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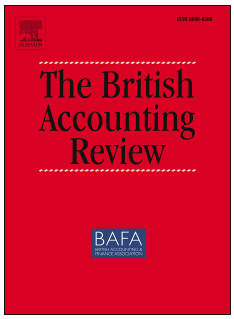

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Jari Huikku, Jouko Karjalainen, Tomi Seppälä

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Jari HUIKKU, PhD[1]
Aalto University School of Business
Department of Accounting
Runeberginkatu 22-24
00100 Helsinki
Finland
jari.huikku@aalto.fi

Jouko KARJALAINEN, PhD
Aalto University School of Science
Department of Industrial Engineering and Management
Otaniementie 17
02150 Espoo
Finland
jouko.karjalainen@aalto.fi

Tomi SEPPÄLÄ, PhD
Aalto University School of Business
Department of Information and Service Economy
Runeberginkatu 22-24
00100 Helsinki
Finland
tomi.seppala@aalto.fi

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[1] Corresponding author: Jari Huikku

The Dynamism of Pre-decision Controls in the Appraisal of Strategic Investments

Abstract

In this study we examine the dynamism of pre-decision controls in the appraisal of strategic investments, an area largely overlooked by the literature, even though it is of the utmost importance to understand the mechanisms companies use to ensure their optimal capital investments. More specifically, we investigate how changes in companies' economic, strategic, and organisational conditions relate to an increased emphasis on pre-decision controls such as policies, procedures, and routines. The empirical data is based on 108 interviews from among the 150 largest Finnish manufacturing companies. The paper contributes to the scarce capital budgeting literature by extending the discussion of the adaptations of pre-decision controls to external and internal environmental changes. We add to the literature by showing that changes in management may play a decisive role in control adaptations. Furthermore, we provide strong support to maintain that increased financial pressure can be related to the tightened use of controls.

Key words: *strategic investment, pre-decision control, management accounting change, capital budgeting, generalised linear model*

1. Introduction

Success in strategic investment decision-making greatly affects the extent to which a company can achieve its strategic objectives. To facilitate optimal capital investment, companies use various types of pre-decision controls before their investment decisions take place, and these controls play a major role in ensuring that a company selects its investments appropriately (Simons, 2000). These control mechanisms typically include policies, procedures, and formal routines related to expenditure authorisation levels, profitability requirements, managerial involvement, and pre-determined financial, strategic, and risk analyses (Alkaraan and Northcott, 2007).

Several studies describe the different aspects and uses of pre-decision controls in companies (e.g., Alkaraan and Northcott, 2007; Arnold and Hatzopoulos, 2000; Carr et al., 2010; Emmanuel et al., 2010). Nevertheless, these studies adopt a static point of view and hence do not cover aspects related to changes in these controls. Additionally, there are studies reporting the changes in capital budgeting trends (Alkaraan and Northcott, 2006; Pike, 1996), but they do not reveal anything about the changes in a particular company. A few prior management control system (MCS) studies have, to a minor extent, included capital budgeting when they

have examined how changes in MCSs are associated with external and intra-organisational aspects such as competition, organisational capacity to change (learn), decentralisation, and firm size (e.g., Chanegrih, 2008; Libby and Waterhouse, 1996; Williams and Seaman, 2001). In these studies, however, various pre-decision controls have been considered as one control, hence providing us with results only on an aggregate level.

In their case study, Vesty et al. (2015) investigated how companies responded in their capital budgeting to changes in new environmental and social regulations. They show that the case companies changed their sustainability-related controls. They do not, however, explicitly compare the status of companies' pre-decision controls before and after the environmental changes. It appears that the only research that explicitly focuses on changes in pre-decision controls in specific companies is Slagmulder's (1997) case study, which examined how companies modify their pre-decision controls to achieve alignment between strategic manufacturing investment decisions and strategy to respond to changes in external and internal environmental conditions.[1] Her findings show that changes in environmental conditions may cause strategic misalignments, and they require an adaptation of pre-decision controls.

As outlined above, our understanding about the dynamism of pre-decision controls during the appraisal processes of strategic investments is still scarce. There is a clear need to know more about how companies respond to the changes in their environments to ensure optimal capital investment. This is also echoed by the calls of Slagmulder (1997) and Alkaraan and Northcott (2007), which urge more research on pre-decision controls. Slagmulder (1997) suggests that it would be fruitful to examine the adaptations of these controls in a larger sample than she did in her case study. Similarly, Alkaraan and Northcott (2007) invite researchers to enhance our current understanding about the choice and design of pre-decision controls. As a consequence, the purpose of this study is to investigate "how changes in companies' economic, strategic and organisational conditions relate to the adaptations of pre-decision controls of strategic investments." We specifically investigate the association between an increased emphasis on pre-decision controls and independent variables, such as increased financial pressure, change

[1] Slagmulder (1997) broadly defines changes in environment as changes in both external environmental (e.g., competition) and internal environmental (e.g., organisation and strategy) conditions. This focus is in congruence with Otley (2016), who separately identified the internal organisational environment, and accordingly, firm internal (vs. external) variables.

in strategic orientation towards exploitation, and changes in management. The choice of our independent variables was greatly influenced by the prior literature, which suggests that changes in economic, strategic, and organisational conditions may actually act as the major drivers of adaptations within companies (e.g., Greenwood and Hinings, 2006; Modell, 2007). Our dependent variable consists of typical adaptations in policies, procedures, and routines that we have identified in the capital budgeting literature. In establishing this, we focus on the more mechanistic pre-decision control mechanisms (Chenhall, 2003) and address these controls on an aggregate level, and also delineated into four subgroups: adaptations in the locus of decision-making, degree of formalisation, tightness of control, and introduction of new control mechanisms.

Our empirical evidence is based on 108 telephone interviews from among the 150 largest Finnish manufacturing companies. To focus the study on a reasonable domain and reach a sufficiently homogeneous basis for precise investigation, we specifically addressed strategic manufacturing investments (SMIs), which are substantial investments in manufacturing plants and equipment (e.g., Alkaraan and Northcott, 2007). We used a structured questionnaire, which included open-faced questions, and the interviews focused on adaptations in the pre-decision controls that had taken place in 2008–2011. It was anticipated that during the financial crisis, many companies would have potentially undergone changes in their environments and consequently would have adapted their MCS (Hopwood, 2009; Van der Stede, 2011). Our interviews revealed both increases and decreases in pre-decision controls. Nevertheless, because the data included evidence almost merely about the increasing emphasis on pre-decision controls, this phenomenon motivated us to narrow our research focus down and move in this direction. The statistical analysis was performed using binomial regression models and was estimated using the generalised linear modelling technique.

This study contributes in many ways to the capital budgeting literature by shedding light on the adaptations of pre-decision controls in response to environmental changes in the appraisal of strategic investments, an area largely overlooked by the literature. Firstly, we show that changes in management may play a decisive role in control adaptations, specifically in terms of increased formalisation and tightening of controls. Secondly, we provide strong support as evidence that increased financial pressure can be related to the tightened use of controls. Thirdly, in comparison to Libby and Waterhouse (1996) and related MCS change research, we add to the literature by providing a more nuanced picture of the adaptations per different

control mechanisms. Accordingly, we not only show whether any kind of change has occurred within capital budgeting, but we also address the adaptations in separate pre-control mechanisms. Fourthly, we consider the direction of the adaptations (i.e., increased control), not just analyse whether adaptations in controls have taken place in any direction. Enhanced understanding about the dynamism of pre-decision controls can also be managerially relevant for companies. Specifically, our findings suggest that key individuals and their perceptions have an important role in selecting the adaptations to be made. Hence, to initiate changes in formal systems, new managers may need to be introduced, or current managers should at least feel more pressure to implement the changes.

The remainder of this paper is structured as follows. Section Two presents the relevant literature and Section Three continues by describing the development of the tentative propositions. In Section Four, the data collection and analysis measures are explained, and the empirical results are presented in Section Five. Finally, discussions are presented in Section Six and conclusions in Section Seven.

2. Literature Review

In this section, we first review the literature on pre-decision controls in capital investment and then cover studies related to the MCS change in general, pre-decision control change in particular. Finally, we end by synthesising the section.

2.1. Pre-decision controls in capital investment

Management controls are devices and systems that managers use to ensure that the behaviours and decisions of their employees are consistent with their organisation's objectives and strategies (Malmi and Brown, 2008). For capital investment, management controls can be divided into two main groups: pre-decision controls and post-decision controls. Pre-decision controls include control mechanisms used before the investment decision takes place (Alkaraan and Northcott, 2007). Respectively, post-decision controls, such as monitoring the implementation phase and post-completion auditing, are used during the later stages of the investment process (Huikku, 2007, 2011; Huikku and Lukka, 2016).

There are voluminous pre-decision controls reported in the literature.[2] Here, we review the most common controls we have identified in the capital budgeting literature (see Appendix A for a list). The adaptations of these controls will be operationalised for our dependent variables later in this paper. The formal standard operating procedures for a company's capital investment typically define the procedures to be followed in the planning, evaluation, and selection phases, including the capital budgeting techniques to be applied (e.g., Alkaraan and Northcott, 2007; Arnold and Hatzopoulos, 2000). Setting investment approval limits for different hierarchical levels is a typical control (Simons, 2000). The largest strategic investments require an approval from Board of Directors (Melgin, 2016). In addition, companies can have formal procedures for investment coordination, presentation of financial estimates, and pre-designed, interim decision points to decide about the continuation of the project (Jörgensen and Messner, 2010; Miller and O'Leary, 2007). The requirements for top management involvement and managers' interaction with other managers to coordinate investments can be formalised (e.g., Emmanuel et al., 2010; Jörgensen and Messner, 2010). Importantly, ensuring the strategic alignment has been reported as a key prerequisite for a strategic investment decision (Alkaraan and Northcott, 2006; Carr et al., 2010; Slagmulder, 1997). In addition to mechanistic controls, it is widely acknowledged that informal types of control, such as managerial judgment based on managers' intuition and experience, may affect strategic investment decision-making to a great extent (e.g., Alkaraan and Northcott, 2006; Harris et al., 2009; Lumijärvi, 1991).

With regard to controlling risk, prior studies report that companies commonly use sensitivity and scenario analyses for their risk analysis of capital investments, whereas other techniques, such as computer simulation and CAPM analysis, are not widely adopted (see, e.g., Alkaraan and Northcott, 2006; Arnold and Hatzopoulos, 2000; Pike, 1996, Vesty et al., 2013). According to Harris (1999), companies may benefit from using rough risk analysis early on in the capital investment process to avoid processing high-risk projects that ultimately did not get funded. Commonly, companies also make project-specific adjustments to account for any higher risk by raising the required rate of return, shortening the payback period requirement, and using more conservative cash flow estimates (Abdel-Kader and Dugdale, 1998; Alkaraan

[2] See Burns and Walker (2009), Clancy and Collins (2014), Haka (2007), and Mukherjee and Rahahleh (2011) for recent reviews of capital budgeting research addressing these aspects.

and Northcott, 2006; Chittenden and Derregia, 2015). Verbeeten (2006) found that manufacturing companies use sophisticated risk tools (e.g., simulation analysis and CAPM analysis) less than other industries do. Instead, they use more frequently "naïve" practices, such as sensitivity analysis, scenario analysis, and adaptation of the required rate of return.

2.2. MCS change

Our study can be considered a factor study sharing a concern regarding identifying the factors that explain MCS change (or a lack thereof) (see, e.g., Innes and Mitchell, 1990; Laitinen, 2001).[3] This group also includes research that explains the environmental, organisational, and technological factors associated with the design and use of MCS and their change (Chenhall, 2003; Otley, 2016). For example, Baines and Langfield-Smith (2003) found that changes in the competitive environment of manufacturing organisations led to changes in MCS via changes in strategy, organisation design, technology, and advanced management accounting practices.[4]

Even though there are factor studies on pre-decision controls, they predominantly adopt a static point of view (e.g., Govindarajan and Shank, 1992; see Haka, 2007 for a literature review on investment appraisal studies). Prior studies have only minimally covered aspects related to changes in pre-decision controls in capital investment. Libby and Waterhouse (1996) studied MCS changes in a sample of Canadian manufacturing companies. They identified and hypothesised four independent variables that may have been partly responsible for their changes: intensity of competition, decentralisation, firm size, and organisational capacity to change (learn). The number of changes in MCS in a specified time period (i.e., a precise count) was used as a measure of change. They found 23 possible changes in MCSs, capital budgeting change being one of them, but their approach does not reveal, *per se*, how capital budgeting was changed. Libby and Waterhouse suggested that organisational capacity, i.e., the number of existing formal accounting systems, is the best predictor of change. Their

[3] The MCS change studies can be delineated into two groups: process-oriented approaches and factor studies (Modell, 2007). Studies that use change process–oriented approaches are commonly concerned with the social, political, and behavioural aspects of a change (see, e.g., Granlund and Modell, 2005).

[4] Burns and Scapens (2000) introduced a typology consisting of different dimensions of MCS changes. Their three dimensions of change are formal/informal, revolutionary/evolutionary, and progressive/regressive (see also Jabbour and Abdel-Kader, 2015). According to Modell (2007), managerial actions and external shocks may boost more radical changes that can be considered formal, revolutionary, and progressive, whereas path dependencies often reinforce informal, evolutionary, and regressive change processes.

research setting has been (at least partly) replicated in different countries by later researchers: Williams and Seaman (2001; Singapore), Sulaiman and Mitchell (2005; Malaysia), Chanegrih (2008; France), and Hoque (2014; Australia). These above-mentioned studies have also described the nature of the changes, but have not analysed capital budgeting in detail, and do not reveal how companies have adapted their pre-decision controls.

There are also studies that address changes in capital budgeting trends (Alkaraan and Northcott, 2006; Pike, 1996). Nevertheless, the empirical literature that addresses adaptations of pre-decision controls in the same company is scarce. To our knowledge, the only study that has focused on the dynamic aspects of pre-decision controls is Slagmulder's (1997) field study of six companies, in which she analysed control changes related to ten investment projects.[5] Following the grounded theory approach, she proposed a theory of how and why pre-decision controls of strategic manufacturing investments evolve to maintain strategic alignment.[6] She adopted an adaptive perspective, assuming that controls adapt continuously in reaction to ongoing changes in environmental conditions (e.g., Miles and Snow, 1978).[7] Her theory identified three major phases in the alignment process (p. 133). Firstly, she suggests that changes in external and internal environmental conditions, such as competitive environment, strategy, and organisation structure, may actually cause strategic misalignments, hence requiring further adaptation of pre-decision controls. Secondly, she suggests that the companies use four techniques to adapt the pre-decision controls: introduction of new control mechanisms, changing the tightness of the controls, changing the degree of formality of the controls, and changing the locus of decision-making. Thirdly, in the final phase of her theoretical framework, the effectiveness of the adaptations to remove these strategic misalignments can be addressed. In addition, more recently, Vesty et al. (2015) used case studies to demonstrate how companies responded to changes in their environment through capital budgeting. Specifically, they investigated what kinds of sustainability-related controls the companies had introduced in their capital investment evaluation processes to respond to changes in new environmental and social regulations. Contrary to our research, however, they

[5] However, see also Ackerman (1970) about changing the tightness of investment pre-decision controls when responding to changes in corporate strategy, and Marshuetz (1985) about the influence of strategy change on the complete redesign of strategic decision-making.
[6] See also Harris et al. (2016) and Langfield-Smith (2005) for analyses of Slagmulder's (1997) study.
[7] In addition, e.g., Kober (2007) shows that there can be a two-way relationship between MCS and strategy, i.e., MC mechanisms can both shape and be shaped by strategy.

do not explicitly compare the pre-decision controls before and after the changes in the (external) environment, i.e., before an event (introduction of certain regulations, or in our case, the Great Financial Crisis).

Taken together, MCS literature suggests that organisations will modify their controls when they encounter changes in their environments. Nevertheless, we know little about how companies respond to the changes in their environments in the strategic investment context. The notable exceptions are Vesty et al. (2015) and Slagmulder (1997). Vesty et al. (2015) show that companies react to sustainability-related regulation and movement by modifying their capital budgeting. Slagmulder (1997) maintains that changes in external and internal environmental conditions may cause strategic misalignments and require adaptation of pre-decision controls. This result aligns with the scholars, suggesting that changes in economic, strategic, and organisational conditions may act as the major drivers of adaptations (Greenwood and Hinings, 2006; Modell, 2007). Consequently, we study how changes in these conditions relate to the adaptations of pre-decision controls of strategic investments. By doing so, we respond to her call to extend the research using larger samples and to test adaptation processes with statistical methods. We focus our study on adaptations in mechanistic controls, such as control policies, procedures, and routines.[8] To reach a sufficient depth in our analysis, we do not consider the relevant controls identified in the literature only as a single group as in Libby and Waterhouse (1996), for example, but instead, following Slagmulder (1997), scrutinise them in four subgroups.

3. Development of the Propositions

3.1. General

This study adopts an explorative approach and does not propose hypotheses because there is little empirical or theoretical knowledge to develop hypotheses in this specific domain. We offer, however, tentative propositions for the aggregate-level associations based on broader management and management control literature and the available capital budgeting literature. Accordingly, we develop propositions about the associations between adaptations in pre-decision controls in strategic investment and the potential change factors on an aggregate level to be used later in Model 1. We construct further models to explore associations between

[8] These kinds of controls can also be classified as “technical management controls” (see, e.g., Tessier and Otley, 2012).

the same independent variables as in Model 1 as well as adaptations in the control subgroups suggested by Slagmulder (1997)[9]. Specifically, we study whether companies have placed an increased emphasis on these controls, which would include more frequent and/or thorough use of these control mechanisms for the planning and decision-making of investment projects (Alkaraan and Northcott, 2013; Dean and Sharfman, 1993). Three change factors (independent variables) addressed in all the models are the increased financial pressure of the firm, the change in strategic orientation towards exploitation related to strategic investments, and changes in management. Our choice of these particular independent variables has been encouraged by the prior literature, suggesting that important stimuli for adaptations may be triggered by a deteriorated economic situation, changes in strategy, and changes in management (e.g., in the SIDM context: Slagmulder, 1997; in the broader MCS context: Greenwood and Hinings, 2006; Liguori and Steccolini, 2011). Slagmulder (1997) also identifies similar environmental change factors as driving forces that lay behind the adaptations in pre-decision controls.[10] Additionally, we use firm size, the change in strategic orientation towards exploration related to strategic investments, capacity to change, generic strategic configuration, and management style of the company as our control variables.

3.2. Adaptations to pre-decision controls and increased financial pressure

According to the MCS literature, it is reasonable to assume that controls can change as a result of an economic crisis (see, e.g., Endenich, 2014; Ezzamel and Bourn, 1990; Janke et al., 2014). Hopwood (2009) maintains that companies facing extreme external pressures due to a financial crisis need to redesign their MCS in order to respond to the new environment. In a similar vein, Van der Stede (2011) suggests that such a crisis produces pressure to change controls related to planning/budgeting and risk management. Accordingly, Becker et al. (2016) show that companies that were affected more by the 2008 economic crisis put more emphasis on resource allocation and planning aspects in their budgeting process and less emphasis on performance evaluation. In line with this, Granlund and Lukka (1998) maintain that the pressure on changes in MCS can come from economic causes, and Innes and Mitchell

[9] (1) Changing the locus of decision-making, (2) changing the degree of formality of the controls, (3) changing the tightness of the controls, and (4) introduction of new control mechanisms. The more detailed specification of the various control aspects for different subgroups is presented in Section 4.

[10] She terms her four subcategories for change in environmental conditions as (1) changes in competitive environment (including economic factors); (2-3) changes in intended & emergent strategy; and (4) changes in organisation structure (including configuration of management). Within the subgroups, her definitions include more aspects than the ones that we explicitly address here.

(1990) propose that declining profitability may motivate firms to adapt their control mechanisms. Also, Reid and Smith (2000) report that changes in MCS are associated with cash-flow crises and shortfalls of finance. With this view, it has been suggested that companies tend to alter their processes when the organisational performance falls below its aspiration level (Wiseman and Bromiley, 1996). Difficulty (hostility, turbulence) in a firm's external environment has been associated with a greater reliance on more formal (mechanistic) forms of control mechanisms (e.g., Chenhall, 2003).

Although there is both theoretical and empirical literature on the influence of a deteriorated financial situation on a firm's tendency to adapt their control mechanisms (see above), the literature that focuses on the type and direction of adaptations in different controls remains scarce. Specifically, in the capital budgeting context, we lack a deeper understanding about the associations of increased financial pressure with pre-decision controls. Nevertheless, Carr et al. (2010) suggest that a financially constrained position tends to drive firms to use a very short perspective and focus on formal financial targets. Additionally, they propose that companies are likely to adjust their investment evaluation practices in response to a long-lasting decline in performance compared to their shareholders' expectations. Van Cauwenberg et al. (1996) investigated the influence of a firm's financial situation on its level of formalism in investment appraisal procedures. They found that the majority of managers tend to emphasise a more formal examination of investment proposals (including risk assessment) when the company faces a challenging financial situation. Additionally, they report that about half of managers agree that companies with more room for financial manoeuvring (free cash flow, auto-financing possibilities) undertake a less formal investment appraisal process. Pike (1986) suggests that lower recent earnings performance of a firm is associated with more formal capital budgeting processes. In addition, Becker et al. (2016) report that during the 2008 crisis, a large majority of companies changed their approval policies for investments by requiring the signature of a person higher up in the hierarchy. Moreover, related to risk assessment, Graham and Harvey (2001) found that highly leveraged firms are more likely to use sensitivity and simulation analysis than less leveraged companies.

Based on the above discussions, we propose that increased control may be positively associated with increased financial pressure on the firm:

Proposition 1: More emphasis on pre-decision controls on strategic investments is positively associated with increased financial pressure on a firm.

3.3. Adaptations to pre-decision controls and change in strategic orientation

Scholars have reached a consensus, agreeing that a firm's strategy is associated with the design and use of its MCS (see, e.g., Bedford et al., 2016; Kober et al., 2007; Langfield-Smith, 1997). It appears, for example, that firms using strategies characterised by cost leadership (defender approach, conservatism, and harvest orientation) tend to focus more on formal, traditional MCSs, whereas companies that have adopted differentiation (prospector, entrepreneurial, and build) strategies use more organic, interactive, and long-term controls (Chenhall, 2003; Langfield-Smith, 1997).[11] Tillema (2005) suggests that the use of a broader scope of accounting instruments is more likely if financial objectives are important and financial consequences are significant but unclear (as in strategic investment decisions). Even though a voluminous amount of literature about the (static) association between strategy and MCSs exists, few scholars have explicitly addressed the association between changes in a firm's strategic orientation and changes in its management controls (Chenhall, 2003). Nevertheless, based on their study, Baines and Langfield-Smith (2003) suggest that changes moving towards a differentiation strategy will result in an increased use of advanced management accounting practices, which is then associated with a greater reliance on non-financial management accounting information, for instance.[12] Kennedy and Widener (2008) illustrate how their case company implemented various control mechanisms in connection with the introduction of a new strategic initiative (the lean manufacturing initiative).

When addressing the association of changes in strategic orientation with adaptations in pre-decision controls in our study, we draw primarily on the notion of exploitation (and exploration) presented in the seminal paper written by March (1991). We believe this

[11] A number of MCS scholars have suggested that there are strong similarities between the various generic strategic typologies (e.g., Chenhall, 2003; Langfield-Smith, 1997; Simons, 1990). The widely used typologies in the MCS strategy context are cost leadership vs. differentiation (Porter, 1980) and defender, analyser, and prospector orientations (Miles and Snow, 1978). Moreover, typologies, such as conservative vs. entrepreneurial (Miller and Friesen, 1982) and build, harvest, or hold (Govindarajan and Gupta, 1985), have been used in these contexts. Further, Simons' (1995) levers of control framework and Moores and Yuen's (2001) organisational life cycle framework have more recently been mobilised by several researchers (see, e.g., Tucker et al., 2009).

[12] Contrary to their study, we do not try to identify the potential antecedents of our independent variables or their causal relations/interdependencies.

approach allows us to account for timing-related aspects in the changes of strategic orientation (i.e., short- vs. long-term emphasis) more explicitly than Porter's (1980) cost leadership vs. differentiation typology, for example. March (1991, 71) stated that "a central concern of studies of adaptive processes is the relation between exploration and exploitation." He continues that exploitation includes refinement, choice, production, efficiency, selection, implementation, and execution, whereas exploration is characterised by terms such as search, variation, risk-taking, experimentation, play, flexibility, discovery, and innovation. Accordingly, exploitation activities focus inherently on short-term performance improvements in terms of reduced production costs, improved production flexibility, and improved yield, for example (Piao and Zajac, 2016; Uotila et al., 2009). In any exploitative activities, firms exploit their existing resources, while in explorative activities, they develop and use their knowledge to explore new possibilities (Gupta et al., 2006). In exploration, firms focus on activities that potentially lead to success in the long run, for example new product development, extending their product range, entering new technical fields, and opening up new markets (ibid.). Consequently and in essence, exploitation activities have great similarities to the cost leader archetype and exploration with differentiation, but they do seem to be more explicit about the time-related aspects of these "strategies". Accordingly, exploitation strategies can be associated with shorter time horizons than can exploration strategies.

Regarding the scarce strategic investment literature in the field, Slagmulder (1997) offers an example of how change towards cost leadership (exploitation) in the strategic orientation of the case company was a trigger to increase the tightness of pre-decision controls. Consequently, a corporate-level body for coordination and screening of investment projects was introduced in the company, and more emphasis was based on more extensive analysis of the profitability and risk aspects of the projects. Furthermore, in line with this finding, Carr et al. (2010) suggested that when evaluating strategic investments, value creators (close to cost leaders) tend to emphasise short-term gains and focus more on formal and financial analysis.

In line with the above discussion, we assume that changes towards more exploitative strategies are connected to developing more mechanistic controls to manage operational efficiency, for example. Hence, we tested the following proposition[13]:

Proposition 2: More emphasis on pre-decision controls over strategic investments is positively associated with the change towards exploitative orientation in investment evaluation.

3.4. Adaptations in pre-decision controls and changes in management

Even though external factors (e.g., financial crises) may act as stimuli for change (e.g., through increased financial pressure), these adaptations may also be shaped by intra-organisational conditions (Greenwood and Hinings, 1996). Namely, aspects related to the interests, values, power, and the capacity for action of the members of an organisation can play a major role in whether the changes will take place, for example (ibid.). Contributions to the prior management research have suggested that managers with a short tenure in the company tend to adopt new thinking and apply new practices, whereas longer-tenured managers tend to rely on already institutionalised practices (e.g., Nakauchi and Wiersema, 2015). Hence, it is suggested that a manager's having short tenure in an organisation has a positive effect on both firm innovation and change (Young et al., 2001). Hambrick and Fukutomi (1991) maintain that as a manager's tenure in a firm lengthens, managers tend to more finely distill and filter information.

With regard to the MCS-related literature, Naranjo-Gil et al. (2009) provide evidence for a negative correlation between the long tenure of a CFO and the use of innovative management control practices (see also Ge et al., 2011). Similarly, Hall (2011) suggests that a more comprehensive performance measurement system can help managers build new mental models of business unit operations, but only for managers with a short organisational tenure. He (p. 71) continues, saying that "managers with a longer tenure are more likely to overlook, not notice and/or selectively interpret information." Further, Burkert and Lueg (2013) provide evidence for a positive association between the short tenure of the CFO and the high sophistication of value-based management.

[13] We also investigate as a control variable the potential association between pre-decision controls and the change towards explorative orientation in investment evaluation.

Cobb et al. (1995), Huikku et al. (2017), and Modell (2001) draw attention to the major role of key individuals in the change process. Davila (2005) found that replacement of the original founder of a firm by a new CEO has a positive impact on modifications in that firm's MCS towards more formalisation. Simons (1994) reports in his longitudinal study that newly appointed managers have a tendency to make major changes in management control systems. Gabarro (1987) suggests that newly appointed managers will initiate changes in formal control systems (or even implement a new system) if their initial assessment shows that the existing system is inadequate. Hence, a change in management can lead to adaptations for controlling risks. Mikes (2009) suggests that choosing the risk management approach is closely related to a firm's calculative culture and the personal beliefs and preferences of senior management. With regard to the capital investment setting, Graham and Harvey (2001) report that top managers with a shorter length of tenure prefer to use more sophisticated discounted cash flow methods (NPV and IRR) than non-discounted cash flow methods, such as the Payback period method.

Accordingly, we provide a proposition to test the potential association between adaptations in pre-decision controls and management change. More specifically, we focus on investigating the change of the manager (the interviewee) that is closely involved and in charge of planning and implementing standard operating procedures for capital budgeting, and is therefore in a position to make or at least suggest those adaptations. Hence, s/he has significant influence when it comes to the design and use of pre-decision controls.

Proposition 3: More emphasis on pre-decision controls over strategic investments is positively associated with the change in management.

3.5. Control variables

Based on the former literature, we have considered several potential control variables that may explain the results and bias them if not included. Therefore, we use the following control variables: firm size, change in strategic orientation towards exploration related to strategic investments, capacity to change, generic strategic configuration, and management style of the company.

Firm size

According to the prior MCS literature, larger companies tend to use more formal controls than smaller companies do (e.g., Chenhall, 2003; Davila, 2005; Merchant, 1981). Large organisations also tend to be more decentralised, so there is inherent pressure to implement more formal procedures and policies (Chenhall, 2003). Typically, larger companies do have more resources and competence to implement complex innovations and systems (Chenhall and Langfield-Smith, 1998). The findings on the importance of firm size as a predictor for change, however, are mixed. Regarding the MCS change literature, Hoque (2014) reports that larger firm size is an important change driver, whereas Libby and Waterhouse (1996) and Williams and Seaman (2001) did not find this kind of positive association.

In the capital budgeting setting, Kumar et al. (1996) report that larger firm size positively relates to the thoroughness of the capital investment process. They further suggest that larger firms require full completion of formalised procedures before authorising investment, whereas smaller firms authorise investments without thorough analysis. Accordingly, larger companies appear to use more formal procedures (Pike, 1986) and more sophisticated techniques in their capital budgeting for profitability and for risk evaluations (e.g., Farragher et al., 2001; Verbeeten, 2006).

Change towards explorative orientation in investment evaluation

In Proposition 2, we test whether more emphasis on pre-decision controls over strategic investments is positively associated with the change towards exploitative orientation in investment evaluation. In practice, there is, however, a consensus among scholars that successful companies simultaneously need both exploitative and explorative activities (ambidexterity), i.e., it is more a question of finding the right balance between these two (see, e.g., Bedford, 2015; Gabrielsson et al., 2016; Gibson and Birkinshaw, 2004; He and Wong, 2004; Kruis et al., 2015; March, 1991). Accordingly, we control whether more emphasis on pre-decision controls over strategic investments is positively associated with the change towards explorative orientation in investment evaluation.

Capacity to change (learn)

According to Cohen and Levinthal (1990, 128), the organisational capacity to learn is "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends." This capacity refers to employees' expertise and experience in converting knowledge into the capability to respond to the changing circumstances (Beer et

al., 2005; Levitt and March, 1988). Libby and Waterhouse (1996) suggest that employees' expertise and knowledge about MCS are essential for organisations to grasp what kinds of changes are actually possible. The organisational capacity to change (via learning) has been reported as a major antecedent for changes in MCS (Hoque, 2014; Libby and Waterhouse, 1996; Williams and Seaman, 2001). In all these studies, the existing number of various MCSs is used as a proxy to measure the MCS expertise (and hence the organisational capacity to learn). Moreover, in the capital investment context, Verbeeten (2006) suggests that expertise in capital budgeting practices provides the capacity to absorb changes in the practices.

Generic strategic configuration of the company

We proposed in Proposition 2 that there is an association between change in strategic orientation towards exploitative orientation in investment evaluation and adaptations in pre-decision controls. In addition to this specific aspect related to change in strategic orientation, we control whether the current generic strategic configuration of the company is also related to the adaptations in pre-decision controls. As in many other management accounting studies (see, e.g., Bedford et al., 2016; Cadez and Guilding, 2008; Carr et al., 2010), we utilise the generic strategy typology by Miles and Snow (1978) for this purpose. Hence, the three options for strategic configuration types are (a) defender, (b) analyser, and (c) prospector. Originally, Miles and Snow typology includes 'reactors', but this is not commonly used in studies.

Management style of the company

According to Goold and Campbell's (1987) management style (parenting style) theory, three generic stereotypes can be identified for companies: financial control, strategic planning, and strategic control. The two main determinants of these groups are related to the corporate centre's planning and control influence on other parts of the company. In financial control companies, most strategic decision-making is left to the business units, and control influence from the centre is characterised by tight financial control (Langfield-Smith, 2005; Nilsson, 2000). Accordingly, annual budget is considered important and budget deviations are seldom tolerated. In strategic planning companies, the centre works with the business unit managers to develop strategy, and less attention is devoted to the control process (i.e., flexible strategic control) (Goold et al., 1993a, b). Finally, strategic control companies combine characteristics of two other management styles. Thus, business unit managers are authorised to make

strategic decisions, but strategy development is coordinated and reviewed by the centre, who sets fairly tight financial and strategic targets (Goold et al., 1993a, b).

4. Data and Methods

4.1. Data Collection

The empirical evidence for this study was gathered during 108 telephone interviews with respondents from among the 150 largest Finnish manufacturing companies between September 2011 and January 2012. Hence, we did not use statistical random sampling; we approached all the target companies. We found the survey method to be the most appropriate to explore the adaptations in a larger sample as suggested by Slagmulder (1997). It was anticipated that the 2008 financial crisis could provide a fruitful momentum for studying potential adaptations in control mechanisms. The crisis had dramatic impacts on the Finnish economy. The GDP fell 8% in 2009 (Statistics Finland, 2017), and the annual capital investment level of the manufacturing industry plunged from 4.7 to 2.9 million euros between 2007 and 2011 (EK, 2012), for example.

The interview survey approach was chosen instead of a mail survey because we felt that by doing so we could ensure that all adaptations were covered and all interpretations of the questions were appropriate. Thereby, we were able to obtain a higher response rate and mitigate the number of missing values. The interviews were conducted by two of the authors, one per each company (Author A conducted 57 interviews and Author B conducted 51, for a total of 108). The response rate (72%) was exceptionally high. The interviewees were the most knowledgeable persons in strategic investment controls in each of the companies. These relevant persons were identified through phone calls, press releases, seminars, newspapers, and referrals from colleagues. Of the respondents, 47% held financial positions (e.g., CFO) and 53% held non-financial positions (e.g., chief operating officer, director of investment, director of technology) in their respective companies at the corporate level. The interviewed managers were closely involved and in charge of planning and implementing standard operating procedures for capital budgeting, and were therefore in a position to make or at least suggest any adaptations. The interviews lasted 42 minutes on average. Of the respondents, 76% had somehow been involved with their company's SMIs for at least four years, and 52%

had been in their current position for at least four years.[14] Hence, the majority of the interviewees had personally been present throughout the whole research period (2008–2011) when the potential adaptations took place.

In many studies, all strategic investments have been addressed as one group (Alkaraan and Northcott, 2007; Carr et al., 2010, Emmanuel et al., 2010). Nevertheless, as in Slagmulder (1997), to limit the scope of our study to a reasonable domain and reach a sufficiently homogeneous basis for analysis, we addressed strategic manufacturing investments (SMI) in manufacturing companies. SMIs play a major role in the capital investment of manufacturing companies. They are substantial investments in manufacturing plants and equipment, such as the introduction of major new production lines, the installation of new manufacturing processes, the introduction of advanced manufacturing technologies, and substantial shifts in production capability (e.g., Alkaraan and Northcott, 2007, Simons, 2000). To ensure that the interviewees perceived this definition of SMI as we did, it was provided at the beginning of the questionnaire. In addition, we listed examples of different types of SMIs and asked whether they had been seriously considered in the company during 2008–2011. The studies done by Slagmulder et al. (1995), and Abdel-Kader and Dugdale (1998) also focused on strategic manufacturing investments.

In 2010, the net sales of the largest company in our database were €42.4 billion, and the net sales of the smallest were €0.1 billion; the average was €1.2 billion. The number of personnel ranged from 42 to 129 000 (the average being 4 222) employees. Of the companies, 55% were listed companies. Strategic manufacturing investments were still highly relevant for the companies studied, even though the capital investment level in the industry decreased during 2008–2011. Almost all the companies (96%) had considered strategic manufacturing investments, and 80% of the companies had considered a substantial increase in production capacity. Additionally, 49% considered the implementation of fundamentally new manufacturing technologies, and 47% entertained the introduction of IT-supported manufacturing processes.

[14] We asked separately how long they had been involved with capital investment procedures in their company, and most importantly, how long they had been in their current position.

A structured seven-page questionnaire (including an additional page defining the concepts) was used to gather data (see summary in Appendix B). The questionnaire was sent by email to the interviewee candidates. Within one week, the managers were contacted by phone and interviews arranged. During the interview, the questionnaire was completed by the interviewer. The questionnaire had three main sections: (1) background questions about the interviewees and their company, (2) the company's current SMI appraisal practices, and (3) recent changes and reasons for the changes, perceived benefits of the changes, and the current need for improvement in the company's investment appraisal practices. Specifically, the third section of the questionnaire also included open questions to ensure an in-depth understanding of the adaptations.

In Section Two (Questions Q8–Q13), which covered current SMI appraisal practices, each of the six questions were addressed twice. First, the current statuses at the time of the interview (2011–2012) were recorded. Then, immediately after each of the six questions, statuses reflecting the situation at the end of 2008 were discussed to record the adaptations that took place during 2008–2011.

Both interviewers were involved in the construction of the questionnaire, and continuous communication between them took place during the interview process. In addition to referring to the concept definition page, this interaction enabled a mitigating of potential interpretation differences related to the questions. The draft of the questionnaire was reviewed by two academics and one executive who had a lot of experience in capital investment and management control systems. Additionally, one pilot interview was conducted by phone with an executive from a company outside the target group. The comments and feedback gained from the academics and the executives resulted in minor changes to the questionnaire.

4.2. Measurement of the variables

Dependent variables

The dependent variable on the aggregate level (for Model 1) consists of 20 pre-decision control mechanisms. These are described in Table 1 (the codes refer to the numbering in the questionnaire). To identify the control mechanisms, we comprehensively reviewed literatures that addressed these aspects. Consequently, the controls we used are a combination of the mechanisms found in Alkaraan and Northcott (2007), Carr et al. (2010), Harris et al. (2009), and Slagmulder (1997). Further, the risk control aspects used can be found in Alkaraan and

Northcott (2006), Arnold and Hatzopoulos (2000), Chittenden and Derregia (2015), Ho and Pike (1991), Pike (1996), and Verbeeten (2006), for example.

An abbreviated version of the questionnaire on which these components are based can be found in Appendix C1. For deeper probing of associations, in line with Slagmulder (1997, pp. 113, 117–8), the pre-decision control (adaptation) mechanisms have been divided into four groups (Models 2–4)[15]: (1) locus of decision-making (max. 4 adaptations), (2) degree of formalisation (max. 6), (3) tightness of control (max. 9), and (4) introduction of new pre-decision control mechanisms (max. 1).

The questions (except for Q9 and Q16a–c) were measured using a Likert-5 scale, indicating how often these controls were used (1=never, 2=sometimes, 3=regularly, 4=almost always, 5=always). Following Alkaraan and Northcott (2007), we chose this scale to facilitate potential comparisons with prior studies. The statuses of these controls were recorded both before and after any adaptations. Because we only wanted to address the directions of the adaptations, not their magnitudes, we calculated the number of controls in which the company had increased their emphasis. This made these counts more comparable with open-ended questions counting only occurrences. Accordingly, we adopted the same dominant approach as other MCS change studies have done in conceptualising the changes as a number of changes done within a specified time period (e.g., Libby and Waterhouse, 1996; Williams and Seaman, 2001; and Hoque, 2014). Contrary to the above-mentioned studies, however, we also explicitly investigated the direction of change (increased emphasis or use of controls).

INSERT TABLE 1 ABOUT HERE

To assess the degree of formality of the existing formal rules for applying capital budgeting techniques (Q9), we asked the interviewees to choose one of six alternatives that best described their policy. An increase in the degree of formalisation was considered if a company had launched formal rules. Additionally, to ensure we were able to cover all relevant

[15] As we will show later in our results, there were no changes in one of the control subgroups (introduction of new pre-decision control mechanisms). Accordingly, we did not construct a model for this.

adaptations in all control subgroups, we also asked in our qualitative part (Q16) whether there had been other adaptations to the controls. In Q16a, we record whether the requirement for authorisation levels had changed (increased or decreased). Furthermore, in Q16b, we record whether the intensity of controls, not just their frequency, had changed. Hence, "more emphasis" is operationalised in our study as the number of controls that are used more frequently or more intensively after adaptations than they were before. In Q16c, we asked whether the firm had introduced new major pre-decision control mechanisms. Each of these three control aspects (16a–c) were analysed, and a dummy variable was formed to indicate whether adaptations had or had not taken place.

Independent variables

Our independent variables include (a) increased financial pressure, (b) change of strategic orientation towards exploitation in the appraisal of strategic investments, and (c) change in management. *Increased financial pressure* has been operationalised as a combination of the deterioration of availability of external and internal funding and a firm's financial performance in relation to shareholder expectations. We asked the interviewees to indicate separately their perceptions of how the changes in the availability of both external and internal funding affected their businesses during 2008–2011. None of the respondents reported changes that moved towards easier availability of funding. Hence, we coded these answers on a scale from 1–5 (1=No, 2=Low, 3=Moderate, 4=High, and 5=Very high impact for more difficult availability of funding; Q15). Measurement of financial performance relative to shareholder expectations was based on Q7 and included seven options: much above (coded as 1), moderately above (2) and slightly above (3) expectations, as expected (4), slightly below (5), moderately below (6), and much below (7) expectations. This item was measured based on the average of Q7 for the years 2008–2010. The independent variable *Increased financial pressure* was constructed using factor analysis and was based on the above three items; the analysis was performed using principal components and varimax rotation. To check the reliability and validity of the construct, we calculated the value of Cronbach's alpha for standardised items (=0.568) and item loadings 0.836 (Q15a), 0.847 (Q15b), and 0.482 (Q7), which were deemed acceptable, considering the fact that there were only three items included in the construct.

To investigate the *change in strategic orientation towards exploitation in the appraisal of strategic investment*, we first asked the managers to indicate how important the various

suggested criteria were in their strategic investment decision-making (see Appendix C2). Immediately afterwards, we asked whether there had been any change in the importance of these criteria. This independent variable was operationalised by combining elements of the Balanced Scorecard (BSC) (Kaplan and Norton, 1996) and exploitation and exploration (March, 1991) literatures. BSC was adopted to comprehensively cover the potentially relevant financial and non-financial criteria (see also Abdel-Kader and Dugdale, 1998; Alkaraan and Northcott, 2007). The BSC approach also helped us pay sufficient attention to all four measurement categories (financial performance, customers, internal business processes, and learning/growth[16]) in constructing the criteria. In our discussions with the interviewees, we were able to ensure that our ex ante–constructed set of criteria covered the essential criteria well. This aspect is also reflected in the trivial number of "other" criteria raised by the interviewees.

In addition to BSC, we draw explicitly on the organisational adaptation literature on exploitation and exploration (March, 1991). We chose this option because it appears to be more explicit regarding the time horizon aspects of the criteria than Porter (1980), and Gupta and Govindarajan (1984), for example. In fact, Gupta and Govindarajan (1984) are also relatively clear in their strategic mission typology (build, sustain, and harvest) regarding the aspects of the time horizon. Accordingly, they suggest that harvest firms (near exploitation and cost leadership) tend to maximise short-term earnings, whereas build companies focus more on market share growth. Nevertheless, we preferred to use only two archetypes and draw on the literature, wherein a more recent discussion in the most prominent management journals on these issues has taken place.

In our hypotheses, we specifically address exploitation aspects (March, 1991). Accordingly, seven criteria were grouped as exploitation: short-term profitability; short-term cash flow; meeting the requirements of the customers in the short run; focusing on less-expensive resources; manufacturing productivity; throughput time, and quality in manufacturing (see

[16] The questions a–d in Appendix C2 relate to financial performance, e–h to customers, i–l to internal processes, and m–p to learning/growth.

Appendix C2).[17] The change towards exploitation was operationalised as the number of exploitation criteria per firm that had become more important in SMI decision-making.

We explored the association between the adaptations in pre-decision controls and *change in management* by measuring the length of tenure of the managers directly connected to the pre-decision controls. We asked the interviewees how long they had been in their current positions (in years). We were specifically interested in whether there had been any change in the position of the best knowledgeable person on pre-decision controls in the company during our evaluation period, 2008–2011. Since this turnover may affect the number of adaptations made in the pre-decision controls during this period, we constructed a dummy variable to indicate whether the interviewee's tenure was 3.5 years or shorter: The dummy variable equalled 1 if tenure was ≤ 3.5 years, otherwise it was 0.

Control variables

We controlled for the effect of *firm size* using net sales[18] for 2011. Regarding Finnish subsidiaries of foreign corporations, we used the net sales of the foreign corporations instead because the (Finnish) subsidiaries themselves are not plausibly responsible for the decisions on their pre-decision control policies (see, e.g., Collier and Gregory, 1995). In our analyses, we used logarithmic net sales.

Because scholars suggest that companies often simultaneously need both exploitative and explorative activities (see e.g., Gibson and Birkinshaw, 2004; Kruis et al., 2015), we control for the *change towards explorative orientation in investment evaluation*. Similar to the investigation of change towards exploitative orientation, we operationalise this as the number of exploration criteria per firm (max. 9) that had become more important in SMI decision-making (see Appendix C2).

As mentioned earlier, the existing control systems' degrees of sophistication may also affect the degrees of adaptations for the controls. In our study, as in many others, this status quo of

[17] These aspects also align with Porter's cost leadership strategy. For example, studies have suggested corresponding divisions for customer and process aspects: He and Wong (2004) in the exploitation/exploration literature, and Baines and Langfield-Smith (2003) and Chenhall and Langfield-Smith (1998) in the Strategy-MCS literature.

[18] Obtained from *Talouselämä,* a Finnish business magazine that lists the 500 largest companies in Finland.

the MCSs is used as a proxy for *Capacity to change (learn)*. More specifically, we operationalise the Capacity to change (learn) as pre-decision control status, which is measured as the number of pre-decision controls used regularly or more often (3–5 on the Likert scale) by the company at the beginning of the research period, i.e., in 2008 (Q11a–g, j; Q10a–c; 13a–e; see Table 1). Nevertheless, in our setting, it is plausible to consider that the degree of sophistication of existing controls may also discourage/limit adaptations in the control mechanisms in extreme cases, if measured only as a frequency of control use. For example, if initiatives on strategic investments are always derived from an explicit strategy, then a firm cannot change that requirement for more frequent strategic alignments. However, in these cases, the thoroughness and strictness of following a specific alignment requirement may change, for example, and influence the tightness of the control.

To control for the effect of *Generic strategic configuration of the company* on the control adaptations, we drew primarily on Shortell and Zajac's (1990) operationalisation of the Miles and Snow (1978) typology (p. 831). Also, e.g., Abernethy and Brownell (1999), Cadez and Guilding (2008), and Chong and Chong (1997) utilised this approach in their accounting studies. Nevertheless, instead of using a Likert-7 scale to determine the strategy of the companies,[19] as in Kober et al. (2007), the respondents were asked to choose one type from the given typology that best described their company's current generic strategic configuration. The three options for the typology were defender (A), analyser (B), and prospector (C) (see Appendix C3; Q5). As the number of defenders was reasonably small (12 firms), we combined them with their closest group, the analysers (Shortell and Zajac, 1990), and formed a dummy variable to indicate whether the firm was a prospector (=1) or not (=0). This dummy variable of *Prospector* was used as an independent control variable in our statistical analyses.

To control for the potential effect of *Management style of the company*, we utilised the descriptions provided by Goold, Campbell and Luchs (1993a, b). The three options are presented in Appendix C4 (Q6): firms with financial control (X), strategic control (Y), and strategic planning (Z). In a similar vein, as with generic strategic configuration of the company, we asked the interviewees to choose one option that best described their company's management style. Again, as the number of firms with financial control was small (9 firms),

[19] Shortell and Zajac classify responses of 1 and 2 as defenders, 3 to 5 as analysers, and 6 and 7 as prospectors. Hence, reactors are not included.

we combined them with their closest group, strategic control, and formed a dummy control variable to indicate whether the firm used strategic planning (=1) or not (=0). This decision also makes sense because firms with financial control and strategic control are similar in the sense that in both cases, their business units are given more power in their strategic decision-making.

With regard to the independent and dependent variables calculated based on counts (i.e., as sums of dummy variables), we emphasise that they can be considered to be formative in nature. Therefore, conventional statistical reliability measures related to them are not reported (Jarvis et al., 2003; Rossiter, 2002).

4.3. Methods

Statistical models

Our dependent response variable for the adaptations of pre-decision controls is the number of adaptations in each company's SMI controls. These numbers are counts limited to the non-negative values 0, 1, 2, …, $\boldsymbol{m}$, where the upper limit $\boldsymbol{m}$ refers to the total number of control types considered in this study. The assumptions of the classical linear regression model estimated with the ordinary least squares (OLS) method demand that the dependent variable is continuous and normally distributed (conditionally on the independent variables). As these assumptions do not typically hold when count variables are used as dependent variables, OLS is potentially not the best (or even a suitable) way to estimate multiple regression models. We verified this issue and checked the residual diagnostics by running the linear OLS model and found this to be the case (see further discussion in the Additional Analysis section). Fortunately, the generalised linear modelling (GLM) technique offers an umbrella under which a wide range of models with different assumptions of probability distributions can be estimated (Nelder and Wedderburn, 1972). Accordingly, we chose to use GLM, which also allows non-linear functional forms to transform the expected value of the dependent variable to the linear combination of the independent variables. The GLM approach has very rarely been used in accounting research, although we sincerely feel it should have been. Nevertheless, Davila (2005) used a Poisson regression model (a special case of GLM where the dependent variable follows Poisson distribution) to study the emergence of MCS. More detailed information about our statistical model can be found in Appendix D.

Non-response bias

To assess the non-response bias, both net sales and the number of employees were compared to the non-respondents with no statistically significant differences detected (t-test; $p>0.05$). Furthermore, the χ^2-test was used to test the difference in the proportion of listed vs. non-listed firms between the respondents and non-respondents; the difference was found to be non-significant ($p>0.05$). Accordingly, it was concluded that non-response bias is not a likely problem in our study. Additionally, the interview approach we adopted enabled us to get answers to all the questions we posed, and hence to eliminate item non-response.

Common method bias

We chose a data gathering method that predominantly relies on self-reporting because we felt confident that the respondents were intimately aware of the tasks they do in their jobs. It is generally recognised that common method bias can be a potential challenge in studies where self-reported data is used instead of archival data. In our study, we used several techniques to mitigate that bias, therefore enhancing the reliability of the data (Podsakoff et al., 2003). Firstly, we told the interviewees that we report results only at the aggregate level and make sure that individual companies and interviewees remained anonymous, thus lowering their incentives to report a prettified picture. On the other hand, we were more focused on elaborating the adjustments that had taken place during the research period than on trying to understand "the degree of sophistication" of their controls *per se*. Secondly, misunderstandings were reduced by conducting the research as a telephone interview, which facilitated defining terminology in detail and posing further follow-up questions to ensure their correct and precise interpretations. Additionally, the questionnaire, including the Appendix on the key concepts, was distributed to the interviewees in advance. Thirdly, the data gathering instrument was pre-tested by pilot respondents. Fourthly, although reported by the respondents, the length of tenure (used for management change evaluation) plausibly included no risk or a trivial risk for bias because the interviewees had no incentive to misrepresent their data. Moreover, the size measures, i.e., net sales and number of employees of each company, were acquired from other sources, independently of our questionnaire and the interviews.

5. Results

The companies were asked to evaluate their firm's average financial performance in relation to their shareholders' expectations during 2008–2011. The results indicated that 41% of the

companies in 2008 and 46% in 2009 perceived themselves to have underperformed, whereas in 2010 and 2011 (34% and 35%, respectively), the situation improved. Hence, it appears that many of the companies were suffering from the depression that began in the autumn of 2008 and hit rock bottom in 2009. Regarding the capital budgeting techniques, 63% of the companies considered the payback period to be their most decisive financial criteria in decision-making (NPV 20%, IRR 11%, and ARR 6%). In addition, almost all the companies (94%) reported the payback period to be one of their three major financial criteria in SMI decision-making (IRR 59%, NPV 57%, and ARR 37%). There were only trivial changes in the emphasis of the major financial criteria between 2008 and 2011. Only one company changed its most dominant decision criterion, and three other companies made modifications to re-prioritise their major financial criteria.

Table 2 shows the statistics for the adaptations in 20 pre-decision controls within the four different subgroups previously introduced in Table 1. To offer a more comprehensive picture of the use and adaptations of various control mechanisms, we show the status averages per question before vs. after the adaptations (i.e., in the beginning of the research period vs. at the time of the interviews). The status questions were measured using a Likert-5 scale to indicate how often these controls were used (1=never, 2=sometimes, 3=regularly, 4=almost always, 5=always). With regard to adaptations, only the direction, not the magnitude, was considered in order to make these answers comparable to the ones where only 0 or 1 option was applicable (Q9, Q16a–c). A trivial number of companies had also decreased the emphasis on some of their pre-decision controls during the research period (see Table 2).[20] Hence, we were in a good position to address only the adaptations related to increased emphasis on pre-decision control (see "Increase" column) and sharpen our exploration accordingly. Consequently, hereinafter we focus our analysis on these adaptations.

INSERT TABLE 2 ABOUT HERE

[20] Altogether there were five companies. We asked them further questions about this phenomenon. Four companies had decreased the requirements for approval level. They reported that their intentional aim was to increase the empowerment of lower level management. In addition, one company had decreased the frequency to require sensitivity analysis. This was related to the changes in its management.

In total, 59% (64 companies of the 108) increased their emphasis on at least one control mechanism. Compared to Slagmulder's (1997) findings in a capital budgeting setting, the companies in our study seemed to adapt their pre-decision controls in similar ways. Specifically, changing the tightness of the controls and the locus of decision-making were common. To a minor extent, companies also changed the degree of formalisation, whereas none of the companies introduced totally new control mechanisms. The major control adaptations were related to the increased intensity in using pre-decision controls (+30%, in 32 companies), such as a more thorough processing of investment appraisals (14 companies), a stricter adherence to (existing) formal instructions and procedures (11), harmonisation of the company's formal procedures (4), and requirements for additional documentation (3). These adaptations referred to a more intense use of controls, not just a more frequent use of them.[21] Additionally, the requirement for higher-level management approvals for investment proposals (+26%) was also a typical adaptation. Other notable adaptations (exceeding 10%) were increased derivation of investment initiatives from an explicit strategy and increased use of sensitivity analysis. In relation to Burns and Scapens' (2000) typology for MCS change, the adaptations clearly seemed to be more evolutionary than revolutionary. Hence, companies commonly made minor, incremental modifications of their pre-decision controls by increasing the frequency or intensity of the control use. Following the categorisation of controls shown in Table 2, the number of increases the companies have made in each control subgroup are presented in Table 3. The companies that made increases typically made only one adaptation per subgroup either, in subgroup 'Locus' or in 'Tightness'. On the aggregate level, the highest number of adaptations made by a company was eight.

INSERT TABLE 3 ABOUT HERE

Based on the interviews, the dominant reasons for keeping pre-decision controls unaltered were a stable environment and/or contentment with the existing controls. Only two respondents named the minor role of SMIs as their only reason, and six mentioned it along with a stable environment or contentment.

[21] These adaptations and their groupings are based on a qualitative interview question (Q16b). In other questions, we focused on the frequency of the control use rather than intensity (as in this question).

Table 4 presents the Pearson correlation matrix for the quantitative independent variables that were studied. The highest correlation was between the size of the firm measured by the logarithm of net sales and its pre-decision control status (r=0.271; p=0.005), indicating that larger firms use more formal and sophisticated controls than smaller ones.

INSERT TABLE 4 ABOUT HERE

Regarding the descriptive statistics of the independent dummy variables, the following findings were recorded: (1) short tenure (≤ 3.5 years) in 48% of the companies; (2) prospector-type of general strategic configuration, 30%; and (3) strategic planning approach in management style, 52%. Additionally, in 50% of the companies, at least one exploitation criterion had become more important, and in 26% of the companies, at least one exploration criterion had.

Table 5 shows the results of our statistical analysis based on the binomial regression model estimated with the GLM. The table presents the aggregate-level model (Model 1) and three models for subgroups (Models 2–4) with the estimated GLM regression coefficients, displayed at the top of the table. The independent variables, including the control variables, are shown on the left. For each model, the estimated coefficients are given with their statistical significance based on Wald's test. The overall omnibus test for the model coefficients is conducted using the likelihood ratio chi-square test, while the deviance and related Pearson chi-square values can be used to check the possible over-dispersion compared to the binomial model choice. In the following, we report the statistical significance at the 10% level or below. The results for Model 1 are also illustrated in Figure 1.

INSERT TABLE 5 ABOUT HERE

INSERT FIGURE 1 ABOUT HERE

Model adequacy

The likelihood ratio and chi-square values for testing the significance of the models are given in Table 5 along with their corresponding p-values: for Model 1 $p<0.001$, Model 2 $p=0.250$, Model 3 $p=0.023$, and Model 4 $p<0.001$. Models 1, 2, and 4 are statistically significant, indicating that the chosen independent variables can jointly explain the dependent variables (the number of adaptations in total, as well as adaptations in formalisation and tightness). However, Model 2 is not statistically significant, and therefore the number of adaptions in locus does not appear to be associated with the independent variables.

The deviance and Pearson chi-square measures can be used to check the probability distribution assumption (McGullagh and Nelder, 1989). As long as their values divided by the degrees of freedom are not extremely far from unity, the models are deemed acceptable, as is the case in our study (see Table 5). Therefore, we concluded that the binomial regression model is adequate.[22]

Financial pressure

As shown in Table 5 (Model 1), the association between financial pressure and adaptations in pre-decision controls is highly significant on an aggregate level ($p=0.003$). Therefore, Proposition 1, which suggests that more emphasis on pre-decision controls on strategic investments is positively associated with increased financial pressure on a firm, is strongly supported. Furthermore, with regard to the subgroup analysis, it appears that increases in the tightness of pre-decision controls are significantly associated with increased financial pressure (Model 4; $p=0.040$).

Exploitative orientation

These results provide evidence that exploitative orientation is significantly related to the adaptations in pre-decision controls (Model 1, $p=0.043$). Accordingly, Proposition 2, showing the positive association between more emphasis on pre-decision controls for strategic

[22] In the case of the binomial regression model, the deviance and Pearson chi-square measures follow asymptotically the chi-square distribution, but for smaller data sets, the p-values may not be relevant (McGullagh and Nelder, 1989), and therefore we do not report them precisely in the report.

investments and the change towards exploitative orientation in investment evaluation, is supported. Additionally, it seems that increases in tightness of the pre-decision controls are significantly associated with change towards exploitative orientation (Model 4; p=0.026).

Change in management

Change in management (here operationalised as the short tenure of the manager directly involved with pre-decision controls) is very strongly associated with adaptations in pre-decision controls on an aggregate level (Model 1; p<0.001). Thus, Proposition 3, suggesting that more emphasis on pre-decision controls is positively associated with management change, is strongly supported. Likewise, change in management is clearly associated with an increasing formalisation of procedures (p<0.001; Model 3) and a tightening of controls (p=0.002; Model 4).

As for control variables, the results show that capacity to change (pre-decision control status before adaptations) is significantly associated with increasing the tightness of pre-decision controls (p=0.007). Furthermore, the strategic planning type of company tends to increase emphasis on pre-decision controls overall (p=0.034), specifically on tightness of controls (p=0.022). We also found a weaker association in Model 1 between strategic configuration and the adaptations of controls (p=0.069). Accordingly, non-prospectors seemed to lean more towards adapting their controls. Changes in strategic orientation towards exploration is weakly associated with increasing tightness of controls (p=0.095). It appears that size of a company is not associated with the adaptations of controls.

Additional analysis

With regard to robustness testing, we estimated alternatives for all models reported in Table 5: (1) multiple linear regression models estimated with OLS; (2) binary logistic regression models predicting whether there was a change; and (3) GLM using an alternative as the link function, or logit function.

We report our findings shortly as follows:

(1) To check the residual diagnostic assumptions of the multiple linear regression model, we ran the OLS model and found that the model assumptions were not fulfilled; the residual plots showed a strong dependence on the predicted levels of the dependent variable, and strong heteroscedasticity as well as a large deviation from normal distribution. Therefore, a multiple

linear regression model estimated with OLS was not suitable for our data, clearly because of the dependent variables being counts. For this reason, we do not report the results of the OLS analyses in more detail.

(2) Although the binary logistic regression (binary logit) model only takes into account whether or not the adaptations were made, it caught the association between management change and adaptations of pre-decision controls (p= 0.002) on the aggregate level, as well as between the increased financial pressure and adaptations of pre-decision controls (p=0.006). However, the association between change towards exploitative orientation and the adaptations was not found to be significant. Although this model also revealed the major associations, we did not find all the relationships as we did with the GLM, or the associations were weaker. However, there was one exception: In the binary logit model for locus adaptations, management change was statistically significant at a 10% level (p=0.054), although in the original model it was not (p=0.163).

(3) We also tried the GLM using the logit function as the link function instead of the negative log-log function used in our binomial regression model. It turned out that both link functions gave practically the same results.

As the log of net sales was not statistically significant in any of our models, we also performed the GLM analysis without it as a control variable. The statistical conclusions actually remained qualitatively similar for all models. Furthermore, we studied other potential control variables, particularly whether listing and different sectors of the manufacturing industry are related to the number of pre-decision control adaptations. Nevertheless, we did not find them significant in our models, and with regard to other variables, the results remained practically the same.

6. Discussion

This study investigated how changes in companies' economic, strategic, and organisational conditions relate to an increased emphasis on pre-decision controls of strategic investments. Based on the prior literature, we identified controls that were further categorised into four control subgroups (adaptations in locus of decision-making, degree of formalisation and tightness of control, and introduction of new control mechanisms). We constructed four separate models - one for the aggregate level and three for each control subgroup as a dependent variable - to explore the associations between these adaptations in controls and the changed conditions. Contrary to our initial plan, we did not construct a model for the control

subgroup "introduction of new pre-decision control mechanisms" because there were no changes in it.

The increased financial pressure on a firm, the change in strategic orientation towards exploitation related to strategic investments, and change in management were investigated as independent variables. In congruence with prior MCS change studies (e.g., Chanegrih, 2008; Hogue, 2014; Libby and Waterhouse, 1996; Sulaiman and Mitchell, 2005; Williams and Seaman, 2001), we opted to measure the adaptations (in dependent variables) as the number of changes made. Nevertheless, contrary to their approach, we analysed the direction of the adaptations, not just the existence of adaptations in the controls. The associations were investigated using binomial regression models estimated in the general linear modelling (GLM) framework. The GLM suits well when the dependent variable is measured as a count. The empirical data was based on 108 interviews from among the 150 largest Finnish manufacturing companies, and the interviews address pre-decision controls of strategic manufacturing investments.

Generally speaking, our empirical examination revealed that companies do adapt their pre-decision controls in order to respond to changes in economic, strategic, and organisational conditions. In our study, we found that 59% had increased their emphasis on these controls. The major adaptations (in 30% of the companies) were related to the increased intensity in the use of procedural pre-decision controls, such as more thorough processing of investment appraisals, stricter adherence to formal instructions and procedures, harmonisation of the company's formal procedures, and the requirement of additional documentation. Additionally, the requirement for higher-level management approvals for investment proposals (26%) and improved derivation of the investment initiatives from an explicit strategy (15%) were among the most typical adaptations.

The companies typically made only minor, incremental modifications to their pre-decision controls by increasing the frequency or intensity of their control usage. Consequently, the adaptations reported in our study seem to be evolutionary (Burns and Scapens, 2000). Our results corroborate Slagmulder's (1997) findings about how companies adapt their capital investment pre-decision controls. As for control subgroups, changing the tightness of controls and the locus of decision-making were common, but a minor number of companies also

changed the degree of formalisation. None of the companies introduced totally new control mechanisms.

In congruence with our proposition, the results clearly suggest that changes in management can play a very significant role in the adaptations of pre-decision controls. Management change was highly (positively) associated with adaptations on the aggregate level and in the subgroups of increased formalisation and tightness. These results are novel in the pre-decision control literature. They are in line with the findings in multiple studies on management (e.g., Hambrick and Fukutomi, 1991; Nakauchi and Wiersema, 2015) and MCS literatures (Davila, 2005; Hall, 2011; Modell, 2001; Naranjo-Gil et al., 2009), maintaining that newly appointed managers have a greater tendency to modify their control procedures. They are also in accordance with Mikes (2009), who suggested that the choice of risk management approach is related to the personal beliefs and preferences of senior management, and with Graham and Harvey (2001) who reported that top managers with different lengths of tenure do prefer using different pre-decision controls in their capital budgeting.

Additionally, the results provide strong supportive evidence for our proposition that companies facing a challenging financial situation tend to emphasise pre-decision controls. Specifically, it appears that firms tend to increase the tightness of these controls. These findings agree with Van Cauwenbergh et al. (1996), who maintain that during financial pressure, managers tend to examine investment appraisals more thoroughly, and also Carr et al. (2010), who suggest that companies may alter their practices when facing a decline. Nevertheless, we add to the literature by verifying this with rigorous statistical analyses and a larger sample. In addition, more generally speaking, our finding is in congruence with the broader accounting literature, thus suggesting that economic causes may thrust companies towards change in their management controls (see, e.g., Granlund and Lukka, 1998; Hopwood, 2009; Van der Stede, 2011).

We also found support to suggest that changes in strategic orientation towards exploitation in investment evaluation are associated with an increased emphasis on pre-decision controls on the aggregate level, and specifically regarding increased tightness of controls. Changes towards exploitation were commonly related to adopting requirements for shorter-term cash flows and profitability, and improvements leading to them (such as improving manufacturing productivity and throughput time and the use of less expensive resources). This parallels

Slagmulder (1997), who found that changes towards cost leadership triggered a tightening in formal pre-decision controls. Accordingly, we extend the literature by statistically corroborating her findings. More broadly speaking, in line with our results, Vesty et al. (2015) also show how environmental sustainability-related pressures can result in changes in corporate strategy and affect the pre-decision controls.

Moreover, we included the capacity to change as a control variable, operationalised as the level of pre-decision controls before adaptations, and we found that a higher level of formalism of controls was highly (positively) associated with the increased tightness of controls. This finding is in congruence with those of Libby and Waterhouse (1996), Williams and Seaman (2001), and Hoque (2014), indicating that companies with a higher existing number of various MCS (used as a proxy to measure their expertise in MCS and therefore the organisational capacity to change) are more likely to modify their systems. In other words, managers in these companies potentially have a better capacity to absorb changes in the controls because they know what kinds of adaptations are actually possible (see, e.g., Verbeeten, 2006). Furthermore, in terms of management style, we found evidence that strategic planning types of companies tend to increase the tightness of their controls.

7. Conclusions

In this study we respond to Alkaraan and Northcott's (2007) call to enhance the understanding of the choice and design of pre-decision controls in strategic investments. The study enhances our understanding of the adaptations in pre-decision controls by investigating their relationships to external and internal environmental changes in a larger sample than Slagmulder's (1997) study. Accordingly, we are able to apply statistical methods to our data and find statistically significant associations. Our study contributes in many ways to the capital budgeting literature by shedding light on the adaptations of pre-decision controls in the appraisal of strategic investments; it is an area largely overlooked by the literature. Firstly, we are the first to show that changes in management may play a decisive role as a trigger for control adaptations in a capital budgeting setting. Secondly, we extend the literature by providing strong statistical support to maintain that increased financial pressure can be related to the tightened use of pre-decision controls. Thirdly, in comparison to Libby and Waterhouse (1996), we contribute to the literature by providing a more nuanced picture of the adaptations of various control mechanisms. We not only show whether any kind of change has occurred within capital budgeting but we also address adjustments in 20 different control mechanisms.

By further grouping the controls into four control groups instead of addressing only one on an aggregate level, we were able to explore specific characteristics of different control subgroups. Fourthly, we add to the literature related to the research of Libby and Waterhouse (1996) by analysing the effect of the direction of the adaptations (i.e., increased control), not by just considering the existence of adaptations in the controls. Our findings can also be relevant for managers; specifically, based on our results, it seems that in order to initiate changes in formal systems, new managers may need to be introduced, or current managers should feel more pressure to implement the changes.

Our results are not free from limitations, and these should be taken into account when interpreting these results. First, we have intentionally targeted a period of major financial crisis (2008–2011) because it was plausible to anticipate that we would find more adaptations during that time than in a less challenging economic situation. In this kind of distressed period, it was expected that companies would modify their use of controls more often. This research period, however, may limit the generalisability of our findings to some extent. Nevertheless, in addition to finding ample companies who were adapting their controls and hence facilitating a more rigorous statistical analysis, we were able to focus on the direction of those adaptations. In other words, our focus was on the increases in controls because only a trivial number of the companies had reduced their use. However, by adopting this approach, we did not account for these (few) adaptations. In our analysis, we have not tried to use the magnitude of the Likert-5 answers (only the number and the direction) in order to make these more comparable to the qualitative questions that were counting only occurrences. Due to the relatively low number of adaptations taking place per control mechanisms, we did not extend our statistical examination to this more detailed, potentially interesting level, but remained at the subgroup level.

It also appears that the open-ended questions indicating increased intensity to use procedural controls, and the requirement of higher-level management approvals were the most often cited. This indicates that despite the pre-testing, we had not accounted for this in our structured questions in the questionnaire. Accordingly, we suggest that researchers undertaking similar studies in the future explicitly account for potential changes in intensity, not just in frequency. Specifically, this aspect can be critical in mail surveys. Nevertheless, thanks to our interview method, we feel confident that we were ultimately able to record all the relevant adaptations that had been made. Moreover, focusing on strategic manufacturing

investments in manufacturing companies may limit the generalisation of our findings, but we feel that it was appropriate to follow Slagmulder (1997) and study a reasonable domain, reaching a sufficiently homogeneous basis for the controls. There is a risk that different types of policies and routines related to Mergers & Acquisitions, ICT, and New Product Development, for example, would have potentially made the questioning too blurry.

Our study could also be extended. For this study, we purposely targeted a period of general financial recession that potentially triggered more increases in the usage of controls than a more normal period would have. Hence, it would be interesting to study the extent to which companies modify their controls during different economic situations and how they do so. Additionally, we specifically addressed strategic manufacturing investments. It would be fruitful to study the pre-decision controls and their dynamism for Mergers & Acquisitions, New Product Development, and ICT investments, and also extend research to other industries. Highly regulated industries like banking and insurance, where a major part of the assets are financial, would provide an interesting setting to further investigate the reasons behind changes in risk controls, for example (cf. Jabbour and Abdel-Kader, 2015).

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Appendix A. Common pre-decision controls used in capital investment

Formal procedures for planning, evaluation and selection

Formal rules for applying capital budgeting techniques
Formal investment approval limits assigned to different hierarchical levels
Formal procedures/dedicated teams for planning phase coordination
Presentation of financial estimates in the formal meetings
Pre-designed decision points during the planning phase
Top management involvement in the planning phase
Managers' interaction with other managers to coordinate investments
Derivation of the initiatives from an explicit strategy
Sensitivity analysis
Scenario analysis
Simulation analysis
Capital Asset Pricing Model analysis
Required payback period to take into account project-specific risk
Required rate of return according to the project-specific risk
Conservative cash flow estimates to take into account project-specific risk

Appendix B. Summary structure of the Questionnaire

Section 1: Background questions about the interviewee and his company
Q1: Current position
Q2: How long in current position
Q3: Types of SMIs considered
Q4: Personal involvement in the appraisal of SMI
Q5: Strategic orientation
Q6: Management styles
Q7: Performance in relation to shareholder expectations

Section 2: Company's current SMI practices
Q8: Primarily used financial investment criteria
Q9: Standard operating procedures for different types of investments
Q10: Adjustments to account for higher level of risk per investment project
Q11: Questions about initiation, planning and decision-making phases
Q12: The most important criteria in SMI decision-making
Q13: Formal risk analysis required
Q14: Strategic analysis (N/A)

Section 3: The recent changes and current needs in company's investment appraisal practices.
Q15: Magnitudes of changes in internal and external environment of the company
Q16: Major recent changes in investment appraisal practices (open question)
The drivers for changes in the pre-decision controls. Reasons for not changing pre-decision controls.
Q17: Perceived benefits achieved through the changes in pre-decision controls (N/A)
Q18: Current needs to change investment appraisal practices. Open question (N/A)

Appendix C1. Abbreviated interview questions (Likert-5 scale; 1: Never, 5: Always)

When using the capital budgeting techniques for evaluating strategic manufacturing investment proposals for strategic manufacturing investments, how frequently do you make project-specific formally stated adjustments to account for higher level of risk? (Q10)
a) Shorten the required payback period
b) Raise the required rate of return according to project risk
c) Use conservative cash-flow estimates

How often do the following aspects apply in the appraisal of strategic manufacturing investments at the moment in your company? (Q11)
a) We use formal procedures for planning, evaluation and selection of SMIs.

b) Initiatives on SMIs derive from an explicit strategy.
c) Top managers get involved early in the planning of the SMIs.
d) We apply formal procedures or dedicated teams to coordinate the various SMIs during the planning phase.
e) Managers responsible for developing investment proposals intensively interact and discuss with other managers to coordinate the various SMIs during the planning phase.
f) We present financial estimates in the formal meetings during the SMI planning phase.
g) We use a pre-designed decision point(s) that can lead to abandonment of an SMI proposal during the planning phase.
j) For capital expenditure in SMIs, we use formal approval limits assigned to different hierarchical levels.

What kind of risk analysis do you require as part of the strategic manufacturing investment proposal? (Q13)
a) Sensitivity analysis
b) Scenario analysis
c) Simulation analysis (Monte Carlo)
d) Capital Asset Pricing Model (CAPM) analysis
e) Other, please specify

Appendix D. Statistical model - GLM

To apply GLM, we made the natural assumption that the counts arise from independent identically distributed (i.i.d.) random experiments (binary trials), therefore, following binomial distribution. In essence, we estimated a binomial regression model. In addition, we transformed the linear combination of the independent variables into the mean of the dependent variable, using a link function, referred to as g(·) (McGullagh and Nelder, 1989).

More specifically, to develop the GLM we considered a linear function of the independent variables X_1, X_2, …X_k as follows:

$$\eta = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k \,, \quad (1)$$

where ***k*** refers to the number of independent variables used in the model and β_1, β_2,…, β_k are their regression coefficients. To apply the GLM, the binomially distributed counts are transformed into the interval [0, 1] by making them proportional to ***m***, which indicates the maximum number of adaptations per company in each control type:

$$Y = \text{count}/m \quad (2)$$

Further, the link function g(·) transforms the expected value of the dependent variable $\mu = E(Y)$ to the linear predictor:

$$g(\mu) = \eta \,, \quad (3)$$

where we have chosen the negative log-log function $g(\mu) = -\ln(-\ln(g(\mu))$ as the link function in our case.

Therefore, since the link function g(·) is invertible, then the GLM for the expected value becomes

$$\mu = g^{-1}(\eta) = g^{-1}(\alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k)$$

$$= \exp(-\exp(-\eta)) \quad (4)$$

where g^{-1} refers to the inverse function of g and exp to the exponential function. It is a non-linear model and is estimated numerically using the maximum likelihood estimation (MLE) technique. We used the negative log-log function as the link function in our GLM analysis, since negative log-log is recommended, if the dependent variable lower categories are more probable, which turned out to be the case for our data. This analysis was performed with the GLM module in SPSS, and the optimisation method used was hybrid. The individual hypothesis tests are based on Wald chi-square statistics.

Appendix C2: Question 12 and division between exploitation and exploration

Considering strategic manufacturing investments, indicate how important are the following criteria in decision-making. Please read through all the criteria before answering (No=1, Low=2, Average=3, High=4, Dominant=5).

Criteria	**Exploitation vs. Exploration**
The proposed strategic manufacturing investment…	
a) ensures the growth of sales	Exploration
b) improves profitability in the short run (within 2 years)	**Exploitation**
c) improves profitability in the long run (beyond 2 years)	Exploration
d) improves cash flow in the short run (within 2 years)	**Exploitation**
e) enables meeting the requirements of customers	**Exploitation**
f) improves our reputation and image as a manufacturer	Exploration
g) enables flexibility to changes in markets	Exploration
h) enables proximity to customers	Exploration
i) enables use of less-expensive resources	**Exploitation**
j) improves manufacturing productivity	**Exploitation**
k) shortens manufacturing throughput time	**Exploitation**
l) improves quality in manufacturing	**Exploitation**
m) enables access to skills and knowledge	Exploration
n) enables gaining experience in promising technologies	Exploration
o) is aligned with the strategy of our network partners	Exploration
p) develops new manufacturing capabilities	Exploration

The last column (division between exploitation and exploration) has been added after interviews. The answers to the other criteria (q-r in the original questionnaire; 'Other, please specify') were almost non-existing and are accordingly ruled out.

Appendix C3. Questions about the general strategic orientation

Which of the following descriptions best describes your company's current strategic orientation? (Q5)

Firm A maintains a "niche" within its industry by offering a relatively stable set of products. Generally Firm A is not at the forefront of developing new products in its industry. It tends to ignore changes that have no direct impact on current areas of operation and concentrates instead on doing the best job possible in its existing arena.	□
Firm B maintains a relatively stable base of products and services while at the same time moving to meet selected, promising new market developments. The firm is seldom "first in" with new products and services. However, by carefully monitoring the actions of companies (like Firm C below), Firm B attempts to follow with a more cost-efficient or well-conceived product or service.	□
Firm C responds rapidly to early signals of market needs or opportunities. It makes relatively frequent changes in its set of products and services. It consistently attempts to pioneer by being 'first in' in new areas of market activity, even if not all of these efforts ultimately prove to be highly successful.	□

Appendix C4. Questions about the management style

Which of the following descriptions best describes your company's current management style? (Q6)

Firm X: Most strategic decision-making is left to the business units. Following up the annual budget and/or financial targets is very important and deviations are tolerated only in exceptional circumstances.	□
Firm Y: Most strategic decision-making is left to the business units but corporate management reviews and challenges strategic plans. Following up the annual budget and/or financial targets is important within the context of strategic and financial performance.	□
Firm Z: Corporate management is highly involved in the formulation of the strategic plans of the business units. Annual budgets and/or financial targets tend to be flexible, and are reviewed within the context of strategic as well as financial performance.	□

Table 1

Adaptations of pre-decision controls

Changing locus of decision-making	
Top management involvement early in the planning phase	Q11c
Managers interaction with other managers to coordinate the various investments	Q11e
Use of formal investment approval limits assigned to different hierarchical levels	Q11j
Requirement for higher level management approvals for investment proposals	Q16a
Changing degree of formalisation	
Use of formal procedures for planning, evaluation and selection	Q11a
Derivation of the initiatives from an explicit strategy	Q11b
Use of formal procedures/dedicated teams for planning phase coordination	Q11d
Presentation of financial estimates in the formal meetings during the planning phase	Q11f
Use of a pre-designed decision points during the planning phase	Q11g
Use of formal rules for applying capital budgeting techniques	Q9
Changing tightness of control	
Shortening the required payback period to take into account the higher project-specific risk	Q10a
Raising the required rate of return according to the project-specific risk	Q10b
Use of more conservative cash flow estimates to take into account the higher project-specific risk	Q10c
Use of sensitivity analysis required as a part of the investment proposal	Q13a
Use of scenario analysis required as a part of the investment proposal	Q13b
Use of simulation analysis required as a part of the investment proposal	Q13c
Use of Capital Asset Pricing Model analysis required as a part of the investment proposal	Q13d
Use of other risk analysis required as a part of the SMI proposal	Q13e
Intensity to use procedural pre-decision controls	Q16b
Introduction of new pre-decision control mechanisms	
Introduction of new major control mechanisms	Q16c

Table 2

Descriptive statistics about adaptations

Changing locus of decision-making	Status before [a]	Status after [a]	Decr.	No Change	Incr.	Increase (%)
Top management involvement early in the planning phase	3.93	3.97	0	105	3	3 %
Managers interaction with other managers to coordinate the various investments	3.24	3.27	0	106	2	2 %
Use of formal investment approval limits assigned to different hierarchical levels	4.37	4.43	0	105	3	3 %
Requirement for higher level management approvals for investment proposals	NA	NA	4	76	28	26 %
Number of companies [b]	108	108	4	72	33	31 %
Changing degree of formalization						
Use of formal procedures for planning, evaluation and selection	3.61	3.70	0	103	5	5 %
Derivation of the initiatives from an explicit strategy	3.44	3.66	0	92	16	15 %
Use of formal procedures/dedicated teams for planning phase coordination	3.23	3.27	0	105	3	3 %
Presentation of financial estimates in the formal meetings during the planning phase	3.57	3.61	0	106	2	2 %
Use of a pre-designed decision points during the planning phase	2.81	2.85	0	105	3	3 %
Use of formal rules for applying capital budgeting techniques	NA	NA	0	106	2	2 %
Number of companies [b]	108	108	0	90	18	17 %
Changing tightness of control						
Shortening the required payback period to take into account the higher project-specific risk	1.99	2.06	0	102	6	6 %
Raising the required rate of return according to the project-specific risk	1.89	1.93	0	105	3	3 %
Use of more conservative CF estimates to take into account the higher project-specific risk	2.19	2.23	0	105	3	3 %
Use of sensitivity analysis required as a part of the investment proposal	3.14	3.32	1	94	13	12 %
Use of scenario analysis required as a part of the investment proposal	2.62	2.76	0	101	7	6 %
Use of simulation analysis required as a part of the investment proposal	1.13	1.14	0	107	1	1 %
Use of Capital Asset Pricing Model analysis required as a part of the investment proposal	1.23	1.23	0	108	0	0 %
Use of other risk analysis required as a part of the SMI proposal	1.29	1.38	0	103	5	5 %
Intensity to use procedural pre-decision controls	NA	NA	0	76	32	30 %
Number of companies [b]	108	108	1	62	45	42 %
Introduction of new pre-decision control mechanisms						
Introduction of new major control mechanisms	NA	NA	0	108	0	0 %
Number of companies [b]	108	108	0	108	0	0 %
TOTAL NUMBER OF COMPANIES[c]	**108**	**108**	**5**	**42**	**64**	**59 %**

[a] Means of Likert-5 scaled variables have been used in the status columns (n=108). Status after (adaptations) shows the situation at the time of the interview. Status before (adaptations) shows the situation before adaptations had taken place.

[b] This accounts for the total number of companies that have made at least one control increase in the control subgroup.

[c] Number of companies totally (decreased, no change, increase) add up to 111 (not 108), because 3 companies have simultaneously decreased and increased different control mechanisms.

Table 3

Adaptations in pre-decision control subgroups

	Number of companies that have increased control, n = 108				
Nr of increases	Locus (4)	Formalisation (6)	Tightness (9)	New controls (1)	Total (20)
0	75	90	63	108	44
1	31	10	30	0	30
2	1	5	7	-	19
3	1	2	7	-	3
4	0	0	0	-	6
5	-	1	1	-	3
6	-	0	0	-	1
7	-	-	0	-	1
8	-	-	0	-	1
9	-	-	0	-	0
10-20	-	-	-	-	0

Theoretical maximum number of adaptations for each subgroup and total are given in parenthesis.
The number of companies that have decreased control is not considered in this table.

Table 4

Pearson correlation matrix of quantitative independent variables. Dummy variables have been excluded from this table

	Financial Pressure	Exploitation	Exploration	Log of Net Sales	Control Status
Financial Pressure	1.000				
Exploitation	0.084	1.000			
Exploration	0.071	0.209	1.000		
Log of Net sales	-0.026	-0.064	-0.067	1.000	
Control Status	-0.009	0.108	0.049	0.271	1.000

Table 5
Results of the generalised linear model

	Type of pre-decision controls							
	Model 1		Model 2		Model 3		Model 4	
	Total		Locus		Formal		Tightness	
	coeff.	sig.	coeff.	sig.	coeff.	sig.	coeff.	sig.
Intercept	-1.516		-1.264		-1.142		-1.903	
Financial pressure	0.099	0.003 ***	0.087	0.204	0.085	0.178	0.101	0.040 **
Exploitation	0.071	0.043 **	0.049	0.496	0.014	0.838	0.116	0.026 **
Changes in management	0.305	0.000 ***	0.187	0.163	0.482	0.000 ***	0.310	0.002 ***
Log of net sales	0.002	0.904	0.046	0.262	-0.066	0.112	0.005	0.869
Exploration	0.078	0.150	0.005	0.963	0.082	0.435	0.134	0.095 *
Control status	0.026	0.071 *	-0.012	0.672	0.018	0.486	0.060	0.007 ***
Prospector	-0.149	0.069 *	-0.261	0.122	-0.069	0.655	-0.188	0.131
Strategic planning	0.146	0.034 **	0.118	0.402	0.015	0.909	0.239	0.022 **
Likelihood ratio Chi-square	48.631	0.000 ***	10.215	0.250	17.7	0.023 **	38.9	0.000 ***
	value	value/df	value	value/df	value	value/df	value	value/df
Deviance	173.4	1.751	88.1	0.890	116.9	1.181	118.6	1.198
Pearson Chi-square	172.7	1.745	99.0	1.000	180.8	1.827	123.3	1.246

Degrees of freedom df=99, for each model; *, ** and *** denote significance at the 0.10, 0.05 and 0.01 level, respectively.

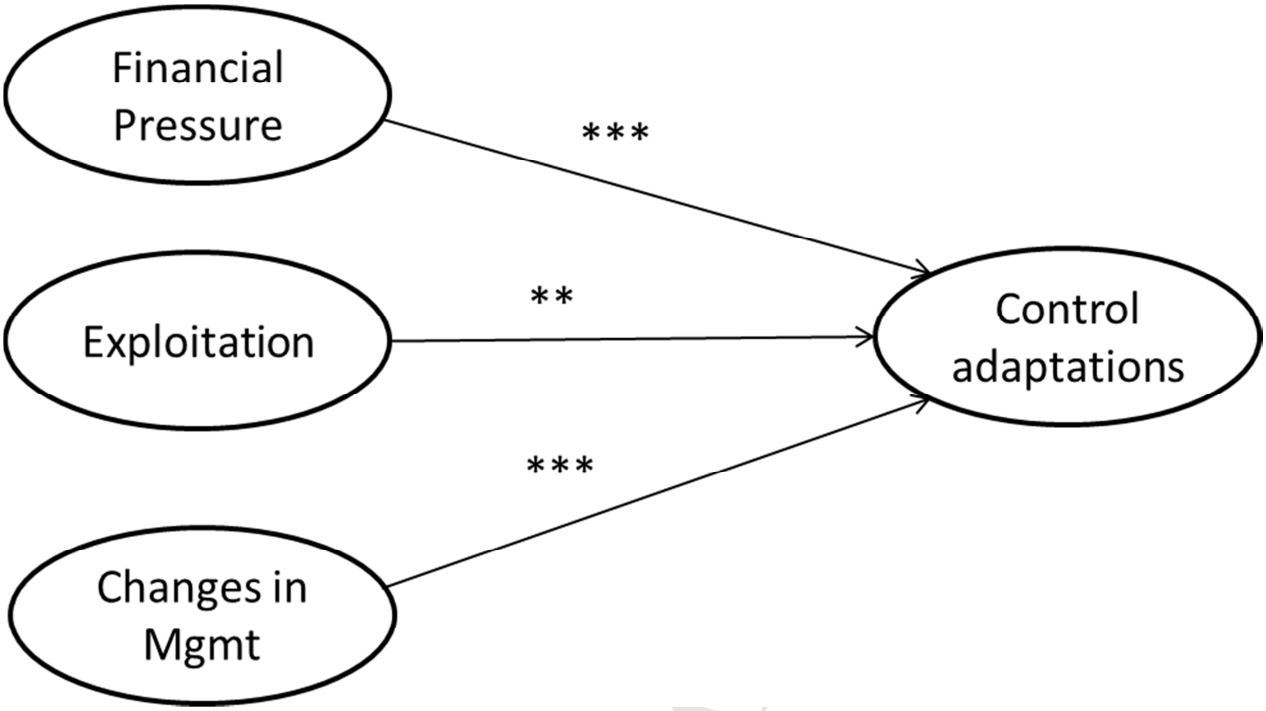

Figure 1. Results of the generalised linear model (Model 1, Aggregate level) (n=108). *, ** and *** denote significance at the 0.10, 0.05, 0.01, respectively.