routine for the
project operations. The design and content of new projects are not set until preceding projects are approaching their deadlines. No direct link between projects is thus necessary to solve dependencies among projects. Moreover, the project model and the use of planning constants are important for guiding the management control activities in Ericsson BSC.

From a management control perspective, the limited dependency between projects poses no severe problem. The control problem for the organisation is instead primarily to maintain the focus on the routines and standard operating procedures. In many MPOs, the strongest instrument for this is the project management model. Each project is required to pass through certain phases and gates, which end with a tollgate decision and which include pre-specified activities that should produce the basis for the tollgate decision. All our case companies use basically the same project management model, PROPS (or variants thereof). Other means of standardisation can be the use of planning constants, as in Ericsson BSC. On the basis of our observations, this control mode very much relies on a routine logic and could therefore best be described as routine-based control.

Situation II differs from the previous situation in the sense that although the projects still display a relatively low degree of uncertainty, they are dependent on each other. Very often, this dependency takes the form of one project being dependent on activities in another project being completed before that project can start or progress, e.g., a certain development project requires for its completion a module or technological solution that is processed by another project. Since uncertainty is low, there is the possibility to use action plans as a main coordinating mechanism (Mintzberg, 1983). An example of this can be found in the Ericsson SRF case where all the functionality and the dependencies between the functions are described in what is known as ‘anatomy plans’. The plan consists of rings where each ring denotes certain functionality and where each ring is dependent on the functionality defined by the neighbouring ring closer to the centre. In the case of a lack of time, the outermost rings can be excluded or removed. In a case where not all coordination can be solved by plans, MPOs in this quadrant turn to coordinating devices such as coordinating committees and operative control by project management offices. In the case of Ericsson SRF, we also observed that the planning function played a significant role in mastering the interdependencies between two projects, both during the early project stages and during the implementation phase. Because of the reliance on plans and various types of the planning functions, the control mode for this situation is referred to as planning-based control.

In contexts with high uncertainty (situations III and IV), plans can no longer be relied on as the main control mechanism since plans require a certain level of stability. Because of the uncertainty, project control requires closer attention to the extent that the organisation’s management does not have the ability to monitor the projects personally. The uncertainty, therefore, typically requires a decentralised control where project management is vital for the success of a project. If projects are rather independent from each other (situation III), no special inter-project coordination needs to be established and the control issues therefore centre more or less on the question of controlling a portfolio of autonomous projects, each with a high degree of uncertainty. From a management control point of view, standards could be set and plans be made but they are of limited use, since the intensity of the activities and the results thereof tend to follow their own logic and not some pre-determined plan. Rather than with output or process, the basic control mechanism is instead found to be on the input side. Drawing on the empirical
studies, two fundamental resource decisions establish the basis for control in this situation. These are

- the choice of project managers (management)
- the resources allocated to the projects.

Since uncertainty precludes the reliance on plans, the fundamental problem of controlling the project becomes the problem of choosing a project manager who, to the best of his or her abilities, acts in the way that the management of the organisation would have done had they had the time and competence. The focus here will be very much on the belief system of the project management team (Simons, 1995) and to facilitate clan control (Ouchi, 1980). This particular control mode was evident in the case of Telia Mobile. Here, a pool of project managers had been trained to carry out the ambitions of top management. Moreover, a project coordinator supported the implementation of each individual project. According to the interviewees, much time had been spent on establishing more or less stand-alone projects to create the required flexibility in each of the projects. The uncertainty was relatively high, primarily explained by the frequent changes in customer needs and requirements. We call this control mode resource-based control.

Finally, when dependencies are high and uncertainty great, the resulting situation (situation IV) is the most exacting from a control perspective. The decentralised control through project managers from the previous situation must be retained, but on top of that, owing to inter-project dependencies, some means of coordinating these dependencies must be found. Empirically, we might expect to find these situations where projects contain elements close to basic research and where development projects within different functional areas display reciprocal dependencies such as those found in the aircraft industry. In cases like this, the solution lies in introducing what Thompson (1967) calls an “over-arching second-order group” (p. 59). Such a group can also be found in the Saab Future Products Division, which has created the function of programme management whose task it is to coordinate the various products. Thus, the programme managers have a key role in the execution of management control in the Saab case. Progress meetings were also arranged on a frequent basis to solve dependencies and detect coordination and control errors in the project portfolio (cf. Lindkvist et al., 1998). The control mode is, therefore, named programme-based control. Figure 2 and Table 3 summarise this discussion.

**Figure 2** Control modes in Multi-Project Organisations
Control setting
Low dependency between projects. Low project uncertainty
High dependency between projects. Low project uncertainty
Low dependency between projects. High project uncertainty
High dependency between projects. High project uncertainty

Primary control mechanisms
Routines, project management models
Planning, planning constants
Self-contained projects, input control
Continuous dialogue, programme management

Key function
Project controllers
Project management office and project planners
Project managers and project coordinators
Programme managers

Table 3 Summary of findings: four modes of control

<table>
<thead>
<tr>
<th>Routine-based control</th>
<th>Planning-based control</th>
<th>Resource-based control</th>
<th>Programme-based control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control setting</td>
<td>Low dependency between projects. Low project uncertainty</td>
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<td>mechanisms</td>
<td></td>
<td></td>
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<td>Key function</td>
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<td>Project management office and project planners</td>
<td>Project managers and project coordinators</td>
</tr>
</tbody>
</table>

8 Conclusions and future research

In many contemporary firms, projects play an increasingly important role. However, as phrased by Shenhar and Dvir (2007, p.205), projects have for too long been kept in the dark, “often ignored by top executives”. Current understanding of the specific management control activities of MPOs is also limited. Turner and Keegan (2001) have argued that the management procedures have to be ‘re-conceptualised’ from their roots to fit the MPOs. In this paper, we build on contingency theory and recent findings on multi-project organising to develop a conceptual framework for analysing one layer of the management control in such environments. Our framework highlights the importance of project uncertainty and inter-project dependency in explaining the control modes and the key control mechanisms applied by R&D units. The framework also illustrates the significances of including both early, selection process and project implementation control to understand the control problem of MPOs. In this way, this paper differs from mainstream research on project portfolio management (see e.g., Anell, 2000; van der Merwe, 1997).

Our study gives necessary empirical evidence to the problems of handling project uncertainty and project interdependence. This framework may also be of value for the general understanding of management control in the project-based firm. As our case studies revealed, management control is very much about setting limits to project uncertainty and of sorting out dependencies among projects within the firm. Arranging for mutual adjustment and the use of belief systems, as discussed in previous research (Mintzberg, 1983; Simons, 1995), in controlling the modern MPOs, are critical activities here. This control logic is, we have argued, underspecified and, to handle the management control problems illustrated in this paper, we pointed to a broader variety of control modes, including the role of routines, planning and input control. The paper also demonstrates and explains the role of programme management, a management control function that is utilised in many contemporary MPOs (Maylor et al., 2006), and positioned the idea of programme management in a larger context of management control modes and mechanisms. In this sense, this paper contributes to the understanding of the relationship between project management and programme management and to the
function of project management systems (Simons, 1995) in controlling the activities of MPOs.

The paper presented a typology identifying four different control situations. We argued that the basic mode of management control in many MPOs would be routine-based control. In many MPOs, however, owing to uncertainty or dependency, additional control modes are required. In the paper, we offered three additional control modes to complement the routine-based mode. The second control mode found in situations characterised by a higher degree of dependency, we argued, would be characterised by greater use of planning. Hence, we labelled this mode the planning-based mode. Here, we stated that the observed interdependency between the projects would be possible to handle with increased planning efforts owing to the limited uncertainty associated with each of the projects. When uncertainty was introduced, more sophisticated control modes were called for. In situations characterised by high uncertainty, but low degree of dependency, we assume that a resource-based control mode would be suitable owing to the limited need of coordination between projects.

In the final cell, we submitted, a more interactive control system would be appropriate owing to the mutual handling of uncertainty and dependency (Bisbe and Otley, 2004). We suggest that this control mode be labelled programme-based to stress the additional layer of control observed in these situations.

Our findings and the presented typology of control modes have, of course, a number of limitations. We suggest that future studies should try to further the discussion and analysis of various types of MPOs settings to create possibilities for developing a contingency perspective on control modes in such settings. The proposed framework might be utilised in future studies that take a broader approach towards control modes operating in R&D and professional companies. Our framework especially illustrates the importance of not only studying management control on the project-centric level (Davila, 2000) and company-wide aspects of project management systems (Simons, 1995, p.114), but also to combine them and to see them as tightly nested. Our conceptual framework thus contributes to previous research in two ways:

- by illuminating the intersection between the control of single projects and the organisation of project management systems in R&D units
- by analysing the early and the implementation phases to fully understand how management control is designed in MPOs.

References


Modes and mechanisms of control in Multi-Project Organisations


