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Allocating human resources to projects and services in dynamic project environments

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Abstract

Purpose – Resource allocation is challenged by dynamic environments where changes are frequent. The purpose of this paper is to identify resource allocation challenges and practices in service units that perform both project and non-project activities in dynamic environments. Its goal is to show that top-down mechanisms of project resource allocation need to be replaced by or supplemented with mechanisms that are more flexible.

Design/methodology/approach – A qualitative comparative case study was conducted in two service units of two project-based firms. The main source of data consisted of semi-structured interviews with 17 service managers and staff members.

Findings – This study shows that resource allocation is not necessarily a top-down process at all, and the practices are context-dependent. Two more flexible approaches are revealed – hybrid resource allocation and bottom-up resource allocation – as examples of managing resource allocation in service units that engage in projects under uncertain conditions. The results of the analysis highlight prioritisation and adapting to change and delay as the main issues that managers face in allocating resources to different types of projects and service activities in dynamic environments.

Research limitations/implications – The two target companies chosen for the qualitative research design limit the analysis to project-based firms in a business-to-business context. Further, the viewpoint of the service unit is central to the study. Studying project resource allocation in different organisational contexts and uncovering the perspectives of product development and delivery units would offer promising directions for future research.

Practical implications – The study reveals that in dynamic project settings such as service organisations, top-down mechanisms of resource allocation need to be accompanied by other, more flexible approaches to ensure the sufficient resourcing of projects and related services in dynamic environments. Companies need to establish practices for resource allocation changes that are caused by re-prioritising tasks and accommodating changes and delays in their project and service activities.

Originality/value – Compared to a top-down perspective taken in previous research, the study proposes a more flexible approach for resource allocation in constantly changing environments with different project and service activities. Previous studies have focussed on resource competition between projects, placing project managers in the central role for resource allocation. By contrast, this study discusses hybrid and bottom-up resource allocation, both of which involve broader personnel engagement in resource allocation tasks, drawing on the experience of all employees.

Keywords Services, Activities, Uncertainty, Resource allocation, Contingency view, Project-based firms

Paper type Research paper

1. Introduction

The increased use of projects in various industries has resulted in changes to organisational structures and a move from functional line organisations to more flexible project-based forms of organisation. Human resource allocation becomes critical for project-based firms when the same resources can be assigned to several overlapping projects as well as non-project activities. Resource allocation is more challenging for organisations that face rapid changes in their environment, activities and priorities. In an uncertain organisational context, using the same resource pool to carry out projects and non-project activities poses difficulties for resource allocation. Such challenges are not yet sufficiently understood, and their solutions have not been sufficiently explored. This study investigates how human resources can be allocated to projects and other services under dynamic conditions.

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This study responds to the need for understanding the situated practice of resource allocation and the related contextual and contingency variables in project-based firms (Söderlund, 2004). Previous project management studies building on the contingency theory have included some aspects of the project and organisational context in their analysis, such as different types of complexity (Baccarini, 1996), technology (Shenhar, 2001), project autonomy (Martinsuo and Lehtonen, 2009) and management control (Canonico and Söderlund, 2010). The majority of such research has investigated construction and product development projects, and the focus has been on selected processes in project management: contracting, decision making, knowledge generation/integration/exchange, project (management) evaluation, projects as business processes, relationship management and risk management (Hanisch and Wald, 2012). Different resource allocation approaches in different organisational settings have not received significant attention in project contingency research.

Previous studies of resource allocation processes within project-based firms and the challenges they face have focussed mostly on the prioritisation of projects and assigning resources to multiple projects. These studies generally employ a top-down perspective regarding resource allocation and consider managers to be the responsible actors assigning tasks to staff (Hendriks *et al.*, 1999; Abrantes and Figueiredo, 2015; Ballesteros-Pérez *et al.*, 2012; e Silva and Costa, 2013). Earlier studies have primarily examined resource allocation in multi-project environments within organisations, such as research and development units, rather than units that face external customers directly, such as service units. Like internal units, these customer-facing units deal with internal uncertainties due to the cross-functional involvement of personnel in projects. However, they also face additional uncertainties stemming from customers and the broader market environment. Thus, new research is needed on how project-based firms facing uncertain conditions use their human resources in both projects and non-project activities.

Project-based firms generally allocate resources from a resource pool – a department or unit – to accomplish parallel projects (Zika-Viktorsson *et al.*, 2006) and non-project activities. One of the main difficulties in assigning resources to project and non-project activities is the potential for resource conflict between the project management unit and other functional units (Kuprenas, 2003; Laslo and Goldberg, 2008), such as service units. Project-based firms benefit from complementing projects with non-project activities, such as services (Artto *et al.*, 2008). Integrating projects with services represents a change to the traditional viewpoint on projects, extending their life cycle beyond the delivery phase (Brady *et al.*, 2005). However, resourcing projects and services in parallel increases the complexity of resource allocation and adds non-project activities as an alternate use of the resource pool. The simultaneous existence of multiple different delivery logics can pose problems for various units of the organisation, such as service units that view their core activities from a specific functional perspective (Davies *et al.*, 2006).

In allocating resources among projects as well as service activities, frequent changes in the customer-facing service environment pose major challenges. The uncertainty in service environments is high, and service people must respond quickly to unanticipated changes. The uncertainties in the environment can affect resource allocation plans in the project-based firm and may result in rearranging resources between project and non-project activities. Previous research on uncertainty in project-based firms shows that the availability of resources is one of the main uncertainties in multi-project environments (Danilovic and Sandkull, 2005; Arashpour *et al.*, 2016; Martinsuo *et al.*, 2014; Laine *et al.*, 2016; Saunders *et al.*, 2016) and can cause various changes in project plans. Meanwhile, other sources of uncertainties in project-based firms, such as scope changes or revisions to plans and consequent adaptation to events and the changing environment (Söderholm, 2008), can challenge the resource allocation process. The literature on project uncertainty has mainly

differentiated uncertainty from risk, mapped the sources of uncertainty and developed various approaches to managing project uncertainty (Saunders *et al.*, 2016), but does not provide insight into how to manage resource allocation under uncertainty. In a dynamic environment, an organisation needs to become more flexible in reacting to changes by choosing between alternative actions (Perminova *et al.*, 2008). However, the dominant approach based on decisions made by managers in advance may limit the organisational flexibility required in dynamic environments (Jerbrant and Karrbom Gustavsson, 2013). It is therefore crucial to understand the resource allocation issues in this type of environment and how resource allocation practices are performed.

This study concentrates on human resources that deliver projects and services within project-based firms in terms of resource planning, allocation and management. Its purpose is to explore the challenges and practices involved in allocating human resources in project-based firms in situations of uncertainty, particularly within service units. Service units are a good example of a high-uncertainty environment, where project activities and non-project activities share the same pool of resources. The study aims to offer new knowledge to optimise resource allocation in conditions of uncertainty by identifying the practices currently used for resource allocation, and by mapping alternative approaches. Thus, the research question is as follows:

RQ1. How do service units manage resource allocation to projects and services to overcome uncertainty?

The empirical study focusses on manufacturing firms delivering complex systems as projects and supplementing their offerings with services for customers. The research was conducted as a qualitative case study in two leading international firms, both of which have a significant global installed base of equipment. Both firms' offerings range from standard equipment and project deliveries to a broad scope of services. This study contributes to the contingency view of projects and project-based firms by identifying the resource allocation issues involved in delivering project-related services and using the same resource pool for both project and non-project activities. Furthermore, it demonstrates that possible resource allocation mechanisms are not limited to top-down mechanisms; more flexible approaches are needed to manage uncertainty. Future studies should undertake broader analyses of experiences from other units; they should also explore perspectives arising from product development and product delivery. This study does not follow a mathematical perspective to resource allocation but, rather, seeks an in-depth understanding of the experiences of managers and staff in managing resource allocation.

The remaining sections of the paper provide an overview of the literature on resource allocation approaches used in project-based firms, resource allocation issues arising in project-based firms and managing resource allocation issues in dynamic environments. In the methodology section, the data collection method and analysis approach used in the two-case qualitative study is introduced. The results section summarises key findings from the two cases as well as conducting a cross-case analysis. The findings are discussed in light of earlier research, and the final section of the paper identifies the key contributions of the study, along with the limitations of the research and suggestions for further research.

2. Literature review

2.1 Resource allocation approaches in project-based firms

Human resource allocation can be viewed as a core process in project-based firms. Resource allocation is the process of assessing resource availability and project needs in terms of specific development needs, expertise, experience working with particular customers and partners and assigning suitable resources to different tasks (Huemann *et al.*, 2007).

Previous research generally approaches resource allocation as a top-down process using strategies to make project portfolio decisions, and resources are allocated to projects in line with strategic priorities. The literature on multi-project management is dominated by the perspectives of project portfolio managers and programme managers and emphasise methods to plan and schedule resources to gain control over the project portfolio (Zika-Viktorsson *et al.*, 2006). Hendriks *et al.* (1999) carried out one of the early practical studies on resource allocation in a research and development environment. Their study proposes a rough-cut-project-and-portfolio-planning approach led by senior management and project managers to connect day-to-day plans to the long-term business plan. Some studies on resource allocation in matrix organisations have highlighted the role of project managers and functional managers in making planning decisions to allocate resources to different activities (Laslo and Goldberg, 2008; Arvidsson, 2009).

While more recent research on resource allocation tries to cover new challenges and decision-making situations in project-based firms, they also continue to reflect top-down approaches where the project manager primarily plans and controls the resource allocation process. For example, Abrantes and Figueiredo (2015) proposed a four-layer resource allocation framework for new product development portfolio, including tasks for the portfolio manager, for the project or programme manager, for the team resource manager and for team members. In this elaborated framework, the project manager and the resource manager are responsible for developing project and resource plans and assigning them to the project teams. In another study on resource allocation in multiple projects, Ballesteros-Pérez *et al.* (2012) provided a quantitative process that enables project managers to assign staff to different work groups or projects. A study by e Silva and Costa (2013) on resource allocation in information systems projects also envisions a project environment where the project manager controls the management of human resources.

In general, the resource allocation process is often explained in previous literature as reflecting a hierarchical structure where the project manager or resource manager has the central role in allocating resources to different projects. However, the inherent uncertainty involved in projects and their environments causes challenges for project-based firms and indicates the need for a closer inspection of resource allocation issues and practices.

2.2 Resource allocation issues in project-based firms

2.2.1 Resource allocation issues in multi-project organisations. Previous research on multi-project management and project offices raises the issue of resource allocation in project-based firms. Resource constraints and the improper allocation of resources are key problems facing multi-project organisations (Elonen and Artto, 2003). Project scheduling failures and over-commitment of resources are key mechanisms influencing resource demand, while deficient management accounting systems and opportunistic managers are mechanisms that have a negative influence on resource supply (Engwall and Jerbrant, 2003). Different projects in the project-based firm may have a different degree of access to resources, and thereby a different degree of resource autonomy, depending on their position in the parent organisation and in the broader stakeholder network (Martinsuo and Lehtonen, 2009).

The literature on multi-project management usually focusses on competition for resources between several projects in an organisation (Fricke and Shenhar, 2000; Laslo and Goldberg, 2008; Zika-Viktorsson *et al.*, 2006). Challenges for resource allocation include estimating resources for each project, dealing with changes to resource needs during the life cycle of a project, setting priorities among different projects and the number of interfaces between the projects and their surrounding environments (Zika-Viktorsson *et al.*, 2006).

Engwall and Jerbrant (2003) describe the issue of resource allocation as a syndrome in multi-project management. Their qualitative case study examining two engineering companies reveals that resource allocation is the primary issue in organisations that manage most of their operations as simultaneous or successive projects.

Some studies on project management offices have covered resource allocation in multi-project organisations. Project management offices may support or take responsibility for resource allocation to projects (i.e. staffing assistance; e.g. Dai and Wells, 2004; Hobbs and Aubry, 2007), or may act as resource pools from which resources can be allocated among projects. Prior research has focussed on competition between projects, resource planning and resource allocation responsibilities in multi-project organisations, with a specific focus on interactions between projects. However, the challenge of resource allocation in project-based firms is not limited to projects alone, but also includes other types of activities competing for the same resources.

2.2.2 Resource allocation issues between temporary and permanent organisations. In contrast to the traditional approach to project management, more recent approaches highlight the interrelationships between projects, organisations and individuals. These interdependencies force projects to compete for resources. In their paper elaborating on Lundin and Söderholm's (1995) temporary organisation theory, Jacobsson *et al.* (2013) highlight the links between temporary and permanent organisations and challenge the contrast between these two forms of organising. Communication problems, conflicts with existing units, difficulty in accessing complementary resources and opportunities to collaborate in the use phase of systems are examples of reasons to interlink temporary and permanent organisations (Jacobsson *et al.*, 2013).

One of the main challenges occurring at the interface of temporary and permanent organisations is allocating resources to projects. Project teams depend on the context of permanent organisations (Lundin and Söderholm, 1995) and face different degrees of autonomy and control in relation to the parent organisation (Martinsuo and Lehtonen, 2009). This means that most of the personnel needed for a project must be borrowed from functional departments, which requires negotiation between project managers and functional department managers, as well as among the personnel themselves (Jacobsson *et al.*, 2013; Turner and Muller, 2003). The collaboration between different departments requires suitable communication skills that differ from those needed to communicate within units (Midler, 1995). The relationships among individuals, and between the team and the environment, are to be managed through building commitment between individuals and legitimate relationships between the team and its environment (Lundin and Söderholm, 1995). Allocating resources between different types of activities is not straightforward, and studies of matrix organisations have revealed that resource conflicts and confusion over roles and responsibilities are possible between projects and functional line activities (Kuprenas, 2003; Laslo and Goldberg, 2008). The tensions related to access to critical resources is one of the main issues that arise in projectified matrix organisations (Arvidsson, 2009). Although the literature has acknowledged the resource allocation issue in principle, practical resource allocation issues at a firm level have not been sufficiently covered.

2.3 Managing resource allocation issues in a dynamic environment

Dynamism represents the extent to which projects are influenced by changes in the environment (Collyer and Warren, 2009). Dynamism in a project environment is not limited to complex technology projects, and it can represent a threat to projects across all industries (Collyer *et al.*, 2010). Collyer and Warren's (2009) and Collyer *et al.*'s (2010) studies are among the few that explicitly focus on dynamic project-based environments. They identify the possible causes of changes in the environment, document the challenges posed by project

dynamism and explore various management approaches to deal with dynamic environments more effectively. The difficulty in finding and managing skilled labour is one of the challenges created by higher levels of change in a dynamic environment. In fact, since different events could occur in the environment, long-term planning can waste time and resources (Collyer and Warren, 2009).

Unanticipated changes may result in re-shuffling resources in a firm and may prompt project managers to go beyond their plans to use resources in new ways (Söderholm, 2008). Previous studies have seen the availability of resources and sharing resources between different projects and functional departments as a major challenge for resource allocation (Danilovic and Sandkull, 2005; Arashpour *et al.*, 2016; Laine *et al.*, 2016; Saunders *et al.*, 2016). Uncertainty management issues of resource allocation include adequate accuracy of resource estimates, estimating resources required, defining responsibilities, defining contractual terms and conditions and selecting capable participants (Atkinson *et al.*, 2006). Organisational or structural complexity has been recognised as the main cause of resourcing uncertainties and challenges (Martinsuo *et al.*, 2014; Maylor and Turner, 2017). Managers usually use planned responses to deal with structural complexities (Liu and Leitner, 2012). Therefore, it has been a common argument that firms that have good systems for allocating resources efficiently, among other required systems, are more successful in managing risk and uncertainty (Kardes *et al.*, 2013). However, different risks and uncertainties can change the effectiveness of the control mode in project-based firms (Liu, 2015). Organisations face also various emergent complexities (besides structural complexities) that include uncertainties and dynamics in the project environment and need more flexible responses (Maylor and Turner, 2017). Jerbrant and Karrbom Gustavsson's (2013) research on managing project portfolios showed that the constant change of plans and constant shifts between projects and activities in the project-based firm forced project managers not to plan ahead but also to improvise when situations change.

Altogether, resource allocation is a source of uncertainty and can also be influenced by uncertainties in a dynamic project environment. The project uncertainty management literature has mainly explored uncertainty from within a single project, and fewer studies have taken a broader approach towards uncertainty management at the level of the project-based firm. Construction and product development projects have been the dominant project types in previous research. Previous studies have analysed the different types of uncertainties, for example, sources of uncertainties (Söderholm, 2008; Atkinson *et al.*, 2006); experiences of environmental uncertainties especially in the construction industry (Arashpour *et al.*, 2016); different sources of uncertainties in R&D project portfolio (Martinsuo *et al.*, 2014); and uncertainties associated with the project network (Atkinson *et al.*, 2006). Also, uncertainty management is increasingly studied, for example, in terms of: ways of managing uncertainties in safety-critical projects (Saunders *et al.*, 2016); different approaches to managing project uncertainty (Atkinson *et al.*, 2006; Perminova *et al.*, 2008); risk management for megaprojects (Kardes *et al.*, 2013); collective sense making in overcoming uncertainties in R&D programs (Laine *et al.*, 2016); and interdependencies and relations in managing product development projects (Danilovic and Sandkull, 2005).

Despite this active research in uncertainties and their management, the earlier studies have not directly investigated resource allocation in dynamic environments. In dynamic environments, multi-project and non-project activities challenge the traditional top-down view of resource allocation. It is therefore crucial to understand the challenges facing resource allocation in an environment with high uncertainty, particularly in settings where project and non-project activities may compete for the same resources, and to explore different approaches to managing resource allocation.

3. Research methodology

3.1 Research design

This research took the form of a qualitative comparative case study, a method seen to be suitable for understanding the experiences and opinions of people in their real-life contexts (Yin, 2003), enabling an in-depth analysis of a relevant and not yet well-known phenomenon (Yin, 2009). We sought for cases that would be informative concerning resource allocation in dynamic environments delivering both projects and services. Since the number of cases that can be studied in any research project is limited, it is not preferable to choose cases randomly (Eisenhardt, 1989), but rather it is important to select cases where relevant data could be gathered. Therefore, two companies were sought in a similar kind of context that would represent diverse resource allocation practices. The companies were approached to describe the processes of planning and managing resources in one of their customer-facing units, along with the effects of other units on its resource allocation decisions.

The study was carried out in two service units that are part of two project-based firms, an industrial equipment and service provider (Company A) and a technology systems provider (Company B). Both companies have a similar background: they design, sell and deliver complex technology-based solutions in global markets. The companies represent typical system suppliers that deliver their systems as projects with other industrial firms as clients, carry out such projects repeatedly on a large scale and complement their systems with services. Service business has increased in importance for both companies. Thus, both units represent good examples of project delivery supplemented with industrial service delivery.

Service units were chosen purposefully for analysis: service units in project-based firms contribute to both projects and service activities which thus compete for the same resources. Furthermore, service units are good example of an organisational context that changes rapidly and faces different sources of uncertainty, from within the organisation as well as from the customer and business environment. The staff in service units are usually allocated to the core projects of the company (equipment design, manufacturing and delivery projects), service projects (e.g. modernisation) and routine activities (e.g. maintenance).

Comparison of the two service units based on three dimensions of complexity, as explained in Maylor and Turner (2017), shows that the service units do not face considerable socio-political complexity. Structural complexity in Company B is higher than Company A, mainly due to the higher number of people involved, higher number of interdependencies across the different disciplines of the service unit and with the core projects of the company, broader variety of work and higher number of disciplines involved in core project-related activities and service projects. Company B also performs in a more dynamic environment in terms of emergent complexity. The novelty of the service projects in Company B is higher and the service people receive more emergency requests from the customers. Table I presents the background information of the case companies. The companies use different resource allocation methods in their service units. The differences between the level of complexity and resource allocation practices make these two cases as excellent examples to study resource allocation practices in a dynamic environment.

Table I. Background information of the case companies

	Company A	Company B
Net sales (millions of euros)	> 1,000	> 1,000
Employees	> 1,000	> 1,000
Service share of net sales (%)	51	17
Portfolio of projects	Similar projects in a specific industry	Various projects in varying industries
Type of projects	Medium complexity	Fairly high complexity

3.2 Data collection

The main source of data consists of semi-structured interviews with 17 respondents, lasting an average of 82 minutes. The interviewees were selected by consulting with a contact person in each company to identify the most knowledgeable people in the organisation concerning resource allocation processes. Many of those interviewed were experienced service managers and staff, who were able to provide detailed knowledge about resource allocation and relate their experiences of uncertainties in their daily work. Table II summarises key information about the interviews and interviewees.

The interview outline was developed iteratively in collaboration with the key contacts at the selected companies. After discussing the resource allocation process and decision-making approaches with a few mangers in each company, an interview outline was developed as the basis for interviews with service mangers and staff. The main themes of the interviews included the structure of the organisation, the types of project and service activities conducted, the work environment, the resource allocation process, key participants in decision making and links to other units. All interviews were performed on-site, enabling the researchers to familiarise themselves with the work environments of interviewees and to observe how managers and staffs used the resource management systems in place within the organisation.

The companies' resource planning and monitoring systems provided secondary data sources. While Company A used a web tool to allocate and monitor human resources, Company B used a simple Excel worksheet as a resource calendar. The researchers observed both tools during the interviews.

3.3 Data analysis

An external service provider transcribed the recorded interviews. The first author reviewed all transcripts to identify and correct any mistakes or gaps. The unit of analysis was the resource allocation practice at the service unit level. The researchers were interested in analysing the challenges involved in allocating service staff to projects and service activities in a situation of uncertainty. Data analysis proceeded inductively, as no previous research offered a preliminary framework concerning resource allocation under uncertainty; this phase included four steps.

First, the transcripts were analysed to identify the different types of activities undertaken by the units, as well as their main resource allocation challenges and practices. In this phase, the activities in the service units were mapped to the following categories: core project-related activities, service projects, service contracts and ad hoc activities. During the analysis, these activities were identified as differing from each other significantly in the nature and degree of uncertainty they represented. Among the four main types of activities, the analysis revealed that the uncertainties and related challenges experienced by the interviewees were mainly related to two types of activities: core project-related activities and ad hoc activities.

Second, the interview transcripts were coded on the basis of identified themes. All the challenges mentioned by the interviewees that affect resource allocation plans and decisions were labelled as resource allocation issues, including uncertainties in the work environment,

	Company A	Company B
Number of interviewees	7	10
Respondents	Director of technical support, project manager of new service systems, service development staff, vice president of technology, director of sales and services, service manager	Service managers, supervisor of service managers, service staff
Average duration (min)	100	70

Table II.
Interview data

changes in priorities, schedule changes, scope changes and information flow among units. All the approaches, practices and processes that the interviewees mentioned that are used to manage resource allocation were labelled as managerial practices, including organisational structure, roles and responsibilities of managers and staff, resource allocation practices, authority to prioritise activities, cross-functional communication and categorising resources.

Third, case-specific stories were developed on the basis of the collected data. Here, the different resource allocation approaches were labelled "hybrid" or "bottom-up" based on their unique characteristics and differences. Finally, the case-specific analyses were compared with each other and with the previous literature to highlight key phenomena. Excerpts from the interviews, cross-tabulation of the key comparisons and illustrative figures are used in Section 4 to highlight the main issues.

4. Results

4.1 Uncertainties in the environment and resource allocation issues

The service staff in both case companies are experienced in delivering project and service activities. They are involved in different projects, from simple service projects relying mainly on service staff to more complex projects that draw on versatile resources from different departments within the firm. Table III shows the main activities involving service staff and their various characteristics, particularly in relation to uncertainty. While service units in both companies engage in all types of activities, the share of project-related activities and service contracts is higher in Company A. Meanwhile, Company B's service staff face more ad hoc requests and provide more urgent repair and maintenance services.

Both companies face similar resource allocation issues. While the service units try to deploy their human resources efficiently among both project and service activities, they have to change their schedules and resource allocation decisions frequently. A manager in Company A explained, "When you come to the office, you never know what is going to happen during the day. That is the special characteristic". As presented in Table III, two types of activities contain additional uncertainties: core project-related activities and ad hoc services. These uncertainties usually come from two separate sources in the service unit environment: from the project management unit and from customers.

Activities that are related to the core projects of the companies are dependent upon project management units. Start-up and commissioning form the last phase of the companies' core project delivery and can last from one week to six months depending on the complexity of the equipment delivery. The timing of these activities depends entirely on the previous phases of the project, which are carried out by other departments. In each company, the product management unit is mainly responsible for the entire project; start-up and commissioning are usually defined in the project plan as comprising one activity. Meanwhile, the service unit plans and manages the details of start-up and commissioning activities. A manager in

Type	Activities	Characteristics
Core project-related activities	Start-up and commissioning, product development	High uncertainty in time Different units' resources
Service projects	Upgrade, modernisation, expansion	Medium uncertainty in time and scope Mainly service unit's resources
Service contracts	Preventive maintenance	Low uncertainty in time and scope Long-term plan Only service unit's resources
Ad hoc services	Spare parts and tools delivery, repair	High uncertainty in time and scope High emergency Only service unit's resources

Table III.
Different types of activities in the service units, and their uncertainty characteristics

Company B explained, "When we are involved in some bigger project, our activities are presented as one activity or item [in the project schedule]". Another manager in Company B continued, "You have to communicate with customers, plan related activities, deliver and test. You need to look at timetables of different departments".

In addition to these core projects, service staff are occasionally allocated to other project activities, such as new product development projects. Their role is usually limited to the final phase of development projects – they might monitor pilot projects and provide feedback for the product management unit. A manager in Company A explained, "Our team is also involved in new product development projects and new product piloting, basically, in monitoring the prototypes. When the product management does not have the available resources or the company launches prototypes all over the world, then service people will help there".

The resource allocation plan may change due to delays in previous phases of a project as a consequence of activities in other departments. Since service staff are involved in the final phases of core projects, their schedules and resource management decisions are affected by these previous phases, which creates uncertainties for the timing of the project-related activities. Service units therefore do not always have resources available to allocate to the project at the required time. This issue becomes more important when the core project relates to the whole production process. In this case, service staff might be involved at various stages of the project execution phase. A manager in Company A explained, "We are in the process of starting up a plant. We have started up the primary part, but we have to wait until the rest of the operation is completed. Then there will be another commissioning until the whole line operates from A to Z. Thus, it is very difficult to find out what the time frame is".

Second, such ad hoc services as delivering spare parts along with repair and maintenance service form a significant part of the work of service staff. Both case companies deal with ad hoc requests from customers and are experienced in providing spare parts and maintenance services in emergency situations. The customers are usually in crisis when they ask for help from these companies, and service units must respond to their unplanned requests as soon as possible. Thus, service staff may be forced to cancel other planned activities to resolve critical issues for customers, on-site. The scope of these activities is usually uncertain, and service staff must estimate the amount of effort required after visiting the equipment or production line.

Those interviewed highlighted the fact that resources allocated during the planning phase do not always represent the actual service staff that carry out activities during the execution phase, because of ad hoc repair and maintenance activity at customers' locations. A service engineer in Company B gave an example of this: "It does not always go according to the plan. For example, a service engineer might be at a customer's site to deliver some services, and the work takes longer than its original estimation. In that case, the service manager allocates another available engineer that has the required skills". Service units must respond to urgent problems, which could lead to a shutdown of the customer's production line. Therefore, solving these issues has the highest priority for service staff and can impact resource allocation plans. Interviewees in Company B mentioned this issue more often than those in Company A because they provide more unplanned services to their customers.

4.2 Resource allocation practices

Besides similar issues that both case companies face in allocating their resources, the study revealed two rather different approaches in resource allocation. Table IV shows an overview of these practices in the two case companies. In the next subsections, these practices are reported for each company separately.

4.2.1 Resource allocation practices in company A. Traditionally, the service managers and service staff of Company A were responsible for planning different activities in the service unit, but this subsequently changed. At the time of the interviews, Company A had

	Company A: hybrid resource allocation process	Company B: bottom-up resource allocation process
Resource allocation practice	The resource planner plans resource allocation based on the availability and technical skills of the staff. The service managers and service staff plan the workload and negotiate to solve issues	The service staff plan their resource allocation. The service managers support them in critical situations
Authority to prioritise activities	The planner sets the priorities in cooperation with the service manager	The service staff set the priorities of their own tasks. The service managers support them in critical situations
Cross-functional communication	The service manager or planner receives updates about the progress of core projects from the project team The service manager has a continuous relationship with the sales unit regarding upcoming projects and contracts	The service manager receives updates about the progress of core projects from the project team, customers or related internal or external contractors The service managers and service staff are involved in sales activities and support the sales unit
Categorising resources in the resource pool	There are specific resources for start-up and commissioning and ad hoc repair and maintenance	There is no specific division of resources based on the type of activity

Table IV.
Overview of resource allocation practices in the two case companies

a hybrid resource allocation process, represented in Figure 1. Besides service managers and service staff, a planner exercised a critical role in allocating activities within the service unit. While the service staff played a significant role in managing their workload, they were required to communicate with the planner regarding any new activities or changes in their plans.

To improve resource utilisation in an environment of uncertainty, Company A dedicated specific staff to provide ad hoc repair and maintenance. This approach helped the unit control the effect of unplanned requests on other planned activities. Company A also allocated some of its service staff exclusively to commission new equipment. The service planner assigned these particular resources based on their technical skills. Different resource allocation strategies were also used for more complex projects. For example, Company A assigned different staff for special equipment delivery projects to help the company increase its competencies in specific areas. While specific technicians are assigned to deliver these projects, the company also tries to rotate its resources. A manager in Company A explained, "These projects are somehow special; therefore, we try to have a bigger team so they gain a detailed understanding about that specific delivery".

While the planner, in cooperation with the service manager and service staff, developed plans for core project-related activities, service projects and contracts, unplanned and urgent requests from customers could change resource allocation decisions. Customers would usually contact service staff directly when they needed urgent repairs and maintenance services. To improve resource allocation, service staff would inform the planner of new customer requests and receive confirmation whether or not the new task has a higher priority than the planned activities.

Due to the uncertainty in the environment, prioritising activities becomes an important practice in the service unit. The planner, with the help of the manager, schedules (and reschedules) project and service activities based on their priorities at the time the decisions are made. Serving the customers who have contracts with the firm takes the highest priority. Project activities are the next highest priority in the service unit. While members of the service unit try to allocate resources according to this deadline, they must consider the sizeable cost of shutdown for some of their customers in a specific industry and re-prioritise activities to solve any urgent problems.

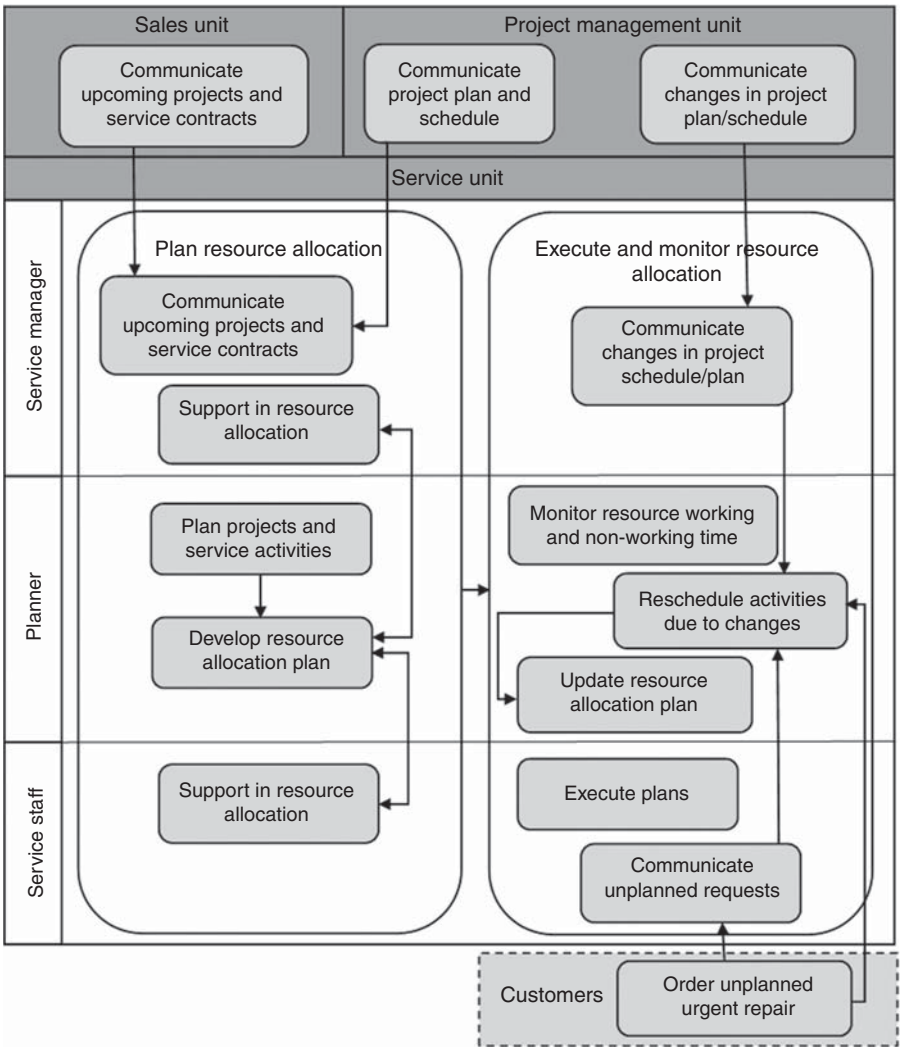

Figure 1.
Resource allocation in company A: hybrid resource allocation process

Uncertainties about the schedule of the start-up and commissioning phase of projects may cause difficulties in developing long-term plans and managing resource allocation. The product management unit of Company A was responsible for managing the core projects of the company. Project managers would communicate with service managers about project-related services, project plans and resource requirements. As a manager in Company A explained, "The service manager, together with the project manager, agrees on who will be sent to the projects and when". To have an up-to-date schedule, the planner or the service manager continuously required information from the project management team about the project's progress. The communication and information flow between the project team and service unit would help the planner to release resources, allocate them to other important activities or find available resources whenever a project requires it.

4.2.2 Resource allocation practices in company B. As presented in Figure 2, Company B took a different approach to resource allocation, here labelled as bottom-up resource allocation. The service managers gave more authority to the service staff and empowered them to make most resource allocation decisions on their own. Interviews with service managers and service engineers in Company B highlighted that due to a high number of unplanned customer requests, the service unit shortened the decision-making process to respond more rapidly to customer requests. Service engineers were required to prioritise their tasks, make their own timetables, communicate with customers and other units and update their plans frequently. A service manager in Company B explained, "Service engineers can do those allocations by themselves. If they need help, then we can discuss it, but I am probably the last one to say what the most important task is".

The service unit did not allocate specific service staff to specific types of activities, such as start-up and commissioning; rather any resources could be used for any activities, depending on their competencies. This approach helped Company B to use all available resources for different tasks, as well as to access various resources with the same level of skills and experiences. By accessing a bigger resource pool, the service unit could manage any changes to their plans more efficiently.

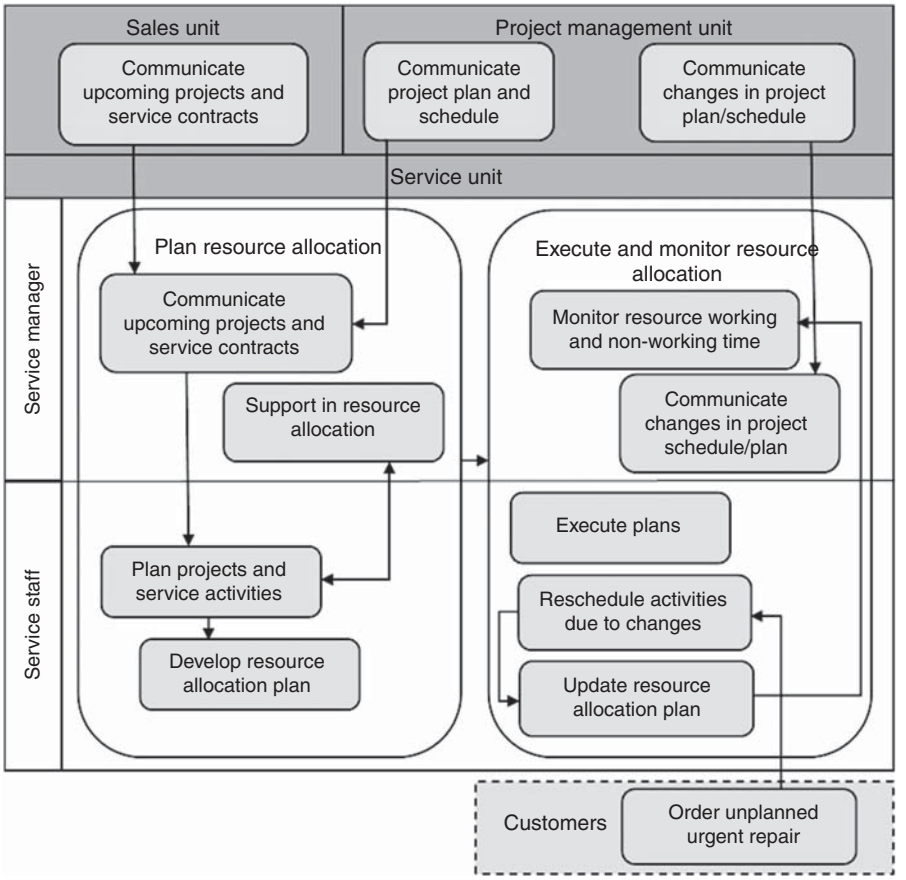

Figure 2.
Resource allocation in company B: bottom-up resource allocation process

The service staff in Company B was also required to respond to customers who have contracts with the company within a defined amount of time. Then, they could allocate their time to project activities and other service activities. However, Company B had a variety of customers in different industries, including such critical industries as transportation and nuclear power. Service staff had to respond to the urgent needs of these customers by re-prioritising their tasks and postponing planned project and service activities.

Regarding start-up and commissioning, service managers were responsible for choosing those most suitable for projects. They made these decisions based on their skills and experiences and then checked the availability of these resources during the estimated timetable. Receiving up-to-date information about project progress played an important role in managing resource allocation. Service managers continuously received information about project progress from the project management team, customers or related internal or external contactors.

While Company B could not reduce the uncertainties arising from unplanned requests from customers, it did try to decrease uncertainties regarding service projects and contracts by maintaining a continuous relationship with the sales unit. The service staff usually accompanied the members of sales units on visits to customers and to make proposals. More experienced staff worked closely with the sales unit and received information about upcoming projects and contracts. This practice helped members of the service unit to have a more reliable picture about their future workload.

5. Discussion

This study focussed on service units that operate in a dynamic environment where project-based firms use human resources for both project and service activities. It contributes to the project contingency theory by revealing alternative resource allocation approaches in the specific organisational contexts of the project-based firms. Different project-based firms have specific critical characteristics that determines the suitable managerial approaches (Dvir *et al.*, 1998; Shenhar, 2001). In the project contingency research, construction projects, R&D and IT projects are the dominant project types (Hanisch and Wald, 2012), without a clear link to other types of activities in the firm. In the context of service-centric projects, previous research has pointed out the very different degrees of autonomy (including resource autonomy) across different types of projects and contexts (Martinsuo and Lehtonen, 2009). This study analysed service units in engineering firms as a dynamic context where both project and service activities are carried out, and the changing needs of customers that must be taken into account. One of the key requirements for human resources in a dynamic environment is to respond quickly to changes. The study showed that based on the level of uncertainty in the environment and activities, service units may use different practices to allocate resources to projects and services.

5.1 Resource allocation approaches in context

This study reveals that two case companies working in a dynamic environment make multiple resource allocation decisions weekly or even daily. This increased frequency of resourcing decisions has made the traditional top-down approach an ineffective way for service units to allocate resources to project and service activities. The traditional view of resource allocation in project-based firms was based on a rational and hierarchical structure where managers would choose the most suitable resources and allocate them to various projects based on the pre-defined plans (Hendriks *et al.*, 1999; Abrantes and Figueiredo, 2015; Ballesteros-Pérez *et al.*, 2012; e Silva and Costa, 2013). The new approach employed by project-based firms highlights the relationship between the project and the parent

organisation (Jacobsson *et al.*, 2013) and emphasises the tensions that result from this interaction (Arvidsson, 2009). While earlier studies have demonstrated the needs for cross-functional negotiation (Laslo and Goldberg, 2008), they have considered the decision-making process mainly as an activity undertaken at the beginning of the project, although it may be rechecked periodically (Hendriks *et al.*, 1999).

Control mechanisms vary across organisational settings (Canonico and Söderlund, 2010). This research argues that resource-related control mechanisms based on a hierarchy is a risky mechanism not only for complex, knowledge-intensive settings such as R&D-driven organisations (Canonico and Söderlund, 2010) but also for customer-facing units. To complement the previous top-down approach to resource allocation (Hendriks *et al.*, 1999; Abrantes and Figueiredo, 2015; Ballesteros-Pérez *et al.*, 2012; e Silva and Costa, 2013), this study elaborated two alternative approaches to managing resource allocation, ones particularly prevalent in the customer-facing service units where project and service activities compete for resources. These are labelled in the study as hybrid resource allocation and bottom-up resource allocation. The study differentiates resource allocation of service units mainly based on complexity as one of the critical project dimensions (Baccarini, 1996). Table V depicts the contexts in which the two resource allocation approaches can be implemented, expected implications, the goals and the way used to implement each approach, based on the case study findings.

While both resource allocation approaches incorporate the experience and skills of staff in decision making, hybrid resource allocation implies that a dedicated planner occupies the intermediary role between service managers and service staff. This approach helps the company to organise the resources in its continuously changing environment while maintaining its trust in individuals and valuing their roles in decision making. By contrast, the other case company empowered its service staff to manage their activities in a bottom-up, customer-oriented and autonomous way. The study confirms that a dynamic project environment requires more flexible responses (Maylor and Turner, 2017; Jerbrant and Karrbom Gustavsson, 2013). This approach helps the case company to respond to change more efficiently.

Analysing the organisational context of the two cases revealed the increased level of environmental uncertainty that arose in the case B. The considerable demand arising from unexpected requests from customers of Company B required a responsive approach to prioritising activities and allocating resources rapidly. Lindkvist *et al.*'s (1998) findings highlighted the use of time-control mechanisms in product development projects; in a similar way, this research demonstrated that determining priorities of activities in service unit defines what must be done and encouraged reflective activities that promote decentralisation, autonomy and self-organisation. This study investigated project-based firms from a practice perspective and showed the considerable effects of the organisation and its dynamic

	Hybrid approach	Bottom-up approach
Where?	Medium complexity in terms of structural and emergent complexities (Maylor and Turner, 2017)	High complexity in terms of structural and emergent complexities (Maylor and Turner, 2017)
What?	Organising resources while increasing responsiveness	Increasing responsiveness
Why?	Ensuring the right prioritisation of activities in a dynamic environment	Reacting fast to the changes in time, scope and type of activities Adapting to uncertainties in the environment
How?	Using a planner as the intermediary role between managers and staff	Empowering individuals; managing the information flow between units; supporting by managers in critical situations

Table V.
Findings on hybrid and bottom-up resource allocation approaches

environment on resource allocation practices. The findings suggest that different risks and uncertainties in the organisational environment require different control modes in the project-based firms (Liu, 2015). Project-based firms need to understand the nature of their activities to choose the best resource allocation approach.

These findings have also emphasised the role of individuals' experiences in coping with unexpected events. The knowledge gained over time enhances the ability of staff to prioritise activities and manage tasks. By contrast, resource control mechanisms that emphasise plan following and systematic change management can have adverse consequences on the resource allocation in a dynamic environment. While the behaviour of these more flexible organisations may appear as chaotic at a first glance, in fact, they have learned to adapt successfully to their changing environment (Collyer and Warren, 2009).

5.2 Challenges in simultaneous delivery of projects and services

The results of this study direct attention to the challenges involved in delivering continuous and ad hoc services alongside planned and scheduled projects in project-based firms. While resource competition across multiple projects is a well-known issue (Fricke and Shenhar, 2000; Laslo and Goldberg, 2008; Zika-Viktorsson *et al.*, 2006), previous research has not sufficiently emphasised the competition for resources between projects and other types of activities in dynamic environments. This paper has adopted a practice perspective and analysed the co-existence of projects and services within service units, thereby complementing previous studies concerning resource allocation in multi-project environments (e.g. Engwall and Jerbrant, 2003). The previous studies on integrating projects and services have mainly emphasised the benefits arising from complementing projects with services (Artto *et al.*, 2008), the necessity of changing the business logic (Kujala *et al.*, 2011) and developing organisational capabilities (Brady *et al.*, 2005; Davies and Brady, 2000). This study has shed light on the delivery of projects and services and revealed resource allocation issues to be key challenges stemming from the existence of multiple delivery logics.

The findings show that the service context, which has a direct connection with customers, ties project activities to an environment with high uncertainties. Both companies selected for this study are organised in a divisional structure. The service unit has focussed on a narrow part of the solution life cycle; therefore, it has specific priorities related to its main function (Artto *et al.*, 2008). In both companies, responding rapidly to customers takes the highest priority for the service staff, and these short response times affect long-term resource allocation and use. The specific function of service businesses (i.e. keeping the customers' operations up and running) changes the allocation of resources away from the projects' planned and scheduled approach to a continuously evolving prioritisation of activities.

Besides ensuring resource availability, continuous prioritisation of project and non-project activities is an important issue in organisations facing high uncertainty. The findings show that even if competencies are the main decision criterion in the planning phase of the core project, the service unit usually faces changing resource requirements in the project execution phase. In addition to urgent repair and maintenance cases, deviation from other project activities that postpone the project-related services may have a considerable effect on resourcing decisions.

5.3 The role of communication and cooperation in enabling flexible resource allocation

In addition to choosing the appropriate resource allocation approach, communication and cooperation are important parameters to manage uncertainties in the service units. The results of this study show the importance of cross-functional links in project-based firms (Fricke and Shenhar, 2000) and the effects of information flow between different units on

resource allocation. The interviews highlighted that managing the interfaces and the flow of information into and out of the project team helps firm manage uncertainties that result from organisational complexity (matrix structure) and from project changes and deviations. This lends support to earlier findings concerning the key role of boundary spanners such as project managers and project owners who have a key role in acquiring and guarding the project's autonomy (Martinsuo and Lehtonen, 2009). This study reveals the importance of accessing information about potential projects and contracts when managing resource allocation. Both case companies pursue up-to-date information about sales, requiring them to optimise the transfer of information to and from the sales unit. Besides using information systems, informal meetings and conversations with the sales force help the service unit to gain a larger picture of upcoming activities. As environmental uncertainties cannot be eliminated, information sharing makes it possible to manage their effects (Perminova *et al.*, 2008).

6. Conclusion

6.1 Contributions and practical implications

In the cases studied in this research, service units organise their activities into projects and service activities and use the same resource pool to deliver both. In such an environment, success of all activities is highly dependent on the resources available, and resource allocation is a critical process required to organise and manage both project and service activities. This challenge becomes more critical in dynamic organisations operating in conditions of high uncertainty. This study has reported evidence from service units to document more extreme cases where the activities competing for resources are highly uncertain in their scope and duration. Managing resources in such a dynamic environment requires an approach that allows a rapid response to changes, sharing information to facilitate decision making.

This paper identified two main sources of resource allocation issues in an uncertain environment involving multiple types of activities, namely, the dynamic nature of customers' service requirements and changes and delays to projects. Our research has shown that urgent requirements from customers may require the organisation to re-prioritise its activities continuously, re-allocating resources between projects and service activities while adapting plans to changes and delays in projects; this, in turn, calls for a cross-functional negotiation of priorities. This paper revealed two approaches used to organise this uncertain environment and to allocate resources, which have been labelled bottom-up and hybrid resource allocation. These approaches extend the findings of previous studies that have focussed on top-down oriented resource allocation as an approach to adjudicate resource competition between projects in a multi-project environment where schedules and resources are planned by managers for projects in advance.

Utilising a bottom-up approach to increase responsiveness – i.e. ability to respond to the changes in the environment and customer requests fast – can result in some practical implications. First, balancing responsiveness with overall efficiency to deliver projects and services can become a challenge in service units, due to the internal competition for resources. In practice, in the bottom-up resource allocation approach, individuals may not be able to allocate their time and efforts efficiently and may respond to the activities that are urgent but are not in the priorities of the firm. The result of this study shows that the supervising role of managers in these critical situations to set and negotiate priorities can enable the service units to balance responsiveness and efficiency.

Second, there is also a possible trade-off between responsiveness and nervousness. In one end, bottom-up approach can increase responsiveness. On the other end, it may increase nervousness by shifting from the original plans to frequently updated plans.

The findings show that proper communication and coordination between the project team and the service unit as well as the service unit and the sales unit can help the service units to balance responsiveness and nervousness. Third, large global firms usually seek for a global optimal top-down approach with clear rationality and structure instead of a more flexible bottom-up approach, to enable forecasting and globally coherent service levels. Top-down resource allocation can be a suitable approach for those contexts where the firms assume good control over the sources of uncertainties. Therefore, when the context of the firm or unit shifts from a dynamic environment to a more stabilised environment, then they will need to reconsider the suitability of the top-down resource allocation approach.

This study recognises that a constantly changing environment requires a completely different, more dynamic logic for resource allocation compared to the previously dominant hierarchical model of resource planning used both in projects and within project portfolios. The results of the study show that service units can improve resource allocation between projects and services by managing the continuous changes in resource requirements of different activities. Moreover, exchanging information with other organisational units that are affected or can be affected by the resourcing decisions of service units can improve the interaction between services and projects.

6.2 Limitations and future research

This study was conducted in the service units of two manufacturing firms organised on a project basis, which limits the generalisability of its findings. The case studies also involved a limited number of interviewees in each company. To improve the validity of the results, interviewees were selected based on their first-hand experience and knowledge of different activities and of resource allocation processes in their units.

Most interviews were conducted with service managers and staff, so the experiences and opinions of other related units remain topics for future study. The interviews revealed that individual employees were becoming increasingly responsible to manage their own activities and to make their own decisions about time allocation. This kind of autonomy within project activities generates a need for research to assess the capacities of human resources working in uncertain conditions in project-based firms. This paper directs attention to the delivery logic involved in complementing projects with services. Future research can investigate the challenges stemming from multiple delivery logics across various organisational contexts and, thereby, enrich research related to integrated solution provision.

This research studied resource allocation from a contingency perspective in service units that perform both project and service activities. The next stage is to study other types of organisations such as manufacturing units, and research and development units involved in project activities. Analysing resource allocation in different organisational contexts will help in determining the linkages between the level of uncertainty and resource allocation approaches.

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