

# Management Control Systems and New Product Development Portfolio: Toward an Actor Network Perspective

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**Abstract** This paper investigates the issue of control in new product development (NPD) portfolio management. Drawing on Actor Network Theory framework, the study sheds light on the ties between people and technology in offering a deeper investigation of the way in which management control systems intrude on NPD projects executed around different company's business units. Our findings add to the growing literature on control in innovation activities, and place stress on control systems as heterogeneous actor-networks of aligned socio-technical interests. The field evidence, carried out at a division of a multinational company operated in the semiconductor industry, emphasize the control over NPD portfolio as a matter of power balancing and action at a distance. Three main control issues emerge from the case study: the conflicts in resource allocations, the interactions between various NPD projects managed at business level, and the tension between centralised and decentralised control.

**Keywords** Control systems, New product, Inscriptions, Portfolio

## 1. Introduction

The increasing complexity of new product development (NPD) projects has led to a debate about the way in which corporate control systems could support multi-projects management. Thus, there are increasing calls for research to examine the dynamic nature of control mechanisms at corporate level as they are constructed and as they perform the firm NPD portfolio, i.e., the whole of projects managed at business level.

Recent contributions in the area of management control put some emphasis on control activities of single projects (e.g. Davila, 2000). These contributions pointed out the general importance of the study of management control in project settings. Nonetheless, the implementation of management control systems (MCS) in innovative settings and multiple projects management represents a fundamental challenge for many companies and an interesting research focus for academics, little attention has been given to the relationship between projects and to the control of NPD portfolio at corporate level.

A number of recent empirical studies, in investigating how MCS affect innovation processes, focused on the corporate level (e.g. Mundy, 2010; Bisbe and Otley, 2004; Mouritsen

et al., 2009) or the business-unit level (e.g. Davila, 2000; Ditillo, 2004; Jorgensen and Messner, 2009, 2010), paying less attention to the interplay between the two levels. Nonetheless, the corporate level has implications in setting the context of management control at the project level (Sivabalan and Bisbe, 2012; Bonner et al., 2002), and the mechanism and control tools, as well as their applicability, may differ, depending on the different organizational levels.

However, a lack of knowledge still remains on how corporate control systems enable the balance and coordination between the NPD projects executed in different business-units. For these reasons, we aim at exploring how corporate control systems affect NPD processes implemented at business level, and the ways in which it can foster NPD portfolio management.

Then, in order to understand the role of MCS in NPD settings, we go further a "human centred" approach, and investigate the socio-technical traits underpinning innovation activities and control systems. In focusing on the interactions between actors, we highlight the actions prompt by both human and non human agents, overcoming the distinctions between "technical" and "social" accounting factors. (Callon and Latour, 1992; Ahrens and Chapman, 2004; Chua and Mahama, 2007). According to the aim of studying the micro context of the interactions, Actor Network Theory (Callon, 1986; Latour, 1987) is particularly fruitful for the study of the interactions between agencies (human and non human) involved in control systems on one hand, and in NPD activities, on the other. Drawing on ANT

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framework, we highlight the role of management accounting and control devices in constructing and exerting control at a distance, i.e., how the corporate control acts over business units' NPD. Moreover, this theoretical perspective allows us to explore the conflicts and controversies between actors (Briers and Chua, 2001; Alcouffe et al., 2008; Chua and Mahama, 2007), and to highlight the tension between corporate control system and business unit control systems.

Finally, in this paper we explicate how corporate control system comes to acquire its existence, meaning and influence through power mobilisation. ANT main concepts are mobilised to explain the evidence drawn from a case study carried out at a multidivisional company operating in the semiconductor industry. In particular, we report on the NPD portfolio management in this company.

An interpretive case-study approach is adopted in this paper. Thereby, from the case discussions, the initial ANT conceptualisation about the role of control in NPD projects are developed and enriched. Thereafter, we worked back and forth between the empirical data and the theory (Ahrens and Chapman, 2006) which was aimed at explaining the role of corporate control system in NPD portfolio as the result of ongoing socio-technical interactions. By doing so, we extend the exiting literature in management control, since we offered a detailed account of how control over NPD portfolio emerges as an exercise of power balancing and action at a distance. This allows managers, at corporate level, to exert control on NPD projects implemented at business level through the presence of inscriptions that enable corporate control system to act at a distance. Therefore, we elucidate how corporate control system in NPD portfolio may be supportive in managing the tension between centralised and decentralised control, conflicts in resource allocations and interactions among various NDP projects executed in different business units.

The work is organized as follows: the following section (2) presents an overview of the concept of project development portfolio; section 3 describes the literature relating to management control at corporate level. Then, section 4 describes the research methodology which guided the explanatory case-study and introduce the case setting. Section 5, drawing on ANT framework, discusses the case data in order to provide a theoretical conceptualization of the role of control in NPD portfolio. Finally, section 6 concludes with a summary of the findings, limitations and future research directions.

## 2. Theoretical Framework

### 2.1. The Concept of Product Development Portfolio

In studying new product development (NPD), researchers have applied different functional perspectives such as a marketing orientation (Wind and Mahajan, 1997), design engineering orientation (Suh, 1990) or manufacturing orientation (Ettlie, 1995). Furthermore, they have examined NPD initiatives at different organizational levels of analysis

such as the firm or business unit (Capon et al., 1992), the product development portfolio (Meyer et al., 1997) or the individual development project (Clark, 1989; Rosenthal, 1992).

Several academics have pointed out the need to balance between project and ongoing functional work activities (Gerwin and Susman, 1996), and balance between a single project and a portfolio of projects (Adler et al., 1995; Meyer, 1977; Muffato and Roveda, 2000). The idea of a balanced portfolio is based on modern portfolio theory by Markowitz (1952, 1991).

Research on multi-project management has witnessed a renewed interest shown by both researchers within the field of project management (e.g. Engwall and Jerbrant, 2003), and by researchers on product development (Cusumano and Nobeoka, 1998). The growing interest is presumably explained by the fact that the success or failure of a single project is, in many cases, explained by its relationship with other projects. Consequently, success cannot be studied and explained only by studying the single-project level (Pinto, 2002). Moreover, several authors have highlighted the importance of companies developing multiple product development projects in order to minimize development time, engineering cost and managerial complexity. Especially in electronic, automobile and software industries, featured by increased speed, variety and reliability in product development, firms need for a multi-project strategy in new product development management (Meyer, 1977; Muffato and Roveda, 2000; Nobeoka and Cusumano, 1997). In particular, sharing critical technologies across a portfolio of projects allows firms to compete effectively in a hypercompetitive environment (Ilinitch et al., 1996; D'Aveni, 2010), where new products initiatives are one of the most important key competitive success factor (Drejer and Gudmundsson, 2002). In addition, a number of researchers argues about the value for firms of developing product development platforms where already existing and new technologies are allowed to be leveraged and transferred among different new product development projects. The concept of platform is quite popular in product development and operations management settings and it affects production and logistic processes, development processes, project organisational structure, or more generic knowledge and know-how transfer among projects. Nonetheless, in literature there are several platform concept definitions, general production oriented, as Muffato and Roveda (2000) pointed out, in the present work we assume the general Meyer's definition as a set of subsystems and interfaces intentionally planned and developed to form a common structure from which a stream of derivative products can be efficiently developed and produced (Meyer and Lehnerd, 1997). This in return exposes the relevance of activities and practices that multiple product development may conduct in order to sustain the competitive advantage for firms (Barney, 1991).

Besides, the multi-product approach has been deeply studied related to the platform strategy concept (Meyer and

Lehnerd, 1997; Shenhar et al., 2001; Meskendahl, 2010). Current literature highlights the importance of project portfolio management in evaluating, prioritizing, and selecting projects in line with strategy (e.g. Cooper et al., 2001; Englund and Graham, 1999). It is pre-eminent in choosing the “right projects” and therefore an important part of strategic management in organisations. Then, portfolio management (Dietrich and Lehtonen, 2005) is a matter of strategic choices and balancing among a number of projects, resources and capabilities available. Portfolio management is a dynamic and uncertain process whereby new projects are evaluated, selected and prioritized, and resources are allocated among different initiatives. (Cooper, et al., 1999).

According to project management literature, a portfolio has to be balanced along a range of dimensions to provide the best value to the organisation (Archer and Ghasemzadeh, 1999). However, there is no consistent convention on the dimension to cover. According to Chao and Kavadias (2008) and Chao et al. (2009) success for project portfolios on new product developments requires the balancing between short-term benefits from incremental improvements of existing products and long-term benefits achieved through radically new products and services. The objectives of project portfolio management suggested by Cooper et al. (2002) are well established in the project management literature (Elonen and Artto, 2003; Killen et al., 2008; Martinsuo and Lehtonen, 2007). The main goals are: maximization of the financial value of the portfolio, linking the portfolio to the firm's strategy, and balancing the projects within the portfolio in consideration of the firm's capacities.

However, the NPD process management problem is more complex when companies manage a portfolio of NPD projects at once. In a multi-project NPD environment, organizations tend to micromanage their NPD portfolio, ignoring the interactions and interdependencies between projects. Instead, scarce development resources should be managed from a NPD system perspective and allocated to maximize the value of the whole portfolio. Many different authors have provided models, tools, and techniques to help managers to control NPD projects more effectively. As Chao and Kavadias (2008) pointed out, the critical features affecting NPD portfolio are:

- strategic alignment: NPD activities influence the firm's strategy in the medium and long term future;
  - resource scarcity: resources allocation and their scarcity are a critical factor in NPD portfolio success. Project managers need to allocate resources effectively among different projects;
  - project interactions: managers should consider NPD technical aspects related to synergies or incompatibilities among different projects;
  - outcome uncertainty: NPD outcomes are highly uncertain. NPD Managers face technical risks related to the overall functionality of the product, and market risks related to the adoption of the product by the costumers.
- NPD portfolio management faces a difficult challenge

because resources must be allocated between innovation programmes and each program may represent conflicting directions in terms of corporate strategy. It requires a critical trade-off: short-term benefits accrued through incremental improvements versus long-term benefits achieved through radical or new-to-the-world products and services (Tushman and O'Reilly, 1996).

## 2.2. Corporate Control Systems in Managing NPD Projects Portfolio

The effective use of MCS at different organizational levels is a critical matter to ensure strategy implementation, to enable coordination and to ensure the achievement of a multidivisional company long term objectives (Anthony, 1988; Ouchi, 1979; Otley and Berry, 1980; Child, 1977). As a firm grows in size, top management has to avoid the coordination of different divisions, especially among R&D departments involved in NPD projects. Head quaters multidivisional firms control over their subsidiaries has been recognized by researchers both in the literature of organization theory and multinational management (Jaeger, 1983; Baliga and Jaeger, 1984) and in management accounting literature (Carmona et al., 2002; Ezzamel and Willmott, 1998; Bloomfield and Combs, 1992; Granlund and Malmi, 2002; Quattrone and Hopper, 2001, 2005). Nonetheless, these studies suggested the relevance of corporate control systems in fostering control between HQ and divisions; however, a lack knowledge still remains on how corporate control systems exert control over innovation initiatives and, in particular, in NPD projects managed around the subsidiaries. Moreover, recent empirical studies investigating on how MCS affect innovation, have focused on the corporate level (e.g. Mundy, 2010; Bisbe and Otley, 2004; Mouritsen, 2009) or the business-unit level (e.g. Davila, 2000; Ditillo, 2004; Jorgensen and Messner, 2009, 2010), paying less attention to the interplay between the two levels.

Control over NPD portfolio management involves both corporate level and of course, the divisional level, since the projects are managed around different subsidiaries. Still, a lack of knowledge remains on how corporate MCS influence a NPD portfolio's projects in multidivisional companies. In such contexts, the corporate level or top management control exhibits higher need for aligning and motivate the resources involved in the different initiatives, communicating the project objectives, analysing and comparing the outcomes of the portfolio's projects (Chiesa et al., 2009; Sivabalan and Bisbe, 2012), and enabling the coordination and the achievement of the multinational company long term objectives. The identification of the main stuffs implicated in the design and implementation of MCS in a multidivisional company can be referred to as two streams of research. On the one hand, to the traditional organizational model in ways that suggest important links among strategy, environment, technology, organizational structure and MCS (Langfield-Smith, 1997; Chenhall, 2003) and the MCS

literature on innovation, especially in multidivisional firms, which emphasized the coordination, the level of autonomy and the control of subsidiaries as critical matters. On the other hand, another stream of research has focused on the use of management control mechanisms at corporate level (Tillman and Goddard, 2008) and on the use of strategic-related information in NPD decision making (Hertenstein and Platt, 2000; Poskela and Martinsuo, 2009).

In the current literature, many influential studies have focused on detailed descriptions of control mechanisms used by corporate management to regulate and coordinate subsidiaries units (Bruns and Waterhouse, 1975; Chenhall, 2003; Merchant, 1981). In such contexts, the most important aspect of control is the level of autonomy given to the R&D units and how head quarter managers influence them. Particularly, in multinational company managers often use various coordinating mechanisms, as direct observations, standardization of input skills, processes and outputs to integrate various units. These studies have increased the current understanding of MCS at corporate level, giving valuable insights into the applicability of three main modes of control in multidivisional firms: centralization, formalization and socialization. These modes are generally established in the organization theory literature (e.g., Etzioni, 1961; Ouchi, 1981; Pugh et al., 1968; Vancil, 1979), and they have been used to model parent–subsidiary relationships in multinational companies (Cray, 1984; Gates and Egelhoff, 1986; Ghoshal and Nohria, 1989). In the centralization, decision-making power is retained at the headquarters, in the formalization mode, the decision-making is routinized through rules and procedures. Finally, in the socialization mode, organization members develop common expectations and shared values that promote decision-making. These contributes are basically contingency studies which focused on cultural and bureaucratic control as the dominant control systems used by corporate management to control their subsidiaries (Baliga and Jaeger, 1984). In these studies the centralization vs. decentralization debate is the main matter. The age of the organization, its size, the industry in which it operates and the relationship between the environment and the organization affect the degree of bureaucratization and centralization (Stinchcombe, 1959; Merchant, 1981; Chenhall, 2003). Bureaucratic control (Child, 1972, 1977; Ouchi, 1979), influenced by the ideas of Weberian bureaucracy, is based on a set of impersonal and codified rules and procedures which allow to monitor and direct subordinates. Individuals must accept the organization's authority, learn organization's rules and follow them.

A number of contributions (Merchant, 1981; Simons, 1994; Dermer and Lucas, 1986; Marginson, 2002) state that the use of hierarchically based administrative controls facilitates the devolution of role responsibilities through the firm and enables managers to monitor and evaluate their subordinate performance. In the bureaucratic system, the interactions between headquarters and subsidiary occur via consultation of rules and regulations, formal and impersonal

contacts such as reports and written directives. It is based on a greater usage of company manuals, and a higher degree of impersonal communication in the form of written reports. This form of control is generally equated with the notion of centralization. The authority of middle and lower managers is limited. Unskilled tasks and standardization of work processes and outputs allow the authority to achieve coordination between subsidiaries and headquarters, which in order to effectively exercise power, tends to centralize operations at corporate level.

Cultural control or value control refers to the use of different mechanisms based on values, beliefs and expectations shared by the organization's members. These studies recognize the role of corporate culture as adaptive and regulatory mechanisms (Ouchi, 1981; Jaeger, 1983; Smircich, 1983; Baliga and Jaeger, 1984).

Compared to bureaucratic control, cultural control is generally related to high levels of delegation. Control is more implicit and informal, and even if explicit and formal control mechanisms are applied, cultural control is essentially based on a pattern of practices, values and beliefs which guide the employee's behaviour in line with the organization objectives. Individuals develop a moral commitment to the organization (Etzioni, 1980) and the communication between headquarters and subsidiary is monitored through interpersonal interactions and personal contacts, such as visits and telephone calls, meetings and retraining sessions. Moreover, the transfer of managers from subsidiary to subsidiary is a control strategy which allows the firm to create international and interpersonal networks (Jaeger, 1983).

Finally, another line of inquiry has highlighted the nature of centralization-decentralization dichotomy according to a different concept of geographical distance. In fact, previous contingencies contributions ignored virtual distance and how it is created by organisational practices and accounting categories (Kirk and Mouritsen, 1996; Robson, 1992; Bloomfield et al., 1992; Granlund and Malmi, 2002; Quattrone and Hopper, 2001, 2005). The dichotomy between controllers and the controlled and the distance between them is based on a recursive process of constructing and accumulating information. As Quattrone and Hopper (2005) pointed out, advancing a non linear notion of space and time, accounting numbers, budgets and other management control tools promote long distance control and at the same time create it. Furthermore, a critical issue, at corporate level, concerns the use of MCS to strategy formulation and implementation. During the past decades, the turbulences and changing featured competitive and technological environment have stimulated a great deal of interest about the use of management accounting practices to support strategic involvement in and support of management decision-making. Especially, for firm operating in high-tech industry and investing in innovation activities, the effective use of MCS at corporate level is strictly related to strategy formulation and implementation. Several characterizations of strategy processes have been proposed by strategy

researchers since the early 1980s (Bhimani and Langfield-Smith, 2007). One stream of research studied strategy in a prescriptive view, whereby strategy is regarded as a statement of intent that is proactive, consciously, formally and rationally planned prior to decisions and actions in a sequential process of formulation followed by implementation (Langfield-Smith, 1997).

On the other hand, other researchers have thought of strategy as adaptive, incremental, and emerging spontaneously in response to unpredictable external threats and opportunities, through experimentation and trial and error (Mintzberg, 1979, 1987, 1994). For firms operating in non stable environments, adaptive strategy is needed to achieve success and competitive advantage over time. Where strategy formulation has less of a predetermined and deliberate orientation, the constraints and discipline imposed by formal MCS are likely to be counterproductive (Langfield-Smith, 1997, 2007). For these reasons managers are likely to be more predisposed to require less formal forms of MCS (Auzair and Langfield-Smith, 2005). The use of management accounting and control systems to this end is generally called strategic management accounting (SMA). Simmonds defined it as "the provision and analysis of management accounting data about a business and its competitors, for use in developing and monitoring business strategy" (Simmonds, 1981: 26). Nonetheless, the term SMA is used to a number of variations, because there is still no agreed conceptual framework about what constitutes SMA. SMA embraces the management accounting techniques with a clear strategic focus, with future-orientated stance and explicit external focus. Additionally, SMA relies greatly on non-financial measures in contrast to the traditional management accounting systems, which tend to be mainly financially oriented, putting on more emphasis to financial evaluation. Reports and other management control tools rely not only on financial information but, more importantly, on non-financial indicators of strategic priorities (Bhimani and Langfield-Smith, 2007; Seal, 2001, 2006).

### 3. Research Methodology

In social science, there exists a certain tension between the research object and the analyses implemented in order to appreciate a given phenomenon. In this perspective, Quattrone (2004) underscores that research method is not a neutral tool, but rather itself addresses the research. During research analyses, authors try to figure out how they make sense of their firm understanding. Beyond the technical criterion of research methodology, rigorous studies have to provide good justifications of methods implemented to reduce the above mentioned tension.

This paper is based on a qualitative case study. The exploratory nature of our research question, together with the complexity and embedded nature of the phenomenon under study, are the main drivers of this methodological choice. We focus on a single case in the hope of providing

distinguishing insights. We maintain that the use of a case study approach is suited to the purpose of exploring the use of inscription to manage the multifaceted, situated, embodied aspects of MCS in NPD projects.

We take into consideration the interactions among the various actants (human and non human) involved in NPD settings. That means studying the actors' relations and paying attention to the network in which they work (Callon, Law and Rip, 1986; Czarniawska, 1997; Chua and Mahama, 2007). In focusing on the interactions between actors, we are interested in paying attention both to individuals, objects and inscriptions (costing systems, reports, material documents, machines), bypassing the distinctions between "technical" and "social" accounting factors (Callon and Latour, 1992; Law, 1992; Ahrens and Chapman, 2004; Chua and Mahama, 2007).

In order to investigate the research subject, a micro research approach is mobilised. In accordance to this statement empirical data are analysed as collective products created by practical procedures and background assumptions of participating actors. (Knorr-Cetina, 1981: 13).

#### 3.1. Theoretical Sampling

Given the aim of this work, "to optimize understanding of the case rather than generalization beyond" (Stake, 1995), we conduct an explorative study in *AB Micro-conductor*<sup>1</sup>, a multinational company, which allowed us to develop an understanding of the way in which corporate may be helpful in managing the tension between centralised and decentralised control, conflicts in resource allocations and interactions between various NPD projects executed in different business *AB Micro-conductor units*.

The breadth of business portfolio includes: Industrial and Multisegment Sector, Home Entertainment, Automotive Product Group and Computer and Communication Infrastructure. We underscore some characteristics of *AB Micro-conductor* that support the choice of our case setting:

1. *AB Micro-conductor* operates in the semiconductor industry, where competition is based on competitive and technological innovations;
2. *AB Micro-conductor* is highly focused on product innovation;
3. the company's NPD processes are highly structured and their protocol certified.

The observations at corporate level allows us to analyse how both the social and technical aspects underpins the role of control in innovation activities. Specifically, the case research allows us to recognize the appropriateness of corporate control mechanisms in fostering NPD portfolio management, and so to shed light on further aspects neglected by the theory.

#### 3.2. Data Sources and Protocol of Analysis

According to the unnecessary separation between

<sup>1</sup> Pseudonym

description and explanation claimed by the theoretical perspective adopted (Briers and Chua, 2007; Latour, 1991), we will analyse the product development stages in the next section, constructing the story as a theorized account (Alcouffe et al., 2008). Our analyses concerns the NPD projects at corporate level.

We collected the field material reported in this study over a ten-month period from September 2012 to July 2013. In line with the ANT ontology calling for the ‘symmetrical’ approach of humans and non-humans, we do not rely on humans as the main information source, but we recognise people, texts, symbols, and technologies play an equally essential part in the construction of actor-networks (Cressman, 2009).

Since we acknowledged most of the empirical material in the aftermath of events, in order to avoid possible mistakes in their recall from our informants, we used multiple data source and processes of triangulation throughout the whole fieldwork and afterwards, so as to be more confident of conclusions. This process of cross-verification not only included the use of different sources, spaces, methods and categories of actors, but also implied the return to some of the same interviewees at different time intervals between 2012 and 2013, especially when contradictions occurred. Our data-base is composed of 15 interviews: 10 one-on-one interviews and 5 group interviews. In order to facilitate the analysis of the material gathered, we tried to maintain, as much as we could, the same broad questionnaire structure for each of the categories of actors identified and engaged. For example, whereas the first question was usually an open and general one concerning the way in which control influences NPD projects, the next gradually tended to turn into more specific network-related issues. Most of the interviews were recorded, so we were able to compare the notes we collected during the meetings with the transcribed information extrapolated from the interviews. This way of collecting data, helped us to confirm or reject the knowledge about the field, avoiding risks of influencing our informants.

Additionally, we spent about 30 days in direct observations within the firm using ethnographic approach. We made field notes of the observations of project selection meetings, product development meetings, functional and executive manager meetings, interviews and other discussions related to product development activities. Finally, we analysed other various sources such as: company archives, reviews, manuals and other internal documents.

#### **4. The Control of Multiple New Product Development Projects. An Actor Network Theory Approach**

In this section, the collected empirical material is presented in accordance with ANT framework. We report on the NPD portfolio management in *AB Micro-conductor*. ANT framework is fruitful to explain the way in which corporate control system affects NPD portfolio. To this end,

we refer to control system as well as NPD portfolio as ongoing socio-technical networks.

Thereafter, we worked back and forth between the empirical data and the theory (Ahrens and Chapman, 2006) which was aimed at reconstructing and explaining the role of corporate control system in NPD portfolio. According to this theoretical perspective, we can refer to NPD portfolio management as a matter of control at a distance and power mediation between centre and periphery, i.e., the NPD portfolio at corporate level and the NPD projects managed at business level by different divisions.

We assumed that ANT (Callon, 1986; Latour, 1987) would be particularly useful for our study for three reasons. First, it provides a framework for conceptualising NPD portfolio (the whole of firm NPD projects) and corporate control systems as socio-technical networks including humans and a series of heterogeneous animate and inanimate elements, i.e., “actants”. Second, ANT proponents refuse to pre-empt the identity of actors independent of the relations or effects they might have within a network (Latour, 1988). In addition, according to general symmetry principle, actants are assumed to be equal to human actors.

The dichotomy between the social and the technical traits of control system and the company NPD portfolio is solved by the perception that both are intertwined. With a view to understanding the role of corporate control system in NPD portfolio, these actors need to be studied without imposing a priori definitions or expectations on them in order to avoid a priori distinctions between the technical and the social. Indeed, actants are both technical and social. This ontological symmetry is fruitful to conceptualise the role of control in NPD activities as a socio-technical creation. This implies that this network of alliances is created because people and things are “aware” that the project can advance their own interests, according to the role in the project they have been assigned.

Drawing on ANT framework we conceptualise NPD portfolio as an actor creating an actor-network by which individual interests are aligned with the organisational objectives. The documents related to the NPD portfolio are therefore inscribed to engage the actors to take collective action and legitimise the action of the focal actant, i.e., the corporate control system, on other actors. Consequently, NPD portfolio itself becomes unproblematic and uncontroversial. At this point the actor-network is stable and irreversible. This is ensured by the presence of a central actant: the control system which acts at a distance and fosters long distance control (Robson, 1992; Quattrone and Hopper, 2005). This is in line with Kirk and Mouritsen (1996) who argue that corporate control system creates and presents certain financial and economic relations which allow to assimilate headquarters and subsidiaries as a set of relationships that are produced to facilitate interaction and control. Management control system in *AB Micro-conductor*, according to the dimension of a multidivisional company, is implemented according to three organisational levels: corporate level, product group level and divisional level. At

corporate level, control system in *AB Micro-conductor* concerns the whole company and is managed by a corporate control manager who supervises the economic and financial performance according to the company's strategic plans. At product group level, the financial controller monitors the key performance indicators related to each product family and refers to the corporate financial manager and his staff. Finally, Divisional control concerns the control of each division and their business units. The Financial Controller at this level ensures that business-level strategic decisions are in line with corporate objectives. The control of NPD portfolio in *AB Micro-conductor* is essentially a matter of economic and financial measures, e.g., growth, profitability and productivity related to the *Enterprise Resource Planning* (ERP) system. Therefore, the main purpose is to monitor NPD projects performance in relation to key financial and strategic measures in order to make sure that the corporation is creating value. Each R&D or NPD project is monitored through a specific software: the *MPT- Master Project Table – Table System*. This software allows to “upload” all the projects managed in the division and it is related, at corporate level, to the *SAP- Systems, Applications and Product in data processing*. The MPT system at divisional level is interfaced with the SAP system at corporate level. When a new project is uploaded in the MPT system, in the SAP system an alphanumeric code, i.e., the internal order (I.O.), is generated and associated to the project. When a NPD project is launched it is formalized in a document called (NPR) *New Product Request* and moved on to maturity level 10. Then, it is inserted into the (PRIS) *Product Referential Information Systems*, which is a software package at corporate level, related to the SAP system, containing a list of all the NPD projects managed in the company.

Figure 1. Project status

| MPT Project Status | MPT Project Status description     | SAP I.O. Status code | SAP I.O. Status description |
|--------------------|------------------------------------|----------------------|-----------------------------|
| 01                 | Insertion                          | 10                   | Open                        |
| 10                 | Development (R&D active)           | 10                   | Open                        |
| 30                 | Production (R&D for maint/support) | 10                   | Open                        |
| 60                 | Stopped                            | 20                   | Blocked                     |
| 90                 | Closed                             | 30                   | Closed                      |

Source: Internal document

In accordance with ANT, the SAP system acts at a distance and make NPD projects, managed in different subsidiaries, “visible” to the corporate level. (Kirk and Mouritsen, 1996). Indeed, all the projects are integrated into the corporate management control and reporting system. The report exemplified in fig. 1 points out the data integration between SAP system at corporate level and MPT system at business level. The I.O. code allows managers to allocate the costs over the different projects which are still “opened”.

#### 4.1. Managing NPD Projects Portfolio as a Balance between Centralisation and Decentralisation

The cost control of each NPD project is taken at business level where different projects are run under the supervision of the respective cost centre manager who reports to the Program Manager. At corporate level, the degree of communication on technical and economic information relating to NPD projects is proportional to the project's strategic relevance. The Program Manager draws all information on the resources required, on technical aspects, delivery, needs for modification, etc. Then, he prepares a report and communicate it to the NPD Product Portfolio Manager.

As emerged during the field observations, corporate control over different NPD projects is a matter of mediation between two calls for control: the requirement for flexibility and decentralised control on NPD projects at business level and the requirement for centralised control, as well as call for NPD portfolio alignment to strategic objectives. This is confirmed by one Corporate Financial Controller who reported: “*We rely on NPD protocol prescriptions...but our main request, at business level is to ensure that divisions are running rationally according to set budgets and goals.*”

An illustration is provided by the revising of a relevant NPD project.

This example enriches the content hitherto presented. The situation is that the HQ stressed on high technical project requirements and called for strictly time schedule about a strategically relevant NPD project. Indeed, when one business unit manages a critical NPD project, detailed profit planning and reports, which embrace almost every a spect of projects' operations, convey performance information from the business unit to the corporate level.

However, since the project was extremely complex, the business unit claimed it needed more time to complete it. This time was claimed to be essential to tailor the product to the prescriptions that were necessary for managing all the project phases effectively.

This point was supported by the argument claimed by one Product Engineer. His resistance was expressed as follows: “*The project is technically complex, we need more time for prototypes tests...we need more time!!!!...we asked our supplier to provide us a modified component...and we are waiting for it.*” And the Program Manager added : “*As you know, this project is a high priority for the corporate (level)... they (corporate managers) ask each month information about it... they are monitoring the project constantly.*” In order to strengthen these arguments, the Financial Officer replied: “*We do not have so much autonomy in managing relevant project like this. The financial targets are well established and we have to deal with them. They (senior managers) control the project closely... they impose to deal with budget objectives and no mistakes will not be tolerated.*” The Program Manager claimed: “*Guys, there is always a tension between respecting financial targets, which lead to*

*improve a project efficiency, and the time needed to be able to work in a creative way. However, costs variation or lead time often mean that we did not work well. However, the main challenge is to respect the directives coming from corporate level in the most effective way.”* Nevertheless, this point was reinforced by one Corporate Manager who stated: *“At corporate level, we try to face with the need to apply the rules contained in the NPD protocol and to deal with financial targets. In addition, we try to take into account the freedom requirement and flexibility emerging at business level...we are conscious that, at business level, you deal with uncertainty and, in some case, you need more flexibility...but we have to optimize our NPD portfolio value. That means that decisions regarding prioritization and selection of projects have to fit with our company strategic plans. We need to manage each project according to its strategic relevance”*.

As it can be detected from the above arguments, a number of NPD projects managed by the business units are of higher priority. This means that these projects define much of the restrictions for other projects in terms of resources and attention. However, the tension between the pursuit of centralised control at the corporate level and the call for decentralised control at the business level is faced by imposing to all NPD program managers the requirement to use standardized work procedures that allow them to achieve a better control and a more effective resource allocation.

Because of this pressure, NPD managers at business level are forced to prioritise some projects and stop other ones. The tension aroused in such occasion was solved as follows. Senior managers at corporate level were responsible for planning and scheduling the project, then, managers at business level had to require materials, award suppliers and subcontracts, as well as manage the overall technical operations. Throughout the life of the project, NPD team had to maintain an on-going communications with the corporate level and they could negotiate with senior managers about time schedule or technical requirements, but always respecting the NPD protocol procedures and in line with company strategy.

Therefore, in ANT terms, this implies that the boundaries of control network are not restricted to the management control system at business and corporate level, but they are extended to the strategic control system. Then, the ability of corporate control system to foster that orchestration between centralisation and decentralisation depends on its ability to act according to a strategic view.

The link between strategy and control system, thus, emerges since they are used interactively. Control system configures itself as both processes and instruments through which the organisation identify, communicate and execute its strategy.

Corporate level is involved with the formulation of plans even if the business unit has a certain degree of autonomy for budget proposals. Corporate Managers regularly compare actual results with budget financial and non financial targets. Moreover, they put high priority on monitoring periodically

(monthly) financial results of critical and strategic relevant projects.

The tension arising from decentralisation and centralisation control is balanced through a negotiation of financial and non financial targets. Key activities are standardized and corporate level provides a clear sense of direction and control for critical projects.

Nonetheless, business units need to operate autonomously to maximise projects performance and to search opportunities coming from the projects managed. Nonetheless, corporate control is essential to prevent dysfunctional behaviour which could destroy corporate value. Moreover, this evidence is consistent with the work by Cooper et al. (2002), which is one of the main contribution to the project management literature. According to it, a portfolio has to be balanced along a range of objectives to provide the best value to the organization, i.e., maximization of the financial value of the portfolio, linking the portfolio to the firm's strategy and balancing the projects within the portfolio in order to minimize development time, engineering costs and managerial complexity (Wheelwright and Clark, 1992; Sanchez, 1995; Muffato and Roveda, 2000).

From the field evidence reported above, we notice how technical and accounting documents, i.e., cost reports, software control package, etc., foster to exert a centralised control at distance on NPD projects managed in subunits which call for decentralised control.

Therefore, according to Quattrone and Hopper (2005), to understand how distances between centre (i.e. the corporate level) and periphery (i.e. the divisional level) is managed and how the corporate HQ operates controls over NPD projects managed by periphery, attention must be devoted to inscriptions. We recall that inscriptions are “transformations through which an entity becomes materialised into a sign, an archive, a document, a piece of paper, a trace” (Latour 1999: 306). These signs could take the most diverse forms: wheels, trees, hierarchies, and logical maps.

For instance, the report transmitted by the Program Manager to senior managers at corporate level, especially to the NPD Portfolio Manager, are a clear way of the ability of accounting and control inscriptions (the report in the case above) to allow top management to increase its control and power over NPD projects. Thus, this way of cost reporting allows accountants, situated at business level, to increase visibility over projects to corporate managers and reinforce central control over strategically relevant NPD projects. This dynamic reproduces the iterative and cumulative reporting of NPD projects as an ongoing information flow from business level to corporate level and from corporate to business level. It defines the distance between centre and peripheries and, at the same time, allows managers to exert centralised control (at corporate level) through decentralised control tools (e.g. reports or MPT system at business level). In ANT terms, it occurs thanks to the inscriptions ability to represent facts in their absence, and therefore, to allow action at distance or, more consistent to this context, control at distance. Moreover,



this is in line with the ANT works by Boland, 2001; Carmona, Ezzamel, and Gutierrez, 2002; Ezzamel and Willmott, 1998; Quattrone and Hopper, 2005, 2006) in which organisational categories such as space and time are recognised as crucial to accounting control. Then, SAP representations, cost reports and other control information emerge after a process of translation involving mediations between various interests and existing technologies that redefine their attributes and why they were introduced. Thus the interaction between SAP (centralised control system) at corporate level and MPT system (decentralised control system) at business level constructs distance and thence control (Ezzamel and Willmott, 1998) in *AB Micro-conductor*. From an ANT perspective, these actions can be seen as strengthening the inscriptions in order to persuade other actors to follow the interests of an efficient NPD portfolio management more closely. Inscriptions produced by MCS at corporate and business levels create a socio-technical distance. (Quattrone and Hopper, 2006). They play an active role in favouring the employment of control practices in a dynamic process of ordering and organising NPD portfolio through a continuous balance between centralised and decentralised control requirements.

#### 4.2. The Need for Control in Managing Interdependencies between NPD Projects

Within the *AB Micro-conductor* corporation, each subunit is a multi-project setting where various projects with different lead time and separate or interdependent goals, happen to run simultaneously. The corporate level stimulates the interactions between NPD projects, especially the ones that share the same technological platform. That means pursuing project goals, surmounting the local barriers and looking for potential NPD technical platform sharing. This is confirmed by the Program Manager who reports: *"Frequently the results we get from our NPD projects are shared with the other divisions because we rely on the possibilities to transfer the technical knowledge accumulated in our business unit to a wide range of development projects managed in other business units."*

Moreover, the argument emerged above are in line with Chao and Kavadias (2008) who pointed out the critical features affecting NPD portfolio: strategic alignment, resource scarcity, project interactions and outcome uncertainty. According to ANT, this suggests that the ongoing interactions between human and nonhuman actors are displaced not only within the confines of the project, but they are also deployed outside its boundaries in order to enrol other projects and their networks. In this perspective, our observation of the influence of control on NPD portfolio at corporate level, stresses the need for exchanges and interactions across different NPD projects.

Indeed, *AB Micro-conductor* needs to face the dependency that, in some cases exists between the different projects. That means, for instance, to take into account how a project will affect the other ongoing projects in terms of critical

resources or time-schedule. Then, the success of a project is in the interest of other projects. This is in line with one corporate senior manager's argument which emphasizes the need for more communication in managing multiple projects in different business units. He reports: *"The best way is to talk to the project managers about the critical aspects emerging from the projects. Formal and informal information flows are essential for a good coordination between the divisional and the corporate level."*

This is what occurs in the case of a NPD project which shared a common technological platform with other projects. In particular, some components to be assembled for the final product of the project were the output of a project managed in a different subunit. However, the complexity of the projects differed. The main project, strategically relevant for the corporate level, was technically advanced with long duration, comprising a large number of different technical sub-systems and components. Moreover, a strong emphasis was put on performance and technical traits of the final products. On the contrary, the project managed in the other subunit was much smaller, had shorter duration time, and was not as technically complex.

In addition, there was a continuously ongoing game of negotiations between the two business units concerning technical specifications and time scheduling for delivering the components. For the Program Manager of the more complex project, the main concern was the project lead-time. Moreover, the components needed for the main project were not available as scheduled. Due to the critical cause-effects relationships between the two projects, this tension was managed by the NPD Portfolio Manager.

The NPD Portfolio Manager, thus, had to decide about processes and standards for the two projects, their prioritization, selection, and evaluation mechanisms. He was responsible for approving financial as well as technical targets from a strategic perspective. Then, in case of perceived deviations or fundamental conflict situations he had to deliver decisions such as re-allocation of resources or re-prioritization of projects in time. In such contexts of interdependence, where the output of the first project is an input for the second one, Program Managers waive a true full control of the NPD processes. Consequently, they delegated to the NPD Portfolio Manager the role to orchestrate the interdependencies between their projects and to coordinate and supervise all the phases related to each project.

As confirmed by other empirical observation, the NPD portfolio Manager is responsible for NPD portfolio strategic planning and in addition he faces the requirement of control emerging in context of interdependencies. This actor allows the effective management of NPD portfolio and the exercise of control at distance from corporate level. Therefore, we can refer to NPD Portfolio Manager as the spokesman for the various Program Managers operating at business level. The presence of the NPD Portfolio Manager, is thus in line with the objectives of both controlling at a distance and improving local decision-making.

According to the argument reported above, NPD portfolio emerges as a big network, defined by its relationships with the different NPD project networks at business level. Then, to appreciate the role of control in NPD projects at corporate level, one needs to look into the intra-organisational focus, i.e., the internal dynamics that sustained each NPD project as a single network, and into the inter-organizational level, i.e., the interactions among different projects managed by different business units. Therefore, control on NPD portfolio is not merely a matter of evaluating NPD projects performances and verifying that these are in line with the overall technical and financial standards established at corporate level. It concerns the management of the interrelationships of heterogeneous actor-network groups, i.e., the NPD portfolio thanks to the mediating role played by humans and technology (e.g., control devices, NPD software, etc). With a view to gather support and accomplish NPD portfolio and its alignment to the overall organisation's strategic objectives, MCS needed to mobilise strong networks, select their allies and translate their visions to create intersement for key-actors in the organization.

### 4.3. Further Insights and Case Study Reflections

From the empirical evidence collected above, three main findings emerge in the context of control of NPD portfolio: the centralization vs decentralization, the conflict between divisions and between divisions and HQ in resource allocation and finally the interactions between NPD projects managed by different business units. The action that each project actor-network at business level forms with other entities, which may be human, such as the NPD team members, or non-human, such as computer systems, contracts, or control software, is related to the control system at corporate level. Corporate control system thus acts as a *mobilizator* in order to align the interests emerging in the different NPD projects at business level to the NPD portfolio objectives. How does it occur? To clarify this point we need to recall the concept of power.

As empirical observation highlighted, during meetings and interactions in *AB Micro-conductor*, corporate control system in NPD portfolio management deals with power balance. According to Law, actor network is about a movement, a displacement: "the struggle to centre and the struggle to centre and order from a centre" (Law, 1999: 5). This concept is also linked to power and control at a distance (Law, 1986). Consequently, translation represents a displacement, a movement, from one context to another (Robson, 1991). As such, translation and the other ANT concepts of network, actors and actants (such as accounting and control inscriptions) help to draw attention to the issues of control at a distance and to power. Through the constitution of networks made of accounting inscriptions and human elements, one becomes able to influence different contexts at the same time (Robson, 1991). Thus, the power dynamics sustained by control systems at corporate level could be explained relying on the Foucaultian notion of power (Foucault, 1980). Certainly there are actors in this

network that enjoy a privileged position, but this position needs to be confirmed continuously through negotiations, and this case has illuminated how this privilege might be challenged or even revoked by new actors or new constellations of actors in the network. So, power 'travels' and every relation in a network is, by definition, a power-relation. "These power-relations do not emanate from one "unique locus of sovereignty"-but is constantly on the move, from one point to another. Thus, saying that MCS represents the most powerful actant of a big network formed by control network and project development network, does not mean that the other actants are not endowed with power at all. By definition, every actor is a network itself, therefore, every actor is potentially more or less empowered, too. As our empirical material highlights, when MCS took place over diverse sets of actors, they did so only because groups of other actors agreed with them or chose not to oppose them. Power is an effect that is performed by corporate control system to entail the tension of aligning and enrolling different NPD networks.

As we detected previously, achieving alignment in the context of NPD portfolio network requires managing the tension between centre and periphery. Drawing on our empirical observations, this is vital for the equilibrium as well as for the strength of the NPD portfolio network. Our perceptions, checked on the basis of data collected during meetings and interviews with different managers, revealed that the allocation of resources exacerbates the tension between headquarters and subsidiaries. That means trying to account for matters as resource allocation and control mechanisms over costs, benefits, and the development and implementation of projects.

In such context, management accounting and control systems play a central role in fostering NPD portfolio convergence, i.e., the alignment of interests and goals and the alignment of resources, according to the overall company strategic imperatives. Power is obtained during the mediation of various interests. Then, power prompted by corporate control system is contextual, built through carefully constructed associations of human and non human elements (Latour, 1986). Then, what constitutes power is conditional on the ability to coordinate human and non human actors in an attempt to strengthen or weaken existing associations (Lowe, 2001).

MCS, at corporate level, exerts power over NPD project running at business level. Corporate control systems obtain a power position and maintain this position in order to institutionalise their *mobilizator* and assume a role in order to make NPD portfolio network strong and durable. They are powerful because of the relatively sophisticated combinations of resources and people which they mobilise. From this perspective, control system at corporate level, is a translation centre where information originate from different NPD projects and is accumulated in centres of calculation and then transferred from business level to corporate level. These activities of translation give rise to debates between NPD projects, which we refer to as socio-technical networks,

and later result in strengthening the whole NPD portfolio. MCS at corporate level therefore, become a means by which an organisation can create networks of power relations and account abilities, that 'act at a distance' (Law, 1986). Moreover, the process of accumulating information in centres of calculation allows to exert control (Latour, 1987; Quattrone and Hopper, 2005; Robson, 1991, 1992). That means control of NPD portfolio does not simply concerns MCS at corporate level. It is more than this. Corporate control system allows the control at a distance over NPD projects thanks to the presence of control system at business level. In line with Quattrone and Hopper (2005), corporate control system creates a centre of calculation (the corporate level) but at the same time, it fosters local discretion (Munro, 1999; Quattrone and Hopper, 2001). The local discretion in such context refers to the role of control in fostering NPD projects management in accordance with the financial and technical targets defined at corporate level, and at the same time, takes into account the need for flexibility and "self-government" emerging at business level. Instead, at corporate level, control system verifies that the NPD portfolio, i.e., the whole NPD projects, is running according to the overall company strategic imperatives. Consequently, corporate control system emerges as a hybrid form of centralized control allowed by decentralization. Thereby, the call for increased management control of the peripheries, i.e., the company's subunits, creates a perceived centralisation of power and control (Bloomfield and Coombs, 1992). This is also in line with Orlikowski (1991: 10) who, talking about Information Technology, states that "they facilitate decentralization and flexible operations on the one hand, while they increase dependence and centralised knowledge and power, on the other". In accordance with this argument, corporate control system becomes an exercise of power to try to establish centres of calculation in relations beyond corporation's control. This is consistent with a notion of control which marks a shift from one centre and one periphery, with heterogeneous interests but shared intents, to multiple centres and multiple peripheries, with heterogeneous interests and intents (Quattrone and Hopper, 2005). As such, our empirical observations confirm a supportive role of control and accounting devices in promoting various goals and interests from actors with opposite views and finally, mobilizing them into a well defined objective: the alignment and managing of the NPD portfolio according to the company strategic imperatives.

In line with ANT assumptions, the hierarchical relationships and the power balance between control systems networks at business level and the corporate control system, as a network itself, enable to control the effectiveness of NPD portfolio management. The combination of the action of the corporate control system and the interest emerging in NPD projects at business level, creates a consortium of actors who bring the NPD portfolio.

However, it is crucial to acknowledge that NPD portfolio as well as MCS are not "a self-containing piece of

technology" (Hanseth and Monteiro, 1997:194). They are heterogeneous actor-networks of aligned interests. In addition, they allow control systems, at business level, to act as centres of calculation and discretion. Then, as we detected previously, the ability of corporate control system to foster NPD portfolio management is allowed by control devices which deal with three needs for control emerging simultaneously at business and corporate level: the tension between centralised and decentralised control, conflicts in resource allocations and interactions between various NDP projects.

## 5. Conclusions

From our conceptual framework, mobilized on a case of corporate control system over NPD portfolio management, we have shown the relevance of exploring social as well as technical agencies in order to understand how MCS affect NPD projects executed at business level.

The implication is that rather than looking only for a human interest to explain how accounting and control systems affect organizations activities, such as the NPD portfolio management, we need to look for deeper explanations based upon the ties between people and technology.

Despite several studies have investigated the role of corporate control systems in innovation activities a lack of knowledge remains about how control can be mobilized to support NPD portfolio management. Therefore, this paper offered an investigation of the role of corporate control systems in NPD projects, carried out in different company sub-units. To this end, we have conducted a field study which allowed us to follow interactions among human and non human agencies.

Drawing on ANT framework, we highlighted how the combination of the action of the corporate control system and the interest emerging in NPD projects at business level, creates a network of actors who make the NPD portfolio management possible.

Field evidence carried out at a division of a multidivisional company operating in the semiconductor industry, offered specific insights into the phenomenon under investigation and allowed the theoretical framework proposed to be redefined and integrated.

Two main control issues emerged from the case study: the tension between centralised control exerted at corporate level and decentralized control exerted at business level, and the interactions between various NPD projects managed at business level. Moreover, corporate control over NPD portfolio emerged as a matter of power balancing and action at a distance. That means inscriptions enable corporate control system to act at a distance. In particular, we highlighted how MCS allow the control at a distance over NPD projects thanks to the presence of control systems at business level. Then, they foster control systems at business level to act as centres of calculation. Consequently we have

shown how corporate control system create a centre of calculation (the corporate level) but, at the same time, they allow local discretion (Munro, 1999; Quattrone and Hopper, 2001, 2005) over the business units which manage various NPD projects.

This work makes a contribution to the existing literature on the phenomena since our discussions suggested a central role of control to mediate the conflicts in resource allocations and in fostering the interactions between projects. This is allowed by accounting and control inscriptions which exert power and provide the adequate NPD portfolio management.

In addition to a theoretical contribution, this study provides new insights for practical business management. The study advances the call for an adequate adaptation of tools and control processes in innovative settings. This work offers a managerial contribution. By exploring the role of corporate control systems in NPD portfolio, we contribute to a deeper understanding of control in multi-project management, especially in a multidivisional context. Moreover, the exploration of the call for coordination between NPD business units and the NPD portfolio at corporate level is useful for practitioners to make an adequate use of accounting and control systems in innovative settings. Therefore, managers may find it a useful way of knowing what they should do, how, where, when and finally why they should do it.

Finally, since this study provides a single case study, as such to ensure the scope of our framework, one needs to extend the analysis to other contexts in order to develop a more complete understanding of the phenomena. Moreover, future contributions on this topic could aim at generating a richer explanation of the socio-technical aspects promoted by the interactions between control over NPD projects at business level and control over NPD portfolio at corporate level.

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