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Managing project-to-project and project-to-organization interfaces in programs: Organizational integration in a global operations expansion program

ABSTRACT

Managing project-to-project and project-to-organization interfaces is a critical part of program management. However, previous program management research says little about management of these two important interfaces. We study a global operations expansion program at Neste Oil when it expanded its renewable fuels operations globally with four plant projects in 2005-2011, examining how integration is managed in project-to-project and project-to-organization interfaces. Our analysis provides understanding on how management of organizational integration is contingent on the interface by illustrating use of different types of integration mechanisms in those two interfaces. The findings are novel in the context of program management, and the theoretical contributions focus on research on program management especially from an organizational integration and contingency analysis perspective.

Keywords: Program management; Organizational integration; Organizational interfaces; Project-to-project; Project-to-organization; Global operations expansion

INTRODUCTION

Recent research suggests that organizations are becoming increasingly sensitive to the need to manage a set of projects as programs in a coordinated manner with an overarching common goal rather than as independent projects (Ferns, 1991; Lycett et al., 2004; Morris, 2013; Pellegrinelli, 2011; Smyth, 2009; Thiry, 2002). While programs have been studied rather extensively in existing literature, little is known about how programs are managed as complex organizations with multiple interrelated projects as their parts. In particular, there is lack of understanding on how organizational integration is managed in programs (e.g., Lycett et al., 2004). It is this gap in the literature that we seek to address in the present study by examining the management of project-to-project and project-to-organization interfaces. We engage in theory elaboration research with the objective of developing further understanding on how organizational integration is managed across project-to-project and project-to-organization interfaces in the context of a global operations expansion program from a contingency analysis perspective.

In regard to operations expansion, especially since the late 1980s, firms have become ever more international and continuously face pressures to globalize through establishing operations in multiple geographical locations, for example to be close to customers and skilled labor or to reduce operations costs (Cheng et al., 2011; Colotla et al., 2003; Ferdows, 1997). Building of new plants in new locations is organized through a set of focused and interrelated projects (Gray and Bamford, 1999). The business goal of establishing manufacturing plants in many dispersed geographical areas globally cannot be achieved without managing these projects (and later, managing the plants) in a coordinated manner as a program. Even though the final outcome of this kind of program to establish and expand global operations may sometimes look like comprising multiple similar facilities located around the globe, the firm can only enhance

the value of its plant network by managing it as a whole (Cheng et al., 2011; Ferdows, 1997; Nohria and Ghoshal, 1997). The global nature of this kind of endeavor requires bringing together and integration of multiple organizational units and geographies in a completely new context, posing significant managerial challenges (Artto et al., 2011; Orr et al., 2011; Turkulainen et al., 2013).

Integration is one of the fundamental issues in program management (Ferns, 1991; Morris, 2013; Pellegrinelli, 2011); information and knowledge existing and developed during the program needs to be shared across the organization, for example to avoid reinventing the wheel, to avoid losing critical knowledge, and to operate effectively (Brady and Davies, 2004; Keegan and Turner, 2001; Ruuska and Brady, 2011). Moreover, the geographically distributed nature of global operations expansion programs increases the integration challenges (Orr et al., 2011; Turkulainen et al., 2013). In programs, integration is especially critical in two interfaces: project-to-project and project-to-organization (Lehtonen and Martinsuo, 2009). Integration of the project-to-project interface in the context of program management is required for coordination, efficient and effective resource utilization, transfer of knowledge, ideas, tools, techniques, and coherent communication (Lycett et al., 2004). Integration of the project-to-organization interface, on the other hand, is required for effective alignment with business strategy, senior management visibility, effective and efficient knowledge and other resource utilization, and coherent communication as well as ensuring that knowledge developed in the projects is stored in the organization (Lycett et al., 2004).

We approach organizational integration in project-to-project and project-to-organization interfaces from an information processing perspective (Galbraith, 1973; Tushman and Nadler, 1978). We analyze extensive data collected during a longitudinal, single embedded-unit case

study of a globally-operating Finland-based oil company, Neste Oil. Our analysis focuses on Neste Oil's program, which we call "NextGen". NextGen was set up in 2003 with the goal of becoming a global leader in the renewable fuels business area. The purpose of NextGen was to build and expand global operations for the biomass-to-liquid (NExBTL) process for producing next generation diesel oil with superior qualities compared to traditional biodiesels and their production. The NextGen program consists of four projects, which were set up to expand operations on a global scale and to simultaneously further develop the product and process technology for global operations in order to reach the overall goal of becoming the world leader in the area. Each plant was developed and built as a separate project but they were managed together as a program: setting up of the first commercial production facility to establish the viability of the technology in Porvoo (Finland, 2003-2007; "Finland 1"), building of the second plant alongside the first plant to double capacity again in Porvoo (2006-2009; "Finland 2"), and then rapidly building two large-scale plants with four times the capacity of the Finnish plants in Singapore (2007-2011) and Rotterdam (The Netherlands, 2007-2011).

The rest of the paper is structured as follows. In the second section, we present the focal concepts of the research as well as a theoretical framework guiding our empirical analysis. The third section presents the research methodology, followed by a description of the case program. In the fifth section we present the case analysis, focusing on how integration is managed across project-to-project and project-to-organization interfaces. Finally, a discussion section follows, including research and managerial implications, limitations and future research directions.

THEORETICAL BACKGROUND

Programs and program management

The early research on project management between the 1930s and the 1950s used the terms projects and programs interchangeably (Artto et al., 2007; Lycett et al., 2004; Morris, 1994). For example Morris (1994: 19) refers to “Program and Project Management” when discussing the early developments of the projects and programs domain as a single, combined domain. Recent research, however, stresses the inherent differences between projects and programs; programs and their management are to be distinguished from projects (Lycett et al., 2004; Pellegrinelli et al., 2007; Thiry, 2004). While there has been significant effort on the study of projects, research on programs and their management seems to lag behind (Artto et al., 2007).

The definitions of programs and program management vary. Some equate program and portfolio (e.g., Turner and Speiser, 1992) and define a program as a grouping of projects, which may or may not include coordinated management (Gray and Bamford, 1999). Pellegrinelli (1997) defines a program as a group of projects, aimed at focusing all the activities required to achieve a set of major benefits. These projects are managed in a coordinated way, either to achieve a common goal, or to extract benefits, which would otherwise not be realized if they were managed independently. Smyth (2009), on the other hand, defines a program as clusters of projects aimed at meeting diverse goals for organizations and diverse societal policies. The PMI (2008) defines program management as the centralized coordinated activity to achieve the program’s strategic objectives and benefits, emphasizing the programs’ long-term benefits, strategic nature, and challenge to integrate and coordinate a complex network of resources.

We define programs to consist of a set of interrelated projects, which are managed in a coordinated manner to achieve a common overarching goal (Ferns, 1991; Nieminen and Lehtonen, 2008; Pellegrinelli, 1997). Programs provide a bridge between projects and organizational strategy (Shao and Muller, 2011) and differ from projects in that despite having

an overarching goal, they do not necessarily have a single, clearly defined deliverable or a finite time (Pellegrinelli, 1997; Thiry, 2004). Moreover, because programs are typically longer in their duration, their needs and expectations evolve, requiring different management practices and logic than projects (Thiry, 2002, 2004).

Organizational integration

We adopt the definition of [organizational] integration from Lawrence and Lorsch (1967: 4) and define integration as “the process of achieving unity of effort among the various subsystems in the accomplishment of the organization’s task”. We approach integration from the most established theoretical basis of organization as an information processing system (Galbraith, 1973; Tushman and Nadler, 1978). This builds on bounded rationality (March and Simon, 1958), which suggests that due to the cognitive limitations of individuals, organizations develop idiosyncratic bases of information and knowledge, creating information processing needs (Lawrence and Lorsch, 1967). Organizations manage information processing by implementing integration mechanisms, which differ in their capacity to facilitate information processing as well as in their costs of use (Burton et al., 2006; Galbraith, 1973; Lawrence and Lorsch, 1967). Integration mechanisms can be divided into three different modes at the top level: (1) impersonal, (2) personal, and (3) group mode (Galbraith, 1973; Van de Ven et al., 1976). Examples of each mode with references are presented in Table 1 and impersonal, personal, and group modes are described in more detail below.

Table 1: Summary and examples of integration modes

Integration mode	Examples of integration mechanisms	References
Impersonal	Rules, written policies, job descriptions, standard procedures with charts and manuals, schedules, formal plans, information systems	Child, 1972; Daft and Lengel, 1986; Galbraith, 1973; Lawrence and Lorsch, 1967; Pugh et al., 1968; Thompson, 1967; Van de Ven et al., 1976
Personal	Temporary and permanent liaison roles, integrator roles, boundary-spanning roles	Lawrence and Lorsch, 1967; Tushman, 1977
Group	Cross-unit teams, task forces, ad-hoc teams, committees, integrative departments	Adler, 1995; Daft and Lengel, 1986; Thompson, 1967; Van de Ven et al., 1976

Impersonal mode refers to programming (March and Simon, 1958); integration is achieved by the use of pre-established plans, schedules, formalized rules, policies and procedures, as well as standardized information and communication systems (Child, 1972; Daft and Lengel, 1986; Galbraith, 1973; Lawrence and Lorsch, 1967; Pugh et al., 1968). The main characteristic of these activities is that a codified blueprint of action is specified. Hence, the action plan for task accomplishment is pre-established, requiring minimal human decision-making as well as minimal verbal communication for task accomplishment (Galbraith, 1973; March and Simon, 1958; Thompson, 1967).

Personal and group mode, on the other hand both relate to Thompson's (1967) coordination by mutual adjustment and March and Simon's (1958) coordination by feedback. In personal mode, organizational members serve as mechanisms for making the mutual adjustment either through vertical or horizontal channels in the organization (Child, 1972; Hage et al., 1971; Pugh et al., 1968). For example, in the lateral direction, personal mode involves establishment of specific assigned liaison and boundary spanning roles across projects (Lawrence and Lorsch, 1967; Tushman, 1977). In the group mode, the mechanism for mutual adjustment is in a group of

organizational members and organizational linkages are created for example through scheduled and unscheduled meetings, committee work, and teams (Adler, 1995; Van de Ven et al., 1976). These could involve personnel from either several projects or projects and the permanent organization.

Theoretical framework

Figure 1 illustrates the theoretical framework guiding our empirical analysis on managing integration in a program. We assess integration across both interfaces of project-to-project and project-to-organization (Lehtonen and Martinsuo, 2009) and follow the categorization of integration mechanisms into three modes of impersonal, personal, and group (Galbraith, 1973; Van de Ven et al., 1976).

Figure 1: Theoretical framework for empirical analysis

RESEARCH METHODOLOGY

Research approach and research context

In order to empirically study integration in the context of a global operations expansion program, we collected data using a longitudinal, single embedded unit case study method (Yin, 1990) and studied multiple projects within a single program. An embedded unit case study design is appropriate for the study because it facilitates developing an in-depth understanding of program management through a detailed analysis of integration across different organizational interfaces within a program. Furthermore, an embedded unit design is advantageous because it allows for the control of a number of different external factors that might affect the management of programs. And finally, recent research on organization designs in general has strongly recommended the use of qualitative studies when studying contemporary complex settings (Greenwood and Miller, 2010).

The case study is based on a multi-year research effort with a global Finland-based oil company Neste Oil. Neste Oil focuses on oil refining and marketing, specializing in low emission, high-quality traffic fuels. At the time of the research it had three main business areas: Oil Products, Renewable Fuels, and Oil Retail. The company's strategy has been based on growing both its oil refining and premium-quality renewable diesel businesses. Neste Oil has a market capitalization of around 3 billion Euros, an annual turnover of around 10 billion Euros, and employs around 5000 people.

We studied the program NextGen that Neste Oil set up to respond to the EU Directive on the promotion and use of biofuels for transport¹, which suggested that renewable fuels should account for 10% of all fuel consumption in Europe by 2020. In response, Neste Oil developed a

¹ Directive 2003/30/EC of The European Parliament and of The Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport

program in the renewable fuels business area and set a goal to become the world's leading supplier of renewable diesel. The program involved gaining a quick entry to market with small-scale production and the rapid expansion of production capacity on a global basis. Description of the case program is presented in the following section.

Data collection and analysis

The case study includes (1) a retrospective analysis of the development of renewable diesel technology and (2) a real-time study of the program to expand operations globally and simultaneous continuous development of it. We used several methods to collect data. Primary data were collected by semi-structured interviews (Patton, 1990). We conducted 36 interviews with key managers involved in the program including senior managers in the business organization of Neste Oil, project directors, and project managers involved in the various projects in the program, and managers in its engineering subsidiary. Interviews were conducted between October 2009 and June 2012. Interviews involved questions on personal professional background, project and program components and lifecycle, internal and external project organization and environment, project interrelations, knowledge sharing, and integration. In addition to these rather open-ended questions, interviewers prompted with more detailed questions when needed. Documents, such as project descriptions and organizational charts as well as the company's website, reports, post-project evaluations, press releases and articles in the popular press were used as complementary material.

We implemented several procedures to ensure high reliability of data collection. First, we developed a detailed research protocol in order to ensure systematic data collection and sent out an interview outline before each interview (Yin, 1990). However, to foster dialog and allow the interviewees to describe the phenomena without being constrained by the questions, we

frequently asked for clarification and posed more detailed questions. Second, at least two members of the research team conducted each interview; one led the interview and the other member(s) took notes to enhance the content of the interview (Eisenhardt, 1989). Third, interviews were recorded and transcribed into text in order to enhance data quality and reliability (Voss et al., 2002). Fourth, although we did some retrospective data collection as well, most of the interviews especially those regarding integration in the program focused on the current state of the organization to avoid recall bias and to enhance accuracy (Magnusson et al., 2004; Miller et al., 1997). Also, combining both a retrospective approach and a real time approach allows us to gain a rich picture of the program and its projects. Fifth, we analyzed the aforementioned primary and archival data to facilitate triangulation (Voss et al., 2002; Yin, 1990).

Following the guidelines of qualitative research (Patton, 1990), the data was analyzed as text. We coded the data in two rounds: first focusing on identifying instances of integration in the three modes of impersonal, personal, and group. We then analyzed these codings and classified the instances under a number of more detailed categories (Table 1). In the second round we re-coded the text with these categories. We also included which interface was integrated with the specific mechanism in the codes, which facilitates the analysis of how the two main interfaces (project-project, organization-project) are managed. After coding and initial analysis, we presented the findings to many of the interviewees in a face-to-face meeting with senior managers. This meeting allowed us to validate the findings (Voss et al., 2002). We specifically asked the senior managers to relate our findings to their experiences. The participants concurred that their experiences were consistent with our conclusions.

CASE PROGRAM: NEXTGEN

Neste Oil's efforts to develop the technology for renewable fuels dates back to the early 1990s when a number of research projects related to renewable diesel were started with some patents being obtained for specific process technologies, but these were discontinued by the mid-1990s due to a lack of clear business drivers. Around the turn of the century EU was preparing a directive on biofuels, which motivated Neste Oil to resurrect its research on renewable diesel in 2001². In May 2003 the EU announced the directive, which laid down targets for the share of biofuels in the transport sector of 5.75% by 2010 and 10% by 2020, creating a massive potential market for renewable diesel.

When the EU directive was announced, Neste Oil decided to implement a major program, NextGen, to enable them to move to the new emerging market. At that time Neste Oil's new technology, NExBTL, was ready to move from the laboratory into production scale and in late 2003 they began the basic engineering for an initial smaller scale plant (capacity of 170,000 tons p.a.) at its existing refinery and developed and implemented a program to globalize operations in this new business area. The whole program for building global operations at Neste Oil renewable diesel consists of a set of four interrelated projects – to develop the technology needed to produce renewable diesel, to set up a first commercial production facility to establish the viability of the technology in Porvoo (Finland 1), to build a second plant alongside the first reference plant (Finland 2), and then to rapidly build and put into operation two large-scale

² Neste Oil had developed a non-esterified renewable diesel, NExBTL, which has properties similar to petroleum diesel, which minimizes blending issues. It has a higher cetane level (for improved ignition), a lower cloud point (for better cold weather performance), higher renewable content, greater fuel stability (for better storage), a broader choice of feedstock, and lower NOx and other tailpipe emissions and greenhouse gas emissions compared to first generation FAME (Fatty Acid Methyl Ethanol) biodiesel.

plants (Singapore and Rotterdam) on a global basis. The timeline for the program is presented in Figure 2 below.

Figure 2: Timeline for the program

The first and the second production facilities Finland 1 and Finland 2

The project to build Finland 1, the first commercial production facility, was set up to establish the viability of the technology in full-scale production rather than in a laboratory environment. The investment decision was made in 2005. The capacity of the plant was set to 170,000 tons per annum, which made it one of the largest renewable diesel facilities in the world at the time. This plant was built alongside the existing refinery operations in Porvoo, Finland. This was considered important as it enabled the collocation of the scientists, engineers and technologists (i.e. those who develop the technology and design the facilities) with operations people (who operate and maintain the facilities).

In September 2006, Neste Oil announced its strategic aim to become the world's largest producer of renewable diesel and embarked on a more aggressive expansion. This involved first

the development of a second plant in Porvoo, Finland (Finland 2), with the same scale as the Finland 1 plant and second, projects for the creation of large-scale plants (capable of producing up to 800,000 tons p.a.) on a global scale. Neste Oil began to examine the possibilities around this large-scale global concept and started the search for suitable locations.

The decision to go ahead quickly with construction of Finland 2 alongside Finland 1 was made while the first plant was still under construction. This marked a departure from the normal practice in the company, as it was typical to have a plant in operation for a while first as a reference plant before expanding capacity in a new plant. The design and procurement for Finland 2 started before Finland 1 was commissioned in 2007. When starting Finland 2, many of the available resources were still deployed in the construction of Finland 1, which had run into a few operational problems. The decision to build the second plant was taken before they had time to reflect on the lessons learnt from the operation of the first plant. By the time Finland 2 was being built some of these lessons had been learnt and led to several changes in design of the equipment and materials being used in Finland 1. Preparation of the construction site for Finland 2 began in early 2007, with a planned mechanical completion in August 2008. But in September 2007 they made changes in the design reflecting the solutions to the issues that had arisen in Finland 1. This pushed back the completion date to May 2009.

The two large-scale plants Singapore and Rotterdam to build global presence

As shown in the timeline above (Figure 2), the program to become a global leader in renewable diesel included next a rapid expansion of capacity based on building two large-scale plants each capable of producing 800,000 tons per annum, four times the capacity of the two plants in Finland. The investment approval decision for the first global plant was given by the board in 2007 and for the second one in 2008, just six months later. This level of investment and

carrying out two huge projects simultaneously was a major departure from usual practice in Neste Oil and represented a significant risk to the company. The first large-scale plant in Singapore (capital expense of 550 million Euros) began operation in March 2011 and the second plant in Rotterdam (capital expense of 670 million Euros) started operations in November 2011.

To help speed up their entry into the new market on a global scale Neste Oil decided that the new global plants would be designed almost in parallel by developing a core design which could be used anywhere in the world whatever the local conditions. The logic for the plant location decisions was as follows. The first plant was located in Singapore to be close to the source of supply of raw materials as well as a growing Asian market for renewable fuels. It is also the third largest location for oil business and provides excellent infrastructure to support operations. The second plant was located in Rotterdam because it is a major port in Europe for ease of distribution to the strong European market for renewable diesel. Both are stand-alone plants yet the sites were nearby local providers of key production inputs and other essential utilities such as hydrogen, steam and water, and good jetty infrastructure. The construction work on both sites started in 2009. The process technology was the same in the two plants. Economies of scale were achieved by purchasing equipment simultaneously from the same suppliers for the two sites, e.g. reactors were ordered from the same supplier using identical design and drawings. Although both projects were originally meant to follow the same schedule, during the implementation phase, mainly due to some unexpected events related to the supply of key infrastructure such as jetty space and provision of wastewater facilities, the schedule of the Rotterdam plant was postponed for six months.

ANALYSIS OF INTEGRATION IN THE PROGRAM

In this section we engage in analysis of how integration was managed in the global operations expansion program at Neste Oil. Integration is analyzed on the two separate organizational interfaces: (1) project-to-project and (2) project-to-organization. The following analysis of integration is based on the classification into impersonal, personal, and group mode as discussed above (Galbraith, 1973; Van de Ven et al., 1976). The integration mechanisms used in the program are summarized in Table 2 below.

Table 2: Analysis of integration mechanisms in the program*

Mode / Dimension	Project-to-Project	Project-to-Organization
Impersonal	<p>Joint purchasing process of main equipment for Singapore and Rotterdam; purchasing done mainly jointly to get economies of scale and lower price but also to ensure similar equipment to facilitate easy sharing of information between projects.</p> <p>Similar operational systems chosen for Singapore and Rotterdam to facilitate development of common knowledge.</p> <p>Similar tag numbers for equipment and pipes in Singapore and Rotterdam to facilitate easy sharing of information between the projects.</p> <p>Similar maintenance tools for all plants in Finland 1 and Finland 2, Singapore, and Rotterdam to facilitate use of common knowledge.</p> <p>Online contact system between projects in Finland 1 and Finland 2, Singapore, and Rotterdam to facilitate information sharing.</p> <p>Standard project reports developed and shared between projects in Finland 1 and Finland 2, Singapore, and Rotterdam to facilitate information sharing in a standardized way.</p> <p>Standard post-project evaluations developed and shared between projects in Finland 1 and Finland 2, Singapore, and Rotterdam to facilitate information sharing in a standardized way.</p> <p>Error reports shared between projects in Finland 1 and Finland 2, Singapore, and Rotterdam to facilitate information sharing in a standardized way.</p> <p>Similar training for all project personnel in Finland 1 and Finland 2, Singapore, and Rotterdam to facilitate development of shared information. Also common training sessions for Singapore and Rotterdam personnel to facilitate sharing of information.</p>	<p>Online IT connections and data management systems from projects in Finland 1 and Finland 2, Singapore, and Rotterdam to business organization focusing on operations. Organization-level unit Technology Office (TO) compares this data feeding it back to projects; TO could see online and in real time operational performance of the plants and share information on a demand basis.</p> <p>Distribution of post-project evaluations to Neste Oil organization to facilitate sharing of information between projects in Finland 1 and Finland 2, Singapore, and Rotterdam and organization.</p> <p>Development of TO organization as an expertise pool to gather experience and knowledge from previous projects in the business organization; these included staff who had worked in previous projects.</p> <p>Projects owner's teams from Finland 1 and Finland 2, Singapore, and Rotterdam delivered information on the technology to TO on a regular basis to facilitate information and knowledge sharing between the projects and business organization.</p> <p>Distribution of project reports from Finland 1 and Finland 2, Singapore, and Rotterdam widely in the business organization to facilitate information sharing from projects to the organization.</p> <p>Development and implementation of similar governance model for projects in Finland 1 and Finland 2, Singapore, and Rotterdam at firm level to facilitate development of common reports, similar information and comparability of the projects.</p> <p>Development of common project procedures and guidelines at firm level to develop company level project capability in Finland 1 and Finland 2, Singapore, and Rotterdam.</p>

		Best practice plant model kept and updated by TO; model is based on experience from previous and ongoing projects in Finland 1 and Finland 2, Singapore, and Rotterdam and development work and will be used for any new plants.
Personal	<p>Moving key people from projects in Finland 1 and Finland 2 to Singapore and Rotterdam to transfer key capabilities and to facilitate use of common information and knowledge between the projects.</p> <p>Creation of informal contacts between the projects in Finland 1 and Finland 2, Singapore, and Rotterdam by various company activities, such as joint training, conferences, project sessions, job rotation, colocation of owner's teams for the projects.</p> <p>Transfer of personnel between projects in Finland 1 and Finland 2, Singapore, and Rotterdam, e.g. operators from Singapore were transferred to manage startup in Rotterdam to facilitate sharing of information and knowledge between the projects.</p> <p>Same systems integrator for projects in Finland 1 and Finland 2 to facilitate use of common information and knowledge in the projects and to serve as a liaison between the projects.</p> <p>Same main contractor and basic engineering for Singapore and Rotterdam to facilitate use of common information and knowledge in the projects and to serve as a liaison between the projects.</p> <p>Mostly same suppliers for both plants in Finland 1 and Finland 2 to facilitate use of common information and knowledge in the projects and to serve as a liaison between the projects. Mostly same suppliers also for Singapore and Rotterdam.</p> <p>Shared use of external consultants across projects in Finland 1 and Finland 2, Singapore, and Rotterdam to facilitate sharing of information and knowledge between the projects and to serve as a liaison between the projects.</p> <p>Use of same trainers for project personnel in Singapore and Rotterdam to facilitate development of common knowledge between the projects. Also common training sessions often organized to facilitate development of personal contacts and sharing of information.</p>	Rotation of personnel between all units and projects to facilitate knowledge sharing between projects and organization as well as gathering learnings from projects to the organization.
Group	Core teams partly same for both projects in Finland 1 and	Projects steering group meetings with corporate members

<p>Finland 2 to facilitate use of common information and knowledge in the projects.</p> <p>Same steering group members for Singapore and Rotterdam to facilitate development and sharing of information and knowledge between the projects.</p> <p>Scheduled weekly phone meetings between project teams in Finland 1 and Finland 2, Singapore, and Rotterdam to share up-to-date information and knowledge between the projects.</p> <p>Joint engineering team for Singapore and Rotterdam at the same premises in Rome where the owner's teams were too to facilitate development and sharing of common knowledge between the projects.</p> <p>Co-location of owner's teams for the projects in Finland 1 and Finland 2 in Porvoo as well as for Singapore and Rotterdam in Rome (Technip's facilities) to facilitate daily communication between the projects and to facilitate development of contacts between projects (especially counterparts in other project). This also facilitated communication and informal information sharing between the projects when the personnel moved to the sites.</p> <p>Organizing of joint seminars for projects in Finland 1 and Finland 2, Singapore, and Rotterdam to facilitate sharing of experiences and knowledge on managing and operating the plants as well as to facilitate development of new knowledge.</p> <p>Organizing joint lessons learnt sessions and post project evaluation for projects in Finland 1 and Finland 2, Singapore, and Rotterdam to facilitate sharing of information and knowledge between the projects.</p> <p>Learning through experience in operations, facilitated to all projects by TO: TO visited all plants in Finland 1 and Finland 2, Singapore, and Rotterdam to gather experience and they shared this to others by organizing visits and meetings at the other plants.</p> <p>Organizing of User's conferences for project personnel in Finland 1 and Finland 2, Singapore, and Rotterdam by TO to facilitate sharing of experiences and sharing of knowledge between projects and the business organization.</p>	<p>to facilitate sharing and development of information between projects in Finland 1 and Finland 2, Singapore, and Rotterdam and the business organization.</p> <p>Organization of User's conferences for project personnel in Finland 1 and Finland 2, Singapore, and Rotterdam by TO to facilitate sharing of experiences and sharing of knowledge between projects and the business organization.</p> <p>Co-location of global R&D in Porvoo, including experimentation with feedstock and other raw materials to facilitate development of common knowledge to be shared with all projects.</p> <p>Co-location of owner's teams for the projects in Finland 1 and Finland 2 in Porvoo as well as for Singapore and Rotterdam in Rome (Technip's facilities). Through selection of persons to the owner's teams and their co-location, this facilitated communication and informal information and knowledge sharing between the projects and the organization.</p>
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* TO = Technology Office

Integration in project-to-project interface

To manage integration in the project-to-project interface, the *impersonal mode* of integration was used in a variety of ways. The focus on integration in the project-to-project interface by the impersonal mode was mainly around the technical aspects of the projects, such as issues related to common production technology and raw material specifications, as well as standardizing various work processes. The impersonal mode of integration involved for example the creation of common designs and drawings for the plant projects, the use of same 3D models and simulations, as well as the development of standard documentation, common guidelines, procedures, and management tools across all projects. These are all mechanisms for facilitating information and knowledge sharing between the projects.

Integration with the *personal mode* in the project-to-organization interface, on the other hand, involved especially the transfer of personnel between the projects; the same people were involved in the different projects to ensure that crucial knowledge and information is shared between the projects. For example, the core project teams in the projects for Finland 1 and Finland 2 were the same to the extent possible and also whenever possible, the same people were recruited to both Finland 1 and 2 project teams. Due to the aggressive schedule for the program, they were simultaneously building the two plants. This meant that many were people were still working on Finland 1 so additional new resources were needed to build and operate the Finland 2 plant. Also, project people from Finland were transferred to be involved in the large-scale plant projects from early on and people with experience on the previous implementation and start-up in Finland were recruited to the owner's teams of the large-scale plant projects. Moreover, key personnel from projects in Finland were given central roles in the projects in Singapore and

Rotterdam, and were also involved in the start-up and commissioning of the plants in Singapore and Rotterdam to facilitate knowledge sharing between the projects.

A number of parties also served as a liaison between the projects to facilitate information sharing between the projects. For example, Neste Oil used the same system integrator. The first two projects in Finland were engineered by their subsidiary company, Neste Jacobs. However, its capacity was too small to manage systems integration of two large-scale plant projects in different parts of the world simultaneously. Therefore, the engineering, procurement and construction management (EPCM) of the two large-scale production plant projects was outsourced in 2007 to Technip, a systems integrator company with sufficient resources and well-proven capabilities to execute the projects. In addition, suppliers on the projects remained mainly the same, which worked as a liaison mechanism to facilitate sharing of existing knowledge between the projects.

Managing project-to-project integration with the *group mode* focused on developing various kinds of groups to facilitate sharing and development of information and knowledge between the projects. The core teams for both projects in Finland were almost the same. Furthermore, Neste Oil established projects' owner's teams for Rotterdam and Singapore to oversee the company's interest and to ensure that the projects were directed towards the firm-level strategic goals. Owner's teams were composed of key individuals from the project teams and from Neste Jacobs, Neste Oil's subsidiary engineering company, which had carried out the design for the Finland 1 and 2 plants. The owner's teams and the main contractor worked closely together to achieve the mechanical completion date. The owner's teams for Singapore and Rotterdam were co-located with Technip's people in their office in Rome for about a year while the detailed engineering design was being executed by Technip. The basic engineering package

that Neste Oil's in-house engineering people had developed for Finland 2 was transferred to Technip. During that phase, there was a daily dialogue between the two owner's teams and the Technip team. This was central in creating a common design, which could be applied in both locations and in any future large-scale plants. The main driver for having the owner's teams for the projects in one location physically was to enable them to share experience of the design; after the completion of the basic design, some of these people moved to the production sites having acquired knowledge on the basic design.

In addition, virtual teams, including key engineering managers who were also involved in the projects in Finland, were created to address specific problems or issues that might come up in the projects in Singapore and Rotterdam. Informal communication between members of the various projects was important and it was facilitated for example by various company meetings, conferences, joint training sessions, and numerous informal get-togethers. Based on the discussion above on how integration in the project-to-project interface was managed, we make the following observation:

***Observation 1.** The project-to-project interface is managed with various kinds of integration mechanisms of impersonal, personal and group modes.*

Integration in the project-to-organization interface

The *impersonal mode* of integration was also widely used in the project-to-organization interface and mainly facilitated by a formal organizational unit in the business organization called the Technology Office (TO). The TO was developed into an expertise pool and consisted of four managers – a general manager and three steering managers, who then oversaw projects staffed by teams of experienced people from different functions such as R&D, engineering, business development etc. The TO was given a role as an internal technology licensor and

accountability for developing the technology further, managing development projects and for managing all the technology-related knowledge such as process technology and raw material specifications. The three steering managers had responsibilities for their own areas: licensing services; technology development; and technology management. The TO also had a role as a central repository and knowledge center for all the technical knowledge via online information and data management system. It was given a role to gather information from the projects to the organization and to maintain the documentation related to the production technology as well as to ensure that all relevant information and best practices and policies are efficiently distributed to all the projects. The TO also managed a plant monitoring system, which ensured them access to all operational information from the plants. The system was used to collect systematic data from the projects to the organization and develop performance models and simulations to compare the different plants and feed the information back to the projects ensuring their efficiency.

Moreover, Neste Oil developed common project guidelines and procedures at firm level to ensure firm-level capability development. A similar project governance model was developed and implemented across the projects. They also distributed project reports and post-project evaluations to the business organization to facilitate sharing of information between projects and organization.

In addition, a team in the renewable fuels business unit was responsible for collecting information about the way the projects were running and sought to gather learning from the projects to gain efficiency improvements and to spread good practice relating to management of the projects. However, their role was more business-oriented, while the TO was more focused on management and development of the process technology.

In the project-to-organization interface, integration by the *personal mode* was less evident. Rotating project personnel between the projects facilitated sharing information and taking the lesson learnt from the projects to the permanent organizations when the rotated personnel were transferred later to the permanent organization. Integration by *group mode* was used to some extent to manage the project-organization interface. Like in the case of project-to-project interface, a number of meetings were arranged throughout the program involving people from the projects, engineering, and production to share lessons learnt and share knowledge between the project and the business organization. For example, the project steering group meetings were organized together with members from the business organization to ensure sharing of information between the project and organization. Also, annual Users' conferences were organized, involving plant personnel as well as technical managers and internal process people from the permanent organization to reflect issues related to plant performance and to learn from the different experiences around the various production facilities. Based on the discussion above on how integration in the project-to-organization interface was managed, we make the following observation:

Observation 2. *The project-to-organization interface is managed with various kinds of integration mechanisms of mainly impersonal mode and only to some extent with group mode.*

DISCUSSION

Taken together, the analysis above points out various kinds of integration mechanisms to manage integration within the program both at the project-to-project and project-to-organization interfaces. Moreover, the analysis indicates that the project-to-project and project-to-organization

interfaces were managed differently: while the project-to-project interface was managed with all three different integration modes (impersonal, personal, and group modes), project-to-organization interface was managed mainly with the impersonal modes, and only to some extent with the group mode.

Taken together, the results suggest that Neste Oil put more effort in managing the project-to-project interface than the project-to-organization interface, indicating a greater integration challenge in the project-to-project interface. Moreover, based on the information processing theory (Galbraith, 1973), the results indicate that uncertainty is greater in the project-to-project than project-to-organization interface as more elaborate integration mechanisms are used (i.e. personal and group modes). One explanation for this comes from the classical project management literature, which traditionally analyzes projects as independent systems, emphasizing the uniqueness of projects and the related uncertainty (e.g., Morris, 1983). Hence, based on this we could assume that there is more uncertainty in managing the interface between two unique interfaces than managing the interface between the organization and a project.

Another explanation for the findings comes outside the theoretical focus of our study. Previous research (e.g., Lehtonen and Martinsuo, 2009) suggests that the interface between program/project and organization is managed with various integration mechanisms but also boundary management and isolation activities play an integral role in managing the interface, at least in the context of change programs. Hence, integration mechanisms are only one way to manage the interface and complemented with other boundary management activities, which were outside the scope of this study. Moreover, it could be that in the program/project-organization interface legitimacy reasons are important for managing integration due to the need to justify the major investments for the program within the business organization and hence, information

processing mechanisms are more used in the project-to-project interface (Lehtonen and Martinsuo, 2008).

Contribution and implications

This study contributes to research on program management and management of complex technical systems in four ways: developing understanding on managing project-to-project and project-to-organization interfaces; providing detailed description of managing integration in programs; providing further knowledge to the contingency analysis of program management; and providing an empirical contribution to program management research by focusing on a global expansion program. The study also develops a bridge between program management and international operations management research.

Managing project-to-project and project-to-organization interfaces in programs. This paper develops detailed understanding on program management and management of complex technological systems (e.g., Davies, 2004; Hobday, 1998; Morris, 1983, 1994). Classical project research has tended to treat projects as independent and isolated entities, though with links to the external environment (e.g., Morris, 1983), paying little attention to interfaces between projects. Our findings highlight how programs are managed as complex organizations, including multiple interrelated projects as their parts. Moreover, the findings on managing project-to-project and project-to-organization interfaces are novel in research on program management. These results give further support to the importance of managing projects as programs in a coordinated manner (e.g., Ferns, 1991; Lycett et al., 2004; Morris, 2013; Pellegrinelli, 2011), including managing both project-to-project and project-to-organization interfaces.

Managing integration in programs. By elaborating the integration framework in the context of global operations expansion program, our study also contributes to understanding on

integration in a program context. The results point out that managers put significant effort in managing organizational integration in the program context both between projects and between a project and the organization. The analysis also points out that a number of integration mechanisms of impersonal, personal, and group mode are used to manage integration in these interfaces. Even though some of the recent research (e.g., Taylor and Helfat, 2009) put emphasis on the lateral type of integration and communication through personal and group modes in contemporary organizations, our results highlight that more traditional impersonal mechanisms such as standardization of operations practices and processes (Child, 1972; Daft and Lengel, 1986; Galbraith, 1973; Lawrence and Lorsch, 1967; Pugh et al., 1968), are still significant and widely used and play an important role in managing integration in the program context.

The identified integration mechanisms resemble some of the learning mechanisms for inter-project learning put forward by Prencipe and Tell (2001). These include for example job rotation, re-use of experts across projects, informal communication, and lessons learnt sessions. However, their approach to classification was different due to their focus on various knowledge processes and the level of learning across projects. Moreover, the mechanisms identified for managing project-to-organization interface resemble the practices for retention identified by Keegan and Turner (2001) for codifying learnings from projects and capturing them in the organization. These include for example lessons learnt sessions and various impersonal mechanisms such as project manuals, standardized processes and practices.

To summarize, our analysis points out extensive use of different types of integration mechanisms of impersonal, personal, and group mode. The study provides a detailed description of how integration is managed in a program context both across projects within a program as well as in the project-to-organization interface. This is important as integration is one of the key

issues in program management (Morris, 2013; Pellegrinelli, 2011). By addressing integration, the study complements prior research on program management, which has for example studied purely control in the context of programs (e.g., Nieminen and Lehtonen, 2008).

Contingency analysis of program management. The results of the study suggest that while the project-to-project interface is managed with an extensive set of impersonal, personal, and group modes of integration, management of the project-to-business organization interface is managed with mainly impersonal and to some extent of group mode as well. The use of the impersonal mode in the project-organization interface is supported by prior research, as the mode is inherently vertical in nature (March and Simon, 1958; Van de Ven et al., 1976) but can be used for a horizontal dimension, such as the project-to-project interface, as well. The finding that the personal mode of integration is more used for linking the projects is interesting. The personal integration mode is traditionally used more in the vertical dimension for decision-making (Van de Ven et al., 1976), which in this context would mean the projects-to-organization interface. This is also reflected in Thompson's (1967) idea of coordination by feedback. This finding, however, may reflect the need for more instant communication and information sharing between the projects beyond the regular meetings that are established for reporting to steering committees; the task-driven nature of the work is subject to the realities of program implementation where issues arise more unpredictably. Hence, organizational integration of the project-to-organization interface through the personal mode actually then, due to for example time-pressures, takes place through the group mode. It is mostly evident that organizational integration of the project-to-project interface with the personal mode by assigning for example some liaison persons (Lawrence and Lorsch, 1967; Tushman, 1977) focuses mainly on exchanging information rather than decision making purposes.

These results add to the contingency analysis of program management (e.g., Yu and Kittler, 2012) as they emphasize that different integration mechanisms are used to manage the organizational interfaces between projects versus between a project and the organization in the context of a program – i.e. management of integration depends on the organizational interface. Moreover, the results imply that when studying programs, we need to be specific about the various organizational interfaces as they are likely managed differently.

Program of global expansion. By focusing on a global operations expansion program, the study also provides an empirical contribution to program management research. In particular, recent research has mainly focused on studying technology development and innovation programs (for an extensive literature review, see Artto et al., 2007), or change programs (e.g., Lehtonen and Martinsuo, 2009; Nieminen and Lehtonen, 2008). Our study provides complementary knowledge on another type of “platform program” (Gray and Bamford, 1999) and its management. Developing understanding on management of programs in the global context is considered critical as it poses significant additional managerial challenges (Artto et al., 2011; Orr et al., 2011; Turkulainen et al., 2013).

Bridging program management and internal operations management. Finally, the study also provides a way to bridge international operations management and project and/or program management; we provide a complementary view to management of global plant networks as a program. Recent research on management of global operations emphasizes the plant network level view and analysis of operations on a global scale as a whole rather than individual plants (e.g., Cheng et al., 2011; Ferdows, 1997, 2006). The plant network research, however, takes a configuration perspective and mainly a static perspective to analysis of plant

roles within the network. This study also complements that stream of research by providing new approach to management of the network as a program with a common overarching goal.

Managerial implications

The study provides the following managerial implications. In particular, the research describes different ways of managing organizational integration in a program both in the project-to-project and project-to-organization interfaces. The study provides analysis tools for practitioners; the various practices and processes for facilitating organizational integration in the context of a global operations expansion program can work as a basis for analysis in how their organizations manage integration in programs currently both in the project-to-project and project-to-organization interface and how to potentially develop management of integration. The results could provide further ideas for managers in how to manage integration in the specific interfaces in various kinds of programs but also provide ideas for managing integration in various organizational interfaces.

Specifically the identified differences in managing project-to-project and project-to-organization interfaces are important from the managerial perspective. These findings can be used as the basis for analysis of integration in programs in practice; how is integration in the current state managed across the different organizational interfaces in a program? How does management of integration differ across the organizational interfaces? What roles do the three different integration modes play in managing the different interfaces? In particular, the conclusions about the contingent nature of managing organizational integration across the different interfaces in a program can be used as a basis for analyzing global expansion programs or any other kind of program in organizations. An important implication for managers is that as the findings indicate, the interfaces are managed differently, with more effort on integration in

the project-to-project interface than the project-to-organization interface. Due to the costs of integration in general, the results encourage managers to undertake careful analysis of where integration is needed and how the different interfaces could be managed in the most efficient and effective way.

Limitations and future research

We studied how organizational integration is managed within the context of a global operations expansion program and concluded that the integration mechanisms vary depending on the organizational interface (project-to-project versus project-to-organization). A single case study approach is justified for the theory elaborative approach used in the study, and one significant contribution of the paper is in understanding program management in a specific type of [global operations expansion] program. Despite this, we suggest that more data is collected in further research from other types of programs to develop further understanding of how integration is managed in different types of programs.

While our focus in studying integration was on internal integration within the boundaries of Neste Oil, future research could address external integration across formal organizational boundaries (e.g., with suppliers, contractors). The research on external integration would however require a different, complementary theoretical basis due to the issues related to governance among multiple organizations within the program's boundaries (Ahola et al., 2014). Moreover, empirical analysis could also benefit from other types of data, such as real-time observations: this type of data could provide more detailed understanding of how all information and knowledge is exchanged across the organizational boundaries, outside the more formal and established mechanisms.

Our focus was on integration of the organizational interfaces. Future research could complement this by looking at other aspects of boundary management between projects, program and organization, such as isolative activities and boundary-shaping activities (e.g., Lehtonen and Martinsuo, 2009).

Future research could elaborate our findings looking at the program management and its relation to program outcomes. Although the renewable diesel program at Neste Oil can be considered to be highly successful as Neste Oil is currently the global industry leader, we did not focus our analysis on the relation between the program management and the outcomes/goals in this study, but we left this for further research to be addressed with more extensive data. Future research could also take a temporal lens, as the interfaces are likely to evolve over time and subsequently also integration is managed differently in different phases of the program.

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