TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

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Performance Measurement Dynamism in Product Development

Julkaisu 1218 • Publication 1218

Tampere 2014

Tampereen teknillinen yliopisto. Julkaisu 1218
Tampere University of Technology. Publication 1218

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Performance Measurement Dynamism in Product Development

Thesis for the degree of Doctor of Science in Technology to be presented with due permission for public examination and criticism in Festia Building, Auditorium Pieni Sali 1, at Tampere University of Technology, on the 19th of June 2014, at 12 noon.

Tampereen teknillinen yliopisto - Tampere University of Technology
Tampere 2014

ISBN 978-952-15-3303-7 (printed)
ISBN 978-952-15-3399-0 (PDF)
ISSN 1459-2045

ABSTRACT

Korhonen, Tuomas, 2014: 'Performance Measurement Dynamism in Product Development'

Keywords: Management control, uncertainty, product development project portfolios, project portfolio management

Guiding action with timely performance measures is crucial for attaining organisational goals. However, we lack an adequate theoretical understanding of the various loci of performance measurement dynamism to provide that timeliness. Consequently, longitudinal, qualitative studies of the notion of performance measurement dynamism have been sought in the literature. The literature has expected performance measurement dynamism to occur in situations characterised with high perceived environmental uncertainty, making product development a potential context for studying performance measurement dynamism. In product development, there are considerable uncertainties involved and also product development project controls should evolve over time to match their context. However, there is currently no adequate understanding of how organisations could maintain the timeliness of their performance measurement in product development.

Contrary to some previous studies in performance measurement dynamism, this thesis takes an actor's approach rather than a systems approach to performance measurement. By taking the actor's approach, this doctoral thesis contributes to the literature on performance measurement dynamism by showing the various loci of performance measurement dynamism inside and outside the formal systems of performance measurement. This thesis also contributes to the literature on performance measurement dynamism by suggesting that in environments with low sophistication of performance measurement systems, the actor's approach to performance measurement might particularly provide evidence of performance measurement dynamism. Furthermore, performance measurement dynamism is discussed along with other controls within a management control system package and as a phenomenon that is present when a management control system repair is made.

This doctoral thesis draws its conclusions based on four original articles. The first and second original articles examine the area of product development project portfolio uncertainties. The findings of these two articles can be used to supplement the previous understandings of performance measurement dynamism drivers, especially in the context of product development. Interviews in Finnish industry serve as data in these articles. The conclusion based on the first two articles is that single-project-related uncertainties should also be considered as possible performance measurement dynamism drivers, supplementing the viewpoints of environment and organisational complexities as such drivers. Moreover, these original articles imply that various types of management control are applied to manage product development project portfolio uncertainties.

The third original article provides a level structure of the loci of performance measurement dynamism. The loci of performance measurement dynamism provided are the role of performance measurement in a management control package, the use of measures, the selection of measures and the components of single measures. In the article, the level structure of performance measurement dynamism is illustrated by an interventionist case study at a geriatric healthcare provider. Furthermore, the positive effect of certain temporal, ad hoc measures is shown by the case study.

The fourth original article examines the dynamics of repair of a management control system, particularly in product development. The article draws from an interventionist case study of the product development department within a machinery manufacturing company. The case study reveals that management control system repair takes place within the interplay of managers at different organisational levels.

As a whole, this doctoral thesis contributes to the literature on performance measurement dynamism, accounting and control in new product development as well as product development project portfolio management. It provides new knowledge on performance measurement dynamism in the context of product development while taking the actor's approach, supplementing the often-emphasised formal and process-related viewpoints to performance measurement dynamism with more informal viewpoints. With its original combination of performance measurement dynamism, product development, management accounting and control and project portfolio management literature, this doctoral thesis provides multiple further research avenues for researchers from these disciplines to draw from.

ACKNOWLEDGEMENTS

There are few ways this doctoral thesis can be attributed to me alone. I have been privileged to work with many talented and kind people that have helped me go forward. I therefore wish to first and foremost thank my co-authors of the articles of this thesis. Prof. Petri Suomala, thank you for offering me the job, helping me to get funded, co-authoring two of the articles in this thesis, providing me with guidance on the topic of accounting and supervising my thesis with all the constructive comments you gave me. I feel that during my doctoral studies, you managed to assure me you trusted in my ways of working. That I greatly value. At times, I gave you some challenging schedules of developing the thesis and going on with the whole process, but to me it simply seemed that you were there to accept the challenge. In short, Petri, you have sorted many things out. Basically for the same reasons, I also wish to thank Teemu Laine, who co-authored all the articles in this doctoral thesis. Thank you Teemu for all the support you have given me inside and outside the Cost Management Center (CMC) office. Without your support it would have been way more painful for me to write this thesis. Already in the beginning of my career, particularly you Teemu gave me a crash course in the practices of industry-university collaboration and in writing scientific publications as joint efforts of different individuals. I hope many kinds of joint efforts are still ahead of us. Similarly, I am deeply grateful to Prof. Miia Martinsuo for co-authoring two articles in this thesis and introducing me to a new field and community of research. Without Miia's contribution I believe this thesis would still be on its way. I also wish to express my gratitude to the pre-examiners of this doctoral thesis, Prof. Hanne Nørreklit and Prof. Trond Bjørnenak. I hope this doctoral thesis can serve as the beginning of many fruitful collaboration projects with all of you.

There are experiences related to writing a thesis and experiences related to working as a researcher in a research group. For both of these facets but particularly for the latter one I thank you, my fellow CMC-ers, the present and the past ones with whom I have had the privilege to work with. So thank you CMC members that have not already been mentioned: Jari, Krister, Sanna, and Santi; and of course Erno and Matti. However meaningful you have become for me in making my work pleasant, you have naturally contributed to the former of the abovementioned facets as well—whether it has been a discussion or a reading. Outside CMC I would like to thank Tomi Nokelainen for the discussions, for example, on the philosophy of science and all the help with different manuscripts, and Mika Ojala for his support and company already starting before my doctoral studies. At the faculty level, I would like to express my gratitude to Stefanie Kohlhoff for helping me notice and meet the deadlines and therefore helping me manage to accomplish the official part of the doctoral thesis process. At the department of Industrial Management, I would especially like to thank Sirpa and Heli for regularly helping with so many small issues and Jukka for keeping the motor running.

Without the company representatives that granted me and our research group access to their data and practices, there would be much less to discuss in this doctoral thesis. So, many thanks go to you kind practitioners who promoted our presence in your companies or let us have a word with you. You have not only provided us sources of interesting data but have also been an inspiration behind many thoughts during my journey as a researcher. I would also like to express my deep gratitude to the companies, Tekes—the Finnish Funding Agency for Innovation and the doctoral programme of TUT's President that all provided me with research funding during my doctoral studies.

Moreover, thank you, my brother Lauri, for your company that is so important to me. Although we have not possibly discussed this thesis too thoroughly (yet!), you have always been there to give your support. And most of all, I am thankful to my loved ones—my dear wife Heidi and my dear kids. Without you this effort that has resulted in this doctoral thesis really could not have been possible. You have been there for me. You have pushed me when I have needed pushing. You have allowed me to pursue this whole thing even though it has consumed a lot of my resources. For all of that and the privilege of having you… I thank you.

Tampere, June, 2014

Tuomas Korhonen

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RESEARCHER'S CONTRIBUTION TO THE ARTICLES

In the first original article, 'Management control of project portfolio uncertainty: a managerial role perspective', and the second original article, 'Identifying, framing and managing uncertainties in project portfolios', I conducted research interviews in Finnish industry together with my fellow researchers. I analysed the interview data gathered using Atlas.ti software and therefore provided key findings on which the conclusions were based. Furthermore, in the first original article, I was the first author. Therefore, I was responsible for writing the majority of the article and going through the review process. In the second original article, my role was to collect and analyse the data as well as to write and improve the results section of the article throughout the review process.

In the third original article, 'Understanding performance measurement dynamism: a case study', I was the data collector and conducted the interventionist case study within a healthcare company. As the first author, it was my duty to write and improve the paper throughout the review process.

In the fourth original article, 'Exploring the possibilities of enabling accounting in NPD projects', my role was the main data collector to gather information from a machinery manufacturing company. My data collection in this case took place in 2010–2012 (2010–2014 with the augmented data set) and comprised most of the data the article is based on. Furthermore, I had a central role in writing the empirical section of the paper and was actively involved in analysing the collected material and developing the paper for the conference.

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Part I: The introduction to the article compilation

PROLOGUE: A DAY AT A FICTIONAL OFFICE

It is a day at a company's office. The atmosphere at the company is quiet but busy, which is typical of this season. The past performance is being appraised, and the next year's budget negotiations are starting. Three managers—a project manager (PjM), a product development manager (PdM) and a business manager (BM)—are sitting undisturbed in the company lobby after attending a steering group meeting during which a new product development project was the focal point. While the PjM will manage the overall project progression, the PdM is now in charge of the product development resources. The BM will be responsible for the new product once it is ready for the market. The discussion has turned towards performance measurement.

BM: Look, guys, I've been thinking… ehh… How we currently measure our product development… Is it relevant at the moment for the work we do? I mean… Does the research and development spending provide any relevant information for our needs? It's only linked to the number of people working, not the outcome of product development.

PjM: True. In any case, what you really know is the resource consumption… but is that relevant for your informational needs?

BM: Exactly. Is that information relevant for our work at the moment? It's important of course. But how important?

PdM: Well… I don't know… I myself need to pay attention to the product development resources, because my budget is limited [winks at the BM]. But still, with my current resources having been cut by the recession, which one should I prioritise now: the product profitability or the cost of used product development resources? The targets are a bit misleading, or at least conflicting…

PjM: …I fully agree with what you've just pointed out. I'm responsible for taking care of this product development project. I need to develop a product with my engineers that will make good business. Right? But the costs of the product development project seem to be more important than product profitability when the performance of this project is appraised. I know there is a common resource pool, don't get me wrong. But the target material costs of the product are important. How can I reliably estimate the costs of a product that has not yet left the drawing board?

PdM: I know. Not all the costs have already been fixed, and consequently it is difficult for me to say whether the project performance is currently at an adequate level or not.

BM: Aha! So, ultimately, you're saying that it's impossible to tell, before the product launch, if the project is a success or a failure? It can't be so, if we want to be steering the project. For me, the project performance kind of equals the outcome we get from it.

PjM: I think so too… Yes… But to what extent should I use the performance targets as guidelines for my actual project management work as there are more critical performance indicators that are driven by the customers? I mean quality, et cetera…

BM: I guess we have to accept that this is difficult and there is no correct answer. Do we have a choice? To emphasise issues at some points of time; to manage; to steer; to measure; to decide… It's all hard. We know it. But it's something we get paid for.

PdM: Yeah, I agree. Sorry guys, I must go now… let's get back to this later…

> We see a move away from simple frameworks and processes to a more nuanced view of the field … Driving performance through measurement is not feasible in situations where the environment is changing rapidly, solutions are uncertain and precise measurement infeasible. These situations are increasingly common in research, new product and service development, … In these situations people need to engage with the intent of the KPIs [key performance indicators] and take them for what they are – just indicators of performance and not real performance. (Bourne et al., in press, p. 2)

1. PERFORMANCE MEASUREMENT DYNAMISM AS A RESEARCH SUBJECT

1.1. Motivation of research and key concepts

1.1.1. The need for research on performance measurement dynamism

Performance as a notion is perhaps undefinable in the absolute; rather, performance is situated in a context and in a decision-making situation (Lebas, 1995). When an organisation evaluates its successfulness in terms of attaining certain goals, the measurement of that performance, or performance measurement (PM), becomes a relevant term to be used. According to Wouters (2009), 'A performance measure is a translation of a notion of performance into a number that can be calculated with available data' (p. 71). These performance measures simplify reality and offer users of those measures a tool to understand complex business phenomena in a bite-size form, i.e. 'measuring means transforming a complex reality into a sequence of limited symbols that can be communicated and that can be, more or less, reproduced under similar circumstances' (Lebas, 1995, p. 23).

A PM system can contain processes, such as 'selection and design of measures', 'collection and manipulation of data', 'information management', 'performance evaluation and rewards' and 'system review' (Franco-Santos et al., 2007, p. 798). PM, however, cannot entirely be defined as *systems*. From a broader perspective than PM alone, management accounting 'refers to a collection of practices such as budgeting or product costing, while MAS [management accounting system] refers to the systematic use of MA [management accounting] … to achieve some goal' (Chenhall, 2003, p. 129). Indeed, goals, objectives, aims, targets or whatever else they are called all set norms directing or guiding people inside organisations to act in a certain way. What this means is that management accounting and target setting are largely intertwined with social aspects of human and organisational behaviour. According to Burns and Scapens (2000),

> programmatic rule-based behaviours could be described as routines–as they represent the habits of the group. Here, routines can be defined as the way in which 'things are actually done'.... In the context of management accounting, rules comprise the formal management accounting systems as they are set out in the procedure manuals, whereas routines are the accounting practices actually in use. (pp. 6-7)

In other words, I do not expect PM to necessarily take place only through some pre-defined systems or processes; I expect that it will also take place in situated actions. Such situated behaviour could be managers informally negotiating whether a performance target has been reached or not. In this negotiation, PM is clearly a relevant viewpoint, but no pre-defined PM processes necessarily exist. This informal viewpoint to PM, which this doctoral thesis portrays, is in line with recent contributions on the philosophical standpoints of PM research. PM can be considered from an objective (systems) or a subjective (actor's) viewpoint that emphasises the subjective interpretation of PM in an actor's reality (Cinquini et al., 2013).

In particular, I shed light in this doctoral thesis on a certain attribute of PM: its dynamism or change. The notion of PM dynamism refers to reviews of PM to match the context in which it is used by providing relevance with regard to timely goals and changes that might have occurred (e.g. Henri, 2010). There is a strong consensus in the literature that PM needs to evolve as the surrounding environment and

organisational targets change.[1] This view is supported by PM studies in business measurement (Bourne, 2008), operations research (Bourne et al., 2000; Kennerley & Neely, 2003; Kennerley & Neely, 2002; Wisner & Fawcett, 1991), management accounting research (e.g. Henri, 2010; Malina & Selto, 2004; Nanni et al., 1992) and strategic management research (Kolehmainen, 2010; Micheli & Manzoni, 2010). If PM dynamism does not occur, organisations are said to suffer from irrelevant measures that are not capable of distinguishing between good or bad performance (Meyer & Gupta, 1994, in Kennerley and Neely, 2002). There is a known need to update performance measures to match them with strategy and appraisal systems, but 'it is rare to see organisations investing in the capability to review and update the system on a regular basis' (Bourne, 2008, p. 69). The lack of updated PM systems, per se, does not, however, dictate that change or dynamism should only exist in formal systems and perhaps not outside the formal domain of control by changing practices (Burns & Scapens, 2000; Lukka, 2007).[2]

There is already an understanding that PM dynamism occurs through systematic processes (Bourne et al., 2000; Kennerley & Neely, 2003; Kennerley & Neely, 2002) or via adoption of ad hoc measures (Kolehmainen, 2010; Vaivio, 1999). However, little is known about the loci of PM dynamism in actual practice. Possibly focusing on the systems approach on PM (see Cinquini et al., 2013), some of the literature on PM dynamism has perhaps reiterated the formal models of PM dynamism that have themselves already been quite elaborate (Bourne et al., 2000; Kennerley & Neely, 2003; Kennerley & Neely, 2002). Have we been dealing with smaller and smaller questions (as stated in, Bourne, 2008, at a general level about how research has progressed) rather than profound ones that would situate PM in time and space? If that is the case, research has possibly begun to slow down the progress of actually understanding that PM always is subject to change (whether it changes or not) inside and outside the formal change processes (whether these processes exist or not).

To further motivate research on PM dynamism, research is called for to provide an 'understanding [of] how organisations maintain their fit with their environment and continue to survive and prosper in what is becoming an increasingly faster changing and more volatile business environment' (Bourne, 2008, p. 71) and to understand the extent to which PM supports organisational change (Franco-Santos et al., 2012). In particular, Franco-Santos et al. (2012) call for further research to answer the question: 'How can CPM [contemporary performance measurement[3]] systems encourage flexibility and dynamism' under the current economic climate (p. 100). The methods for building substantial dynamism in PM systems have been underemphasised (Kolehmainen, 2010, p. 528). In sum, a more in-depth understanding of PM dynamism, as a theoretical concept, must be acquired, which has been noticed in the literature (Henri, 2010).

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[1] It has long been acknowledged that accounting is a dynamic phenomenon. In the 1930s, Scott (1937) stated in The Accounting Review that: 'Accounts are always in process of changing. Their development is to be seen in changing forms of original records and in evolution of the balance sheet and income statement.... We must remember that our fundamental problem is not elimination of the confusion in accounting practice or conflicts of opinions among accountants but rather an adaptation of accounting to the situation which has given rise to conflicting opinions and confused practice.' (p. 141)

[2] Another disclaimer is that while PM dynamism may exist in an organisation, this does not necessarily ensure that an organisation is heading in the intended direction (Micheli & Manzoni, 2010, p. 472).

[3] A thorough definition of a contemporary PM system is given in the literature. Based on this definition, I argue that I am raising a possibly contradictory viewpoint to Franco-Santos et al. (2012) with regard to understanding PM processes as a necessary condition for a CPM system to exist or not. They do, but I do not because I see the potential of informal, situated behavior to contribute to the dynamism of PM. They say, 'We argue that a CPM system exists if financial and non-financial performance measures are used to operationalize strategic objectives. This definition is based on a number of assumptions. Firstly, the definition assumes that the role of CPM systems is to evaluate performance for either informational or motivational purposes (regardless of the organizational level at which performance is evaluated). Secondly, it assumes that CPM systems comprise a supporting infrastructure, which can vary from being a simple method of data collection and analysis (using, for example, Excel) to a sophisticated information system facilitated by enterprise resource planning platforms or business intelligence solutions. Finally, it assumes that CPM systems involve specific processes of information provision, measure design, and data capture, regardless of how these processes are conducted.' (Franco-Santos et al., 2012, p. 80)

As an answer to the above calls for further research in PM dynamism, this doctoral thesis explores the concept of PM dynamism. In this doctoral thesis, I examine the various types of longitudinal, context-situated PM dynamism that occur in relation to a broader variety of management controls. This means that PM dynamism might not be examinable if it is separated from its wider management control context (e.g. from values and administrative controls, in Malmi & Brown, 2008). In sum, this doctoral thesis provides a framework through which PM dynamism can be understood and further examined and illustrates the variety of loci of PM dynamism that can complement the formal PM change processes suggested by some authors (e.g. those by Bourne et al., 2000; Kennerley & Neely, 2003; Kennerley & Neely, 2002).

1.1.2. The need for research on performance measurement dynamism in product development

The previous literature portrays various case studies on the notion of PM dynamism (e.g. Bourne et al., 2000; Braz et al., 2011; Kennerley & Neely, 2002; Kolehmainen, 2010), and the very scientific core of PM dynamism research largely relies on case accounts. However, contextual generalisations of PM dynamism have not been a key emphasis (i.e. small or medium-sized companies, information technology firms, etc.), which makes it possible that PM dynamism, particularly in certain contexts, is not yet entirely understood. This holds, although the context of manufacturing has been an emphasised context for PM dynamism research (Kolehmainen, 2010). Studies by Wisner and Fawcett (1991), Ghalayini et al. (1997), Bititci et al. (2000), and Bourne et al. (2000) are some examples of studies on PM dynamism in manufacturing. Therefore, quite a lot is already known about PM dynamism, particularly the management of PM dynamism in the manufacturing context, via the accumulation of knowledge. The emphasis of possibly similar contextual generalisations, particularly when combined with understanding the diffusion of management accounting constructs and specific change processes, could possibly provide a variety of researchers with insightful results (Burns, 2000; Lukka & Kasanen, 1995). In line with these arguments, longitudinal in-depth case studies of PM dynamism have been sought (Bourne, 2008; Henri, 2010). However, the outcome has often not been a contextual, in-depth account of PM dynamism in that context, per se, but an elaboration of the notion of PM dynamism (for instance, Braz et al., 2011, in maritime industry). Henri's (2010) study on PM dynamism was on 383 manufacturing companies; however, it was quantitative and did not operate at the level of single organisations.

Nevertheless, research acknowledges the need to contextualise PM dynamism. According to Micheli and Manzoni (2010), in order to *purposefully* design a strategic PM system (SPMS), managers should ask *themselves* '[w]hy is the organisation introducing (or reviewing) an SPMS?'; '[w]hich roles do we want it to play?'; and '[w]ill its characteristics be consistent with its aims?' (pp. 473–474). These questions pave the way for understanding a PM system in a context somewhere in time and space. According to Micheli and Manzoni (2010), the answers to the questions above can (or should) then:

> determine the number and kind of performance indicators, the type of reviews that will be conducted, and the main features of the SPMS as a whole. In particular, the organisation will have to decide the degree of flexibility it wants to embed in the [strategic performance measurement] system, according to its envisaged use in both the short and the long term. The balance between alignment and empowerment, and the frequency of reviews and audits will determine the dynamism of the system. Also, the design of the SPMS will have to depend on the environment in which the organisation operates, its strategy, its links with key stakeholders, and the implications the measurement system may have in maintaining the current, or shaping the future, organisational culture. (p. 474)

Micheli and Manzoni (2010) call for cross-disciplinary research that 'will have to provide a clear definition of both key features and teleological aspects of the PMS [Performance Measurement System] (or SPMS) under consideration' (p. 474). Miller (2007) also points out that there is a need to 'pay attention to the links between calculative practices and the programmes they seek to operationalise' (p.

294). Malmi and Granlund (2009), in line with the previous argument, state that 'the goodness of any MA [management accounting] practice depends on the objectives of the users of MA as well as the organizational and social context in which MA practice takes place' (p. 598).

In this doctoral thesis, I make the teleological assumption that product development PM is a part of organisational efforts to assess whether the work done in product development is done well or not. Hence, the meaning given to PM is to support product development control. Numerous viewpoints support the argument that PM dynamism should be studied in the context of product development. First, empirical results show that PM dynamism is more likely to occur if perceived environmental uncertainty is higher (Henri, 2010). In the context of product development, uncertainties are considered high due to a time-space distance between the actual product development work and the outcome of that development (Hertenstein & Platt, 2000; Jørgensen & Messner, 2010). In addition, the transformation process of some inputs to certain outputs is not absolutely known beforehand in research and development (R&D), which creates uncertainty (Ouchi, 1979). Intuition and creativity are present; thus, the outcome of product development is uncertain and not easily (if at all) a priori estimated. Second, previous evidence of PM dynamism leaves room for more elaborate scrutiny of PM dynamism occurring in the context of product development. Third, project management literature shows that some dynamic controls should take place in dynamic projects. A dynamic project:

> [r]equires the creation of new controls that are changed regularly during execution[;] [h]as high levels of unknowns at the start and a high rate of new unknowns throughout[; and] [m]ust resolve the unknowns at a faster rate than they appear, and in time for completion (Collyer & Warren, 2009, p. 357).

However, there is little evidence of the product development context being accompanied by dynamism of performance measures. This is the case although a variety of PM objects have been identified in the R&D setting, i.e. measures concerning a project, a project portfolio, the R&D function and the level of innovation (Davila & Wouters, 2007). Consequently, there is no adequate knowledge on how organisations are able to maintain the relevance of their PM systems, particularly in product development. Another factor further necessitating research on PM dynamism in product development is that it would be useful to understand PM dynamism drivers in product development because product development performance is a central part in setting and fulfilling organisations' long-term business objectives (e.g. Brown & Svenson, 1988; Hertenstein & Platt, 2000). Without goal-aligned measures, such fulfilment is hampered (though possible, as in Jordan & Messner, 2012).

In sum, dynamism is considered an important attribute of PM in keeping performance indicators up-to-date, and it seems likely that PM dynamism occurs in product development (at least to some extent) due to the inherent uncertainties of the context. The study of PM dynamism in product development could further the understanding of the actual loci of PM dynamism in an uncertain context. There is still an inadequate understanding of the loci of PM dynamism taking place in the context of product development. This doctoral thesis is an attempt to address this lack of knowledge. In particular, this doctoral thesis addresses PM dynamism drivers in the context of product development and investigates some context-situated dynamism in product development PM.

1.1.3. The need to discuss performance measurement dynamism in product development in relation to management control change

Since there are few studies on PM dynamism in product development, it is reasonable to allow more widespread and discussed areas of research to inform my work on understanding PM dynamism. PM systems can be considered one part of the management control system (MCS) package of different control mechanisms (Malmi & Brown, 2008). Malmi and Brown (2008) state that, '[S]tudying these systems

individually may influence any conclusions we can draw, if the use and impact of a new MCS element is related to the functioning of the existing broader MCS package' (p. 288).

Based on this background, it seems valid when studying PM dynamism in product development to build upon the literature of accounting and control. Moreover, MCS literature provides a broad and theoretically elaborated background to create an understanding of how MCSs change—and how PM dynamism occurs as a part of that broader MCS change. Literature on accounting and control provides some background knowledge on the characteristics of the product development context in particular and on MCS changes, especially in product development. A handful of MCS system adoptions and changes have already been studied and reported in the product development context (e.g. Burns, 2000; Jørgensen & Messner, 2009; 2010; Nixon, 1998). Too little, however, is still known about the types of management control change through which PM dynamism occurs in product development.

In order to understand the role played by PM dynamism in the overall response to change pressures in the context, one must also understand other change responses within an MCS and the sources of those change pressures. Following Malmi and Brown (2008), and in addition to their cybernetic (i.e. measurement) systems, I also acknowledge the existence of certain administrative, cultural, planning and reward and compensation controls as parts of an MCS package. The (dynamic) intertwinedness of these different types of controls has been explicitly sought by researchers to draw more coherent and reliable conclusions on MCSs (Malmi & Brown, 2008). With this background in mind, in this doctoral thesis, I consider PM dynamism, i.e. change in cybernetic controls (Malmi & Brown, 2008), or cost and financial management to operate in a wider context of management controls that are a means to managing product development (project portfolio) uncertainty.

1.1.4. The need to do research on local control system repair in product development

This doctoral thesis presents a level structure of PM dynamism—a structure that could be used to study the context of product development. A local PM adaptation to change pressures could be interpreted as a local repair effort of an MCS that takes place in the formal and informal domains of control (Burns & Scapens, 2000; Lukka, 2007). Such 'repair' has been proposed as a characteristic of an enabling control (bureaucracy) in contrast to a coercive one (in addition to 'internal transparency', 'global transparency' and 'flexibility', in Adler & Borys, 1996).

The dynamics of the local MCS repair have not been researched in the past in the context of product development, although a top management repair has been proposed (Jørgensen & Messner, 2009). In this doctoral thesis, particular interest is directed towards changes that take place in the informal domain of control in order to examine the levels at which PM dynamism occurs in product development in connection to the types of MCS dynamism. This doctoral thesis sheds light on the dynamics of the repair of a product development control system.

1.1.5. Summary of the research objectives and their relation to the original articles

This doctoral thesis aims to scrutinise the concept of PM dynamism in the context of product development. In order to reach this objective, I draw from literature found under the broader topics of management accounting and control, operations management, strategic management and general management on the topics of PM dynamism and MCS change and their drivers, particularly in product development. The literature on product development project portfolios further illustrates the context of product development. Furthermore, new product development (NPD) accounting and control literature provides a comprehensive background to draw from and contribute to with regard to contextual characteristics of product development.

Therefore, this doctoral thesis is a cross-disciplinary one between the disciplines of management accounting, project portfolio management and R&D. After examining this background, I ground the theoretical findings to a product development context in the Finnish machinery manufacturing industry. I believe this doctoral thesis has the potential to contribute to PM literature by providing some practice-grounded insight to the theoretical understanding of PM dynamism. However, scrutinising the concept of PM dynamism in the context of product development could be impossible without dividing the task into smaller questions. In Figure 1, I present which areas of this task, i.e. which research questions, each article of this compilation-type doctoral thesis presents.

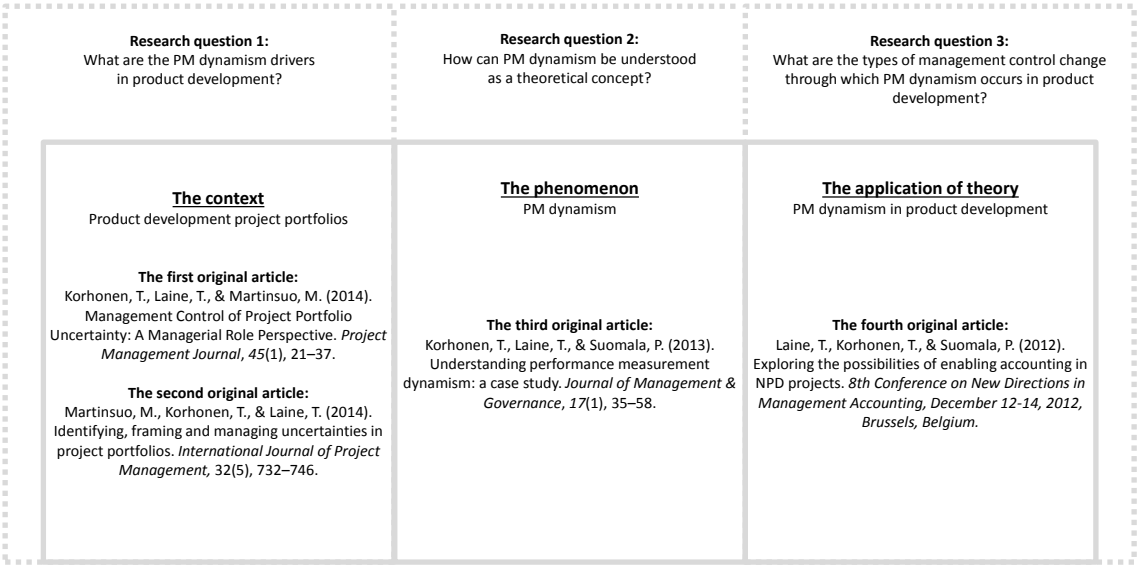

Figure 1. Partitioning of this doctoral thesis into the original articles.

In summary, the first original article and the second original article provide information on the context of product development by providing insight from sources of product development project portfolio uncertainties and the means of managing them. The third original article provides a theoretical framework that can be used to analyse the loci of PM dynamism in the product development context. Finally, the fourth original article provides a contextualised account of longitudinal PM dynamism within the NPD accounting of one machinery manufacturing company. The fourth original article specifically examines PM dynamism (or the lack of dynamism) that took place around a target cost measure of a new product under development. This account can be interpreted through the theoretical framework introduced in the third original article, and further developed in reflection to the literature on MCS repair. This doctoral thesis augments the findings of the fourth original article to provide conclusions on PM dynamism in product development, as a part of a MCS repair.

1.2. Research methodology and data

1.2.1. Overview of the methodological choices made

In this doctoral thesis, two methodological choices are emphasised, i.e. the choices to conduct interview research and interventionist case study research. Both approaches represent methodologies that draw from real-life accounting phenomena. As a whole, I have made the assumption that by drawing from these methodological choices, and respectively two sources of qualitative data, it is possible for me to answer the research questions of this doctoral thesis. As Flyvbjerg (2006) has noted,

> The case study is useful for both generating and testing of hypotheses but is not limited to these research activities alone. (p. 229)

The previous note from Flyvbjerg can also be referred to when discussing the interviews carried out for this doctoral thesis, because using these interviews can be seen as a multiple case study. The overall strategy of this doctoral thesis is largely based on the assumption seen in Flyvbjerg's note above, that a case study can provide input for further research by theorising and, for example, providing testable propositions. In Flyvbjerg's (2006) terminology, the selection of the cases in this doctoral thesis is possibly nearest to paradigmatic cases, i.e. 'cases that highlight more general characteristics of the societies in question' (p. 232). In this case, the *societies in question* would, in particular, comprehend organisations conducting product development, especially in Finland.

The interview study, in this case, is a field study since it draws from more than one organisation; the interventionist case study focuses on only one organisation (Hesford et al., 2007). Philosophically, there is no contradiction among the choices made since both methodologies can be fuelled by the researcher's interpretation. In terms of recent contributions to the field of management accounting (Kakkuri-Knuuttila et al., 2008), this doctoral thesis assumes that although interpretation is a source of the findings, some objective theorisations can also be made based on them. Grey areas in Burrell and Morgan's (1979) strict dichotomy of functionalist versus interpretive paradigms have been proposed, for example, in management (Gioia & Pitre, 1990) and information systems (Goles & Hirschheim, 2000) literature.

The empirical research data in this doctoral thesis is qualitative and has been collected through observation and interpretation. The ultimate objective is not to find causal explanations but to examine phenomena that would probably be difficult to address from a distance. The concept of PM dynamism, with its variety of manifestations in the formal and particularly informal domains of control, could potentially be a phenomenon that would benefit from thorough, real-life access to organisational practices. These practices can be accessed through research interventions, for example (Suomala & Lyly-Yrjänäinen, 2012). In order to provide an in-depth understanding of PM dynamism in product development, it is important to examine how the notion occurs (rather than 'why', e.g., in Lukka, 2007). However, in this doctoral thesis, the drivers of PM dynamism play with the idea that a driver of (or a 'why' behind) PM dynamism can be identified. It must be remembered, however, that seeking causal chains might even be detrimental to advancing the understanding of 'directly lived experience' (Denzin, 2001, p. 44). Regardless of this viewpoint, I still believe there is potential to further the field by taking small steps toward understanding PM dynamism in product development. A *relationship* between certain phenomena can be seen as central to theoretical contribution (Whetten, 1989); here, the relationship is between a PM dynamism driver and the loci of dynamism with regard to PM (or other mechanisms of control).

Table 1 portrays an overview of the data collection methods of the original articles compiled in this doctoral thesis. Methodological choices are presented in more detail in the following sections. As Table 1 shows, the data in the first and second original articles was gathered from interviews in Finnish industry. The third and fourth original articles use data from two separate interventionist case studies.

Table 1. Overview of the data collection methods in the original articles.

	Original article 1	*Original article 2*	*Original article 3*	*Original article 4*
Subject	A managerial role perspective to product development project portfolio uncertainties	A framing perspective to product development project portfolio uncertainties	The loci of PM dynamism	Developing enabling accounting for NPD project management
Methodology	Interview study	Interview study	Interventionist case study	Interventionist case study
Timeframe	~ 11 months (2011–2012)	~ 11 months (2011–2012)	~ 19 months (2009–2010)	~ 36 months (2009–2012) The augmented data set and analysis: ~ 52 months (2009–2014)
Data type	21 interviewees from six machinery manufacturing companies; over 31 hours of transcribed interview recordings	28 interviewees from 10 Finnish industry companies (comprising the data from original article 1); over 42 hours of transcribed interview recordings	Mainly field notes from an interventionist study in and interviews from a balanced scorecard development project within a geriatric healthcare provider	Field notes from 118 (augmented to 130) data collection situations in a multinational machinery manufacturing company
Data analysis	Systematic Atlas.ti coding used	Systematic Atlas.ti coding used	No systematic coding used; instead, findings were thematically discussed	No systematic coding used; instead, findings were thematically discussed (Systematic Atlas.ti coding used during the augmented analysis)

As seen in Table 1, systematic coding with Atlas.ti software was not used in all articles (the third and fourth original articles were written earlier than the two first articles). While this can be considered a possible weakness (inconsistency of the articles of the compilation or a less-transparent path from fieldwork to conclusions), the research methods in this doctoral thesis have been subject to the natural development of the researcher's ability to conduct research and provide findings to a wider academic audience. When Atlas.ti software was later used (original articles 1 and 2), it was possible to provide a more transparent path from initial interview data to conclusions made. Interview quotes were linked to researchers' interpretations and cross-tabulated in order to draw conclusions about the relationship (cf. Whetten, 1989) between certain matters (in original articles 1 and 2). Also the data in the fourth original article was later analysed with Atlas.ti software, but those findings are beyond the scope of the version of the fourth original article. However, this introduction (Part I) of the doctoral thesis draws also from the later analyses that augment the scope of the fourth original article.

Although the third and fourth original articles might lack some of the systematic data analysis methods used in other articles compiled in this doctoral thesis, there is no reason to believe the results of the other articles would merely be accredited to the methodological choices made. Indeed, it is important that a piece of research is conducted with important research questions in mind, with reasonable scientific rigour and with consistent philosophical assumptions made about what can be said about certain phenomena. All the original articles in this doctoral thesis have specific research questions or an objective that are addressed or strived for, documented methodological choices to ensure assurance of rigour, and the interpretivist philosophical assumption that although there is no objective truth, some small steps can humbly be made in order to advance knowledge of certain phenomena (in line with the famous Epistle to

the Reader, in Locke, 1700) be it natural scientific or behavioural scientific. In particular, I try to avoid the conclusion that little advice could be given to the practitioner audience because the reality is complex.[4]

1.2.2. Interview study on performance measurement dynamism in product development

The first and second original articles compiled in this doctoral thesis were based on interviews conducted within the Finnish industry. Multiple-informant interviews were conducted in ten companies[5] (see Table 2) representing a sample of machinery manufacturing companies (1–7) and a control group of other industry companies (8–10). The interviews represented purposeful sampling of a homogeneous population to some extent (Merchant & Van der Stede, 2006). People in the roles of 'Portfolio manager (business)', 'Portfolio manager (financial)', 'Program manager', and 'Project manager' were interviewed concerning their viewpoints on product development project portfolio uncertainties and their management. The interview questions concerning product development project portfolios were part of a wider interview agenda on the roles of management accounting in product development. The questions the first and second original articles were mainly based on addressed the sources and management of change pressures that affected the product development project portfolios in the interviewed companies during the past year.

Table 2. Overview of the interview data collected for original articles 1 and 2.

#	*Industry*	*Managerial roles interviewed*	*In original article 1*	*In original article 2*
1	Machinery and service provider	Portfolio managers (business and financial), Program manager, Project manager	X	X
2	Manufacturing systems and service provider	Portfolio managers (business and financial), Program manager	X	X
3	Machinery and service provider	Portfolio manager (financial), Program manager, Project manager	X	X
4	Manufacturing machinery and service provider	Program manager		X
5	Manufacturing machinery provider	Portfolio managers (business and financial), Program manager, Project manager	X	X
6	Manufacturing machinery provider	Portfolio manager (financial), Project manager	X	X
7	Machinery and service provider	Portfolio manager (business), Program manager, Project manager	X	X
8	ICT product and service provider	Program manager		X
9	Consumer product manufacturer	Portfolio managers (business and financial), Program manager		X
10	Information systems and services provider	Portfolio manager (business)		X

[4] 'The more sociologically grounded literature has frequently offered practitioners little advice beyond emphasising the complexities of purposeful management control' (Ahrens & Chapman, 2007, p. 24).

[5] The interview round of this doctoral thesis was conducted quite similarly to the interviews conducted by Davila (2000) for his study on MCS development in NPD. In his study, 12 business units in seven companies were studied by interviewing project managers, marketing managers, R&D managers, general business unit managers and a person in charge of NPD process guidelines.

The interview with company 4 was not included in the first original article because it did not provide a multi-informant perspective of the firm. The interviews with companies 8–10 were not included in the first original article because they did not provide information on the chosen industry, i.e. machinery manufacturing. Since neither of these conditions was necessary for data in the second original article, interviews from all the companies served as data for that article.

The interview data enables the first and second original articles to have the potential to acquire an 'understanding of multiple environmental, organizational, and individual factors that might affect the design, implementation, and/or effectiveness of the management accounting practices being studied' (Merchant & Van der Stede, 2006, p. 128). However, the interview data allows only snap-shot views of project portfolio management in product development. Therefore, these original articles are not able to provide a thorough analysis on longitudinal intertwinedness of PM with other control mechanisms within an MCS. Instead, these original articles paint a picture in which product development as a context incorporates uncertainty and change and management controls (including PM) can be used to manage those issues. In order to acquire an understanding of how PM dynamism occurs in product development, in a real-life organisation over a longer period of time, a more longitudinal data set must be used.

1.2.3. Interventionist research on performance measurement change in product development

In uncertain and changing environments, such as product development, PM should be considered outside single (measurement) frameworks (Bourne et al., in press). This consideration can take place, perhaps, through situated accounts of PM under different contextual factors (e.g. environmental uncertainty and organisational culture) that allow the leeway to balance the use of financial and non-financial measures between corporate-level managers and local organisations (Franco-Santos et al., 2012). Interventionist research provides a way to engage in longitudinal change. Suomala and Lyly-Yrjänäinen (2012) state that:

> While the studies with observation-based data gathering have to limit themselves to interpreting management accounting and control practices that have already been implemented, this limitation does not necessarily concern interventionist studies. It has been shown by a substantial amount of empirical research that there are many constructs in management accounting which are not especially widely implemented by real-life organisations … Interventionist research can engage in the implementation processes of new … MA constructs and thus provide valuable empirical insights into the interdependency between novel accounting approaches and organisational values or norms. (p. 13)

PM dynamism can be seen as a viewpoint on one side of an accounting-related phenomenon, PM, that has not necessarily spread from a systems perspective (Bourne, 2008) and whose manifestations from an actor's perspective could be difficult to capture from a distance since they might be 'bubbling under' (Suomala & Lyly-Yrjänäinen, 2012). Bourne (2008) calls for longitudinal data collection to be discussed in conjunction with addressing big questions on PM and PM dynamism:

> Keeping the measures up to date with the latest data is a problem in many organisations, but keeping the whole system up to date so it reflects the latest strategic priorities is an even bigger task.… One consequence of increasing academic rigour is that we focus on smaller and smaller problems. We refine existing models and test simply constructed models of the world. The result is that big-picture problems are not addressed through academic research, and in particular we are short of longitudinal studies following policies and changes through time. (p. 69)

Equally explicitly, (Henri, 2010) has called for empirical evidence gathered over longer than 12-month periods to further motivate the use of longitudinal, qualitative data and provide an understanding of PM

dynamism. A case study is a suitable method for conducting research on PM dynamism since case studies can provide knowledge on the relationship between MCSs and strategy (Langfield-Smith, 1997, p. 221). This doctoral thesis can also be positioned as an observational, participatory and in-depth case study in a real-life context (Eisenhardt, 1989; Yin, 2009). In general, ethnographers have been observing the real world in different contexts since the beginning of the 20th century. Early studies include those within anthropological (e.g. Radcliffe-Brown, 1940) and industrial contexts (e.g. Collins, 1946; Roy, 1953), for example. With regard to accounting, 'An ethnography of accounting seeks to understand what was said, done and understood in a particular situation' (Miller, 2007, p. 291).

Discussions on whether to use other terms than 'interventionist research', such as 'action research', can be found, e.g., in Jönsson and Lukka (2007, p. 373). In management accounting, it seems the term 'interventionist research' has increasingly attracted attention—for instance, in a special issue of *Qualitative Research in Accounting and Management* (volume 7, issue 1). It is possible to create practically and theoretically meaningful contributions through interventionist research; however, opposition also exists alleging that the closeness of interventionist work to consultancy hampers theoretical work (Jönsson & Lukka, 2007). In this doctoral thesis, I assume that the interventionist research methodology is able to provide accesses to meaningful research data (Suomala & Lyly-Yrjänäinen, 2012) and a basis for theory contribution (Jönsson & Lukka, 2007) outside 'mere storytelling' (Ahrens & Chapman, 2006, p. 820).

In this doctoral thesis, I provide two interventionist case studies (Table 3). In the third original article, a framework of PM dynamism is empirically validated in a healthcare context. In this healthcare context, there was a need to provide the company with a PM system that would continuously match the timely challenges the company would have. Hence, PM dynamism was a central concept in that interventionist case study. In the fourth original article, a longitudinal case study in a machinery manufacturing company provides an understanding of a repair effort of an NPD MCS.

Table 3. Overview of the interventionist case data collected.

Data collection situation type	*Time window*
PM dynamism at the healthcare provider	2009–2010
Mapping the strategic needs of the company	2009
Interviews about using PM	2009
Developing the PM system	2009–2010
A follow-up interview	2010
MCS repair at the machinery manufacturing company	2009–2014
The data set in the fourth original article	
Steering group meeting	2009–2012
Other, mostly informal data collection situations within the organisation	2009–2012
Weekly case NPD project meetings	2010–2012
Case NPD project production ramp-up meetings	2011–2012
Interviews (part of the documented interviews described in Table 2)	2011–2012
The augmented data set in this doctoral thesis	
Follow-up interviews on the case NPD project and the following project	2011–2014

Because this doctoral thesis particularly deals with PM dynamism in the context of product development, in the following, the data set of the interventionist case study at the machinery manufacturer is depicted in more detail. During the interventionist case study on the machinery manufacturing company, 'Original Equipment Manufacturer' (OEM) the researchers witnessed real-life accounting in an NPD department and participated in accounting development. The two researchers, i.e. the first two authors of the fourth

original article, acted as interventionist researchers inside the machinery manufacturing company. The researchers' work took place as a part of a research project funded by the Finnish Funding Agency for Innovation (Tekes) and the participating companies (including the machinery manufacturing company studied). Following Suomala and Lyly-Yrjänäinen (2012), who highlighted the significance of access to a real-life context, the unique access to the machinery manufacturing company provided a fruitful data set to study PM dynamism in real-life product development. In this doctoral thesis, the existing product development processes and activities were studied in the machinery manufacturing company, and suitable accounting tools for management purposes were eventually developed (typically in spreadsheet form). The interventionist researchers' task was to create some of the cost calculations needed and diffuse cost-consciousness among the parties involved in product development, e.g., engineers, production, purchasing and after-sales personnel. The machinery manufacturing company had already cooperated with the researchers' group for over 10 years, and this cooperation gave the researchers a unique and trusting relationship with the company.

Meetings at the machinery manufacturing company were documented as jotted notes. In particular, after the data collection for the fourth original article, interview recordings were used in some situations, but these interview recordings were mainly used to facilitate keeping a research diary (for confidentiality and depth-of-access reasons). However, these interview recordings were later a subject of systematic data analysis with Atlas.ti software but this analysis was outside the scope of the fourth original article. Outside the scope of the fourth original article, data collection was extended to 2014, totalling the number of data collection situations to 130, and the time window from 2009–2012 to 2009–2014. During the time period after the data collection of the fourth original article, data was collected in 12 follow-up interviews on the studied NPD project and a following project. Although the fourth original article focuses on the studied NPD project, the conclusions of this doctoral thesis are drawn from that project and the subsequent one. The conclusions represent both projects and are drawn from one project following the other, using the augmented data set.

1.2.4. Questions of validity

Although the data for this doctoral thesis has been collected in separate events through interviews and interventionist research, the conclusions are drawn from the data set as a whole. The conclusions are drawn from the viewpoint that PM dynamism is driven by certain drivers, PM dynamism can be observed at multiple loci, and PM dynamism can take place intertwined with MCS repair. Finally I suggest that the relationship between these phenomena could be studied by using data from interviews and interventionist research. In the following, I attempt to show the validity of the line of argument above.

In this thesis, I use Maxwell's (1992) categorisation of validity in qualitative research. In his account, Maxwell points out that while it is not necessarily beneficial to evaluate the validity of a qualitative piece of research (particularly with the instrument-driven validity evaluation methods used in positivist inquiry), some advice for evaluating the validity of qualitative research can be given. In particular, Maxwell points out five categories for evaluating the validity of qualitative research: descriptive, interpretive and theoretical validity, generalisability and evaluative validity.

Descriptive validity refers to the extent to which a piece of research is able to provide an account of certain circumstances in a truthful manner; i.e. whether the report given corresponds to what really happened, e.g., if 'the person known as William Shakespeare actually wrote Hamlet' (Maxwell, 1992, p. 286). In this thesis, the interview recordings and transcriptions have allowed going back to the data regarding the first and second original articles. In the third and fourth original articles, field notes and earlier reports of the circumstances have helped going back to data when needed. Moreover, although the first and second original articles rely on counting things (and drawing from that counting without the instruments of quantitative inquiry), it is more important to focus on the interpretations and impressions

of data rather than the exact figures. The researcher's influence on the interpretations of the data is unquestionable. In this doctoral thesis, as the key data collector and analyser, I find that making these interpretations has been close to data (Atlas.ti), and close to real-life phenomena (interviews and interventionist research)—contributing to the descriptive validity of this doctoral thesis.

Interpretive validity refers to the meanings that what certain objects mean to people engaged with them (Maxwell, 1992). In this thesis, the accounts on the sources of product development project portfolio uncertainty (the first and second original articles), were analysed by using Atlas.ti, an instrument that does not itself guarantee the interpretation of the findings but provides tools for keeping a record of the interpretations made. The interpretations made, about what meanings certain interviewees gave to the project portfolio uncertainties, are made bona fide, trying to distil the essence of an interviewee's account of a particular phenomenon. It is possible, that while acquiring the emic perspective (Maxwell, 1992; Suomala & Lyly-Yrjänäinen, 2012), the third and fourth original articles might provide an even more valid account of the meanings given to certain phenomena, with regard to interpretative validity. The interventionist research setting (such as in the third and fourth original articles) makes it possible for a researcher to assess and reassess the meanings given to phenomena by certain people studied, and hence continually test the interpretations made. Therefore, the interpretations of the circumstances in the third and fourth original articles have been continually tested and reassessed.

Theoretical or construct validity refers to 'an account's validity as a *theory* of some phenomenon', and it focuses on the validity of some concepts to apply to certain phenomena and 'the validity of the postulated relationships among the concepts' (Maxwell, 1992, p. 291, emphasis in original). In this thesis, the review of literature on PM dynamism, project portfolio management, and MCSs, show that there is a need for research that addresses the concept of PM dynamism in the context of product development and takes the actor's approach rather than a systems approach on PM. Being able to point out a research gap within this literature increases the validity of these concepts for this thesis. Regarding the relationship between the concepts of PM dynamism, product development project portfolio uncertainty, and MCSs, the relationship between these concepts is existent based on prior literature but unclear. In short, the relationship between PM and MCS packages has been mentioned to require further research (Malmi & Brown, 2008); managing project portfolio uncertainties outside rational control has been suggested (Martinsuo, 2013); and PM dynamism has been mentioned as a valid viewpoint to product development PM as well (e.g. Driva et al., 2000; Karlsson et al., 2004).

Generalisability 'refers to the extent to which one can extend the account of a particular situation or population to other persons, times, or settings than those directly studied' (Maxwell, 1992, p. 293). In the case of this thesis, rather than addressing the need to directly generalise the findings to certain other settings, I stress the importance of creating theoretical generalisations. As Flyvbjerg (2006) notes,

> One can often generalize on the basis of a single case, and the case study may be central to scientific development via generalization as supplement or alternative to other methods. But formal generalization is overvalued as a source of scientific development, whereas "the force of example" is underestimated. (p. 228)

Similarly, in this thesis, the level of generalisation is not necessarily small pieces of findings, e.g., that in all or some contexts PM dynamism *should* have certain characteristics presented in here. Rather, I find important to examine what PM dynamism *can* be, in the context of product development, i.e. presenting an example of the concept (cf. Flyvbjerg, 2006).

Evaluative validity refers to, for example, whether certain deeds are right or wrong (Maxwell, 1992). This thesis tackles this form of validity by attempting not to be value-laden (deciding between good or bad). The teleological assumption here is that PM serves the product development control of an organisation, and hence it serves deciding whether the organisation is doing *well* or not. This assumption is adequate

for justifying the need for PM dynamism to serve that same purpose, but I do not make an attempt to decide whether the organisations studied are doing things right or wrong. Whether the interviewed people (in the first and second original articles) or the organisations studied in the interventionist case studies did right or wrong is outside the scope of this doctoral thesis. Rather, the focus of this doctoral thesis is in attempting to describe and interpret the circumstances observed.

2. LITERATURE REVIEW

2.1. PM dynamism in product development

2.1.1. PM dynamism drivers in product development

Previous research acknowledges the dependence of accounting information's usefulness on task uncertainty and complexity in decision making (Burchell et al., 1980; Chapman, 1997; Hopwood, 1972; Thompson & Tuden, 1959). PM can be understood as one source of accounting information. In particular, Henri (2010) saw perceived environmental uncertainty and changes in strategic direction as drivers for PM (system) dynamism and found that 'firms facing a higher level of PEU [perceived environmental uncertainty] (proxy for external change) are more likely to make periodic reviews of performance indicators' (p. 85).

This section examines the literature on uncertainties in product development, especially at the project portfolio level. Such an area of interest is selected because (1) there seems to be an understanding that PM dynamism might be driven by uncertainty or change (Henri, 2010); and (2) product development is an uncertain context (Hertenstein & Platt, 2000; Jørgensen & Messner, 2010) where (3) uncertainty is seen to drive the design and use of an MCS (Davila, 2000). Moreover, although it is known that (4) project portfolios require bottom-up learning in order to learn from successes and failures (Olsson, 2008) and (5) NPD management can be repaired by employees or the top management (Jørgensen & Messner, 2009), too little is known, especially about the types of management control change through which PM dynamism occurs in product development.

The project portfolio management literature will provide a suitable background to draw from since in this literature, studies often focus on R&D (Blomquist & Müller, 2006). The selected background literature on project portfolio management is compatible with Davila's (2000) management-accounting-related viewpoints on uncertainties in product development stemming from the market, technology and project scope. In addition, there seems to be no contradiction between uncertainties stemming from the project portfolios and the drivers of change identified by Kennerley and Neely (2002) with regard to the evolution of PM systems (in PM literature that builds upon operations management). Therefore, PM drivers and uncertainties affecting product development portfolios are combined here.

Change in organisational strategy is a strong driver for PM dynamism (e.g. Ferreira & Otley, 2009; Kaplan & Norton, 1993; Wisner & Fawcett, 1991) since, by definition, PM is linked to strategy implementation. In addition to the strategy, the environment and single projects, for example, can cause turbulence in organisational life and thereby lead to welcome change in PM as well. According to the literature (outside project portfolio management), external triggers for new PM introduction can be 'customer requirements', 'legislation' and 'national standards/awards requirements'; internal triggers can be 'problem recurrence prevention', gaining visibility and control and planning (Hudson et al., 2001, p. 1107).[6] Wisner and Fawcett (1991) state that it is necessary to evaluate the appropriateness of a PM

[6] Circular reasoning of the inadequacy of control and planning (Hudson et al., 2001) acting as a driver for using controls (Malmi & Brown, 2008) as a means for managing those purposes is now avoided by not using PM dynamism drivers as input for project portfolio management (particularly concerning the first and second original articles). Instead, the direction is the opposite. Project portfolio uncertainty management is now understood as a

system in light of the current competitive environment. Other external drivers for PM dynamism include 'customers, the marketplace, legislation, new industries, nature of the work and future uncertainty'; internal drivers include 'actual performance, dysfunctional behaviour, effective review/monitoring systems reflecting different levels of review' (see Figure 1., Kennerley & Neely, 2002, p. 1227). A study by Waggoner et al. (1999) further notes the political and organisational perspectives that influence the evolution of PM systems. Eisenhardt and Sull (2001) provide a launching pad for Micheli and Manzoni (2010, p. 471) viewpoints that in highly dynamic environments, only a few, and likely boundary-type, performance indicators should be favoured.

In their editorial in a special issue of *Long Range Planning* on strategic PM, Micheli and Manzoni (2010) sum up Kolehmainen's (2010) article (in that special issue) by noting that 'especially in dynamic environments, measurement systems have to be flexible, as they might otherwise hinder change and inhibit organisational transformations' (p. 468). Kolehmainen (2010) uses the expression 'turbulent industries' (p. 529) to characterise the setting of her case study (at DynComp, a telecommunications company). Although machinery manufacturing (which is a key context of this doctoral thesis) is not an ultimately dynamic industry, NPD activities are typically subject to a certain level of environmental dynamics (e.g. due to plurality of goals, in Jørgensen & Messner, 2010). Moreover, Dossi and Patelli's (2010) work (in the same special issue of *Long Range Planning*) brings up the changing emphasis of different elements of a PM system: changes in performance (of a subsidiary) or in the operational environment may shift emphasis on PM (Micheli & Manzoni, 2010, p. 471). A headquarters of a company may change its emphasis on (subsidiary) PM during the lifecycle of a subsidiary: financial measures focused on when the performance is poor and the PMS may, as a chief financial officer stated, become 'more sophisticated' when the subsidiary turns profitable (as quoted, in Dossi & Patelli, 2010, p. 518). Ferreira and Otley (2009) promote asking questions such as 'How have the PMSs [performance management systems] altered in the light of the change dynamics of the organization and its environment? Have the *changes in PMSs* design or use been made in a proactive or reactive manner?' (p. 267, emphasis in original) although not specifying which kinds of changes in the organisation or the environment could create pressures for PM dynamism.

Similarly, the project portfolio management literature identifies uncertainties stemming from the larger business context (technical and market uncertainties, technology turbulence, norms and regulations, stakeholders) that affect the project portfolio level (Petit, 2012; Petit & Hobbs, 2010; Voss & Kock, 2013). The project management literature in general notes that projects operate in dynamic environments and that 'all projects have some degree of dynamism' (Collyer & Warren, 2009, p. 355).[7] In addition to environmental sources of uncertainty, the research on project portfolio uncertainties has centred on internal sources of uncertainty, focusing on organisational complexity (Teller et al., 2012; Unger et al., 2012; Voss & Kock, 2013; Zika-Viktorsson et al., 2006) and organisational structures and systems (Petit, 2012; Petit & Hobbs, 2010) (Table 4). Although the project scope uncertainty mentioned by Davila (2000) has been increasingly studied in project portfolio management literature, single-project-related uncertainties have not often been linked to the portfolio level (Olsson, 2008; Petit & Hobbs, 2010)—notable exceptions being, for instance, studies by Nobeoka and Cusumano (1995; 1997), Olsson (2008), Petit and Hobbs (2010) and Abrantes and Figueiredo (in press).

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possibly similar PM dynamism driver in product development to the more general PM dynamism drivers and therefore a complementary viewpoint perhaps furthering knowledge on PM dynamism drivers.

[7] 'In the project management context dynamism is taken to be a dimension of a project that represents the extent to which a project is influenced by changes in the environment in which it is conducted' (Collyer & Warren, 2009, p. 355). Although such a definition exists, the sources of dynamism are not limited to those coming from the environment in this doctoral thesis.

Table 4. The expected PM dynamism drivers in product development (uncertainties in product development).

Type of driver	*Accounting-related literature*	*Project portfolio management literature*
Environment		
Society	Perceived environmental uncertainty, legislation, standards/awards, nature of work, future uncertainty (Henri, 2010; Hudson et al., 2001; Kennerley & Neely, 2002)	Norms and regulations (Petit, 2012)
Markets	Markets/marketplace, customers (Davila, 2000; Hudson et al., 2001; Kennerley & Neely, 2002)	Markets (Petit, 2012; Petit & Hobbs, 2010)
Industry	Technology uncertainty/turbulence, competitive environment (Davila, 2000; Kennerley & Neely, 2002; Kolehmainen, 2010; Wisner & Fawcett, 1991)	Technology turbulence, technical uncertainties, cooperative parties (Petit, 2012; Petit & Hobbs, 2010; Voss & Kock, 2013)
Organisational complexity		
People	Political and dysfunctional behaviour, PM skills (Kennerley & Neely, 2002; Waggoner et al., 1999)	Work overload in multi-project environments, competences (Petit & Hobbs, 2010; Zika-Viktorsson et al., 2006)
Company	Strategy, hampered planning and control (Ferreira & Otley, 2009; Hudson et al., 2001; Kaplan & Norton, 1993; Wisner & Fawcett, 1991)	Structures, systems and processes (Petit, 2012; Petit & Hobbs, 2010)
Inter-project relations		Outcome, resource or knowledge interdependencies; project termination, shared resource pool (Petit & Hobbs, 2010; Teller et al., 2012; Unger et al., 2012)
Single projects		
Project characteristics		Needs for customisation (Petit & Hobbs, 2010)
Evaluation		Learning from single projects (Olsson, 2008; Petit & Hobbs, 2010)
Time		Delayed projects (Petit & Hobbs, 2010)
Cost		Budget overruns (Petit & Hobbs, 2010)
Scope		Shared components, design transfer, product versions (Abrantes & Figueiredo, in press; Nobeoka & Cusumano, 1995; 1997; Petit & Hobbs, 2010)

Table 4 indicates a variety of sources of product development project portfolio uncertainty. Although the organisational complexities and the environmental uncertainty have been emphasised, there is still room for contributions, particularly when it comes to portfolio-level uncertainties stemming from single projects, especially in the accounting-related literature on PM dynamism. In this thesis, the first and second original articles attempt to fill this gap. Based on the first and second original articles, the thesis as a whole attempts to draw wider conclusions of how the previous viewpoints on PM dynamism drivers can be supplemented. The division of the types of uncertainty in Table 4 is similar to that in the first original article, which facilitates the later underlining of possible contributions to academic research (on examining the sources of project portfolio uncertainty outside environment and organisational complexity).

2.1.2. Previous conceptualisations of PM dynamism

PM dynamism is ambiguously characterised in the literature. The idea of this doctoral thesis is not to try to fully clarify that ambiguity because I find that many authors have made significant contributions to our

understanding of PM dynamism by bringing along a variety of different viewpoints. Indeed, the phenomenon of PM dynamism has been acknowledged by many and given various definitions. However, a clear idea held by PM dynamism researchers seems to be that PM dynamism is understood as change of a PM *system*, i.e. they take the *systems approach* to PM (see Cinquini et al., 2013). In the following, a brief attempt is made to understand where I stand when I discuss the notion of PM dynamism from the viewpoint of previous studies.

Before a PM *system* can be updated, redesigned or reviewed, it first needs to exist in order for it to be improved.[8] As the following list of possible changes taking place in a pre-existing PM system shows, 'PM dynamism' is only one name given by a few researchers (e.g. Henri, 2010; Kolehmainen, 2010; Micheli & Manzoni, 2010) to the phenomenon of PM systems changing or dynamic PM systems (Bititci et al., 2000). Others name the change of PM *systems* as the 'reevaluation' of the 'appropriateness' of PM (Wisner & Fawcett, 1991, p. 9); the addition and deletion of measures (Nanni et al., 1992); the revision of a PM system (Ghalayini & Noble, 1996); the introduction and deletion of measures (Waggoner et al., 1999); reviewing measures (Bourne et al., 2000; Kennerley & Neely, 2002); the evolution of PM systems (Kennerley & Neely, 2002); redesigning PM systems (Kennerley & Neely, 2003); and updating PM systems (Braz et al., 2011; Lebas, 1995). However, 'PM dynamism' is used in this doctoral thesis as an overarching term to comprehend the above understandings and to supplement the contextual character of PM from the *actor's approach* perspective (see Cinquini et al., 2013). PM dynamism continuously takes place in time and space, in and between the events of intentional PM alteration and in the conscious and subconscious roles given to PM.

What is common to some of the studies above is that they seem to take PM dynamism as something that can be managed by *processes*. For example, Kennerley and Neely (2003) promoted auditing a PM system in terms of finding its dynamic parts that are not systematic and systematising the dynamism of those parts. A systems approach (Cinquini et al., 2013) to PM seems to be dominating studies on PM dynamism. Some authors explicitly state that they have taken a systems perspective (e.g. Salloum, 2013). If a systems approach is taken, the conclusions are also likely to be at the systems level. For example, in Salloum (2013), proposed guidelines include that there should be a performance measure change process that needs to be 'recurrently executed' and that the performance measure 'change process' within the PM system needs to be harmonised (p. 101). However, while identifying the political aspect of PM within organisations, some studies (Kennerley & Neely, 2002; Waggoner et al., 1999) note that PM is not merely about processes and systematisation but is also linked to organisational complexities. A study conducted from an actor's approach to PM could provide different answers to similar problems than the systems approach. In the actor's approach, an individual is at the centre with his or her reality dimensioned by 'facts, possibilities, values and communication' (Cinquini et al., 2013, p. 364). A conclusion of PM dynamism in a study with the actor's approach could thus emphasise formal PM systems less and put emphasis on the individual's role in PM dynamism.

It is difficult to place the studies by Malina and Selto (2004) and Wouters and Wilderom (2008) on the continuum (or a dichotomy) of systems or actor's approaches (cf. Cinquini et al., 2013). Although Malina and Selto (2004) draw from system-based and contingency-based strategy theories, they seem to put less emphasis on processes that implement PM change than on the attributes (such as strategy communication and informativeness) that PM dynamism serves; therefore, they theorise rather than provide guidance for

[8] I do not delimit myself from only considering the redevelopment of performance measures as PM dynamism; the initial implementation of any measures can also be seen as PM dynamism. It is only a matter of definition and how broadly one wishes to understand longitudinal PM dynamism in a context. However, one needs to bear in mind that, 'While it is frequently possible to improve an existing accounting performance measurement system, it is often, if not always, impossible to achieve the ideal system' (Hopwood, 1972, p. 158). To my understanding, the same idea follows that practices also are suboptimal because an optimum hardly exists.

the management of PM dynamism. In addition, Ferreira and Otley (2009) do not refer to the 'change and its dynamics' of performance *management* systems as processes (in fact, they explicitly avoid doing so). Instead, they seek a more in-depth understanding of PM dynamics.[9] Ferreira and Otley (2009) work on

> the extent and type of change that has taken place in the PMSs [performance management systems] design and use as a response to or in anticipation of changes in the organization and its environment … [drawing] attention to the antecedents (i.e. the causes) and consequences (i.e. the outcomes) of change in the PMSs, leaving issues of process aside … why performance measures were introduced or removed from the PMSs and examine the economic and/or behavioural implications of those decisions, rather than dwelling on the detail of change processes. (p. 275)

Although Wouters and Wilderom (2008) state that their study is about PM *systems*, they discuss experimentation on the conceptualisation of PM, saying,

> the first development of a new performance measure and subsequently allowing time to test and refine (in several rounds) its conceptualization, definition, required data, IT tools, and presentation, together with employees (whose performance is going to be measured), to arrive at a measure that is a valid, reliable, and understandable indicator of performance in a specific local context. (p. 495)

Therefore, Wouters and Wilderom (2008) seem to take a broader view than process perspective to PM dynamism. In addition, Burney et al. (2009) take the technical validity route to PM dynamism through the timeliness of measures. Furthermore, Wouters (2009) finds that PM dynamism at a company (in his case, Grolsch) took the route of a very pragmatic development of something old into something new. As Wouters (2009) states,

> At the start of new performance measurement initiatives at Grolsch, the first step was to identify existing experiences with performance measures.… These measures would be quite particular to the specific conditions and processes within a certain area of the Logistics department. The Controller's office may or may not have had a role in developing these, and may or may not be aware of their existence. New measures would only be developed after understanding and re-using as much as possible from the measures that were already in place. (p. 70)

By drawing from this background, it seems plausible that informality plays a role in PM dynamism, and a transformation coordinated by a controller, for example, could possibly lead to excluding some measures from the analysis. Complementing the findings by Wouters and Wilderom (2008), Wouters (2009, p. 70) brings up the rationales behind existing measures, the limitations of individual people considering the existing measures and development ideas people have for PM ('or may even be working on'). According to Wouters (2009), understanding such contextual matters was a starting point for developing a PM system. The previous account from Grolsch continues,

> Development activities that we also observed in the case study at Grolsch included conceptualizing of the definition, scope, etc. of a performance measure; identifying available data in the company for determining the actual values of this performance measure; establishing procedures for tracking new data required for the metric; building information systems for reporting performance measurement results; setting performance level targets for a performance measure; and further reviewing, revising and refining both single measures and the overall PMS. The latter activity of experimentation was important: going back to the conceptualization, scope, data, tables, graphs, etc., and tinkering with these. (Wouters, 2009, p.71)

[9] Performance management is not synonymous to performance measurement, but can be used here as a background.

The studies by Wouters and Wilderom (2008) and Wouters (2009) in particular provided the understanding that more abstract issues (conceptualisation) and the practice of PM (e.g. data, tables and graphs) need to be addressed when managing PM dynamism. These studies imply that PM dynamism is not entirely about processes of change although procedures were mentioned (in Wouters, 2009). Where many contributors show that organisations need to systematise their firm-level PM reviews into formal procedures in order to reach adequate PM dynamism (Bourne et al., 2000; Kennerley & Neely, 2003; Kennerley & Neely, 2002), some authors conversely advocate a more informal and micro-level change as an important enabler of PM dynamism since people's personal targets change according to timely (or ad hoc) requirements (for example, subjective measurement at an employee's level, in Kolehmainen, 2010). The use of ad hoc measures as facilitators of accounting change (Vaivio, 1999) and as facilitators of a strategic change process (Fiorentino, 2010) has also been noticed. There is, however, an inadequate understanding of the contribution of ad-hocism to PM dynamism in particular. The previous literature focused on systematising PM dynamism has a shortcoming in that an increased bureaucracy in PM dynamism might make organisations unable to react to changes quickly due to too many formal structures of change (Kolehmainen, 2010). A representation of such formal structures can, for instance, be read from Kennerley and Neely's (2002) work in which they identify three levels of reviewing and updating measurement systems: 'the individual measure', 'the set of measures' and 'the supporting infrastructure' (p. 1243). Naturally, PM dynamism could manifest itself at only one or two of these three levels; however, reviewing or updating a supporting infrastructure could possibly take time and would therefore hamper a quick response to a change pressure.

Some previous studies that focus less on the processes of PM dynamism (e.g. Henri, 2010; Malina & Selto, 2004; Nanni et al., 1992), however, might not offer many adequately tangible means to manage PM dynamism. The outcome of these studies could be a set of tips for what to consider if PM dynamism is a problem to be solved, but these studies do not seem to comprehensively define the multiple possible loci of PM dynamism. For example, based on Henri's (2010) work, which is built on Bourne et al. (2000), PM dynamism would be expected to occur as additions to performance indicators, deletions of indicators, changes in targets or changes in indicator definitions. However, there is still an inadequate understanding of the concept of PM dynamism (Henri, 2010), although the more conceptual-understanding-oriented stream of research has been enriched by numerous contributions, especially in recent years (e.g. Kolehmainen, 2010; Malina & Selto, 2004). It seems that there is room to contribute to the actor's approach to PM dynamism since the previous literature emphasises the systems approach. Consequently, the previous process-reliance of PM dynamism could be less emphasised, and room could be given to an individual, or group of individuals, contributing to PM dynamism.

Furthermore, there is little literature that explicitly addresses the fact that *product development* PM is dynamic, although it is acknowledged that a set of measures will not remain definite over time in R&D either (Bremser & Barsky, 2004; Driva et al., 2000; Hertenstein & Platt, 2000; Karlsson et al., 2004). One of the few articles mentioning PM dynamism in product development is a study by Bititci et al. (2000), who provide a single case study data point on product development measure changing during their research project. The focus point of the article by Bititci et al. (2000) is not the measure that changes; thus, there is no in-depth story providing an understanding of PM dynamism in product development. In the case study by Bourne et al. (2000), one R&D measure was deleted and another was replaced due to PM system evolution during the research project. In their data, the PM review process identified problems in product development measures and redefined an R&D slippage measure; but again, evidence on PM dynamism in product development per se remains thin. Karlsson et al. (2004) connect the design of a productivity measurement in R&D to longitudinal changes in what is expected as output from research. More quantitatively, Hauser (2001) introduces a 'metrics thermostat' to place timely weight on product development measures with regard to their contribution to profits and mentions that the right metrics must be selected. Such a selection of measures can be understood as PM dynamism (e.g. Nanni et al., 1992; Waggoner et al., 1999). In addition, Hertenstein and Platt (2000) show the perceived high importance of

product cost measurement, recognise the need to weight NPD performance measures and report that firms in their study had changed their PM by introducing NPD performance measures. Hertenstein and Platt (2000) also argue that 'there is little empirical evidence that strategy guides the selection of NPD performance measures in practice' (p. 307). However, Bremser and Barsky (2004) mention that in R&D, current metrics (within a balanced scorecard) would be reviewed and those metrics selected that 'closely link to strategic goals' (p. 235). Driva et al. (2000) note that no set of measures 'will remain definitive over time. Performance measures, as with the organisation itself, should be flexible to change' (p. 148). Driva et al. (2000) emphasise the need to consider the design of a product development PM system as an iterative process to ensure that the measures are refined and implicitly bring up the possibility of using some project-specific measures in addition to more long-term measures. Therefore, the possibility of some ad hoc measures is at least plausible in product development, according to previous literature.

In summary, where some advocates for PM dynamism as processes can be found, other authors conceptualise PM dynamism as operating within more informal changes. More research is needed, however, particularly on the loci of PM dynamism, the actor's approach and ad hoc measurement as specific viewpoints to PM dynamism and PM dynamism in product development. This doctoral thesis addresses these issues.

2.1.3. PM dynamism as management control change in product development

Overall, the literature on maintaining the relevance of performance measures in product development is scarce. To overcome this dearth of knowledge, I consider PM as the 'cybernetic' part of the MCS package, following Malmi and Brown (2008). I draw a parallel between Malmi and Brown's cybernetic controls and PM because the authors explicitly list controls that come in the form of measurement as cybernetic ones. Malmi and Brown's control package consists of certain cultural controls (values and clans), administrative controls (policies and procedures and organisational structure), planning (long range and action planning), cybernetic controls (budgets, financial, non-financial and hybrid measurement systems) and reward and compensation. According to Malmi and Brown (2008),

> there is still limited understanding of the impact of other types of control (such as administrative or cultural) and whether/how they complement or substitute for each other in different contexts. Gaining a broader understanding of MCS as a package may facilitate the development of better theory of how to design a range of controls to support organisational objectives, control activities, and drive organisational performance. (p. 288)

Indeed, change pressures and MCS development are driven by an understanding of how MCSs are used as a package at a certain point. In terms of PM dynamism discourse, performance measures might, for example, be deleted and then compensated for by other areas of control within the MCS package. Conversely, when organisational growth takes place, certain value-like cultural controls might have to be turned into cybernetic ones in order to maintain certain control over the organisation. By considering PM dynamism as possibly taking place within a control package, it might be possible for this doctoral thesis to build on some previous literature on MCS change. First, I examine some general thoughts on MCS adoption and change and then more specifically discuss thoughts on MCS change in product development.

The previous, mainly contingency-based general work on MCS adoption has revealed a number of determinants for MCS adoption and the appropriateness of specific measures (Griffin & Page, 1996). Davila and Foster (2005) argued that the influence of external investors and chief executive officers' experience drove the adoption of MCSs. Furthermore, the fit between the MCS and strategic choices has fallen under scrutiny fairly extensively in contingency research in the past. The choice of strategy (e.g. price or differentiation) has been found to be a key factor explaining MCS adoption and use (Chenhall & Langfield-Smith, 1998; Chenhall, 2003; Langfield-Smith, 1997; Sandino, 2007). Some MCS adoption

literature (Davila et al., 2009; Sandino, 2007) has described the adoption of MCSs from a distance and framed it largely as a specific event rather than as a sequence of events. Other authors have suggested quite the opposite and stated that the adoption of control mechanisms might be a continuous process of constitution, institutionalisation and reconstitution (Ahrens & Chapman, 2007; Burns & Scapens, 2000; Lukka, 2007). This means that MCSs get adopted and are used continuously in the ever-evolving interpretations of MCSs and organisations they are adopted in as well as through the interdependence of these two. With this background in mind, reviewing of (a) PM (system) might not only be a question of providing an organisation with strict procedures for PM review but also some more informal, continuous (re)conceptualisation of PM.

At the management accounting system level, Sulaiman and Mitchell (2005) provide a typology of technical-level management accounting change: the addition, replacement or reduction of techniques and modification of information output or operations of the management accounting system. Kasurinen (2002) refines Innes and Mitchell's (1990) and Cobb et al.'s (1995) findings on management accounting change processes and sees market globalisation, environment complexity, mature product life-cycle and problems with financial measures as motivators of PM system implementation.

As with the literature on PM dynamism, literature on MCS change in product development also often sees the development of MCSs as a process; however, it is a process of change in the formal and informal domain of control. According to Burns and Scapens's (2000) and Lukka's (2007) work on the change and stability of accounting and management control, PM dynamism is enabled and restricted through the evolution of informal management practices, not necessarily through the formal domain of control.

Burns (2000) provided a longitudinal case study on accounting change in a product development department. In Burns' rich story, an adoption process involving accounting routines occurs as the institutionalisation of accounts, accounting practices and accountability into unquestionable forms of management control. Burns also says that changes in accounting should be congruent with existing institutions within the context that might act as barriers to change. He also reports, for example, an external cash flow crisis as one factor that internal changes originated from and implies that changes could be facilitated by mobilisation of power rather than meanings. Again, from the more product-development-specific literature on accounting and management control change, Nixon's (1998) study can be interpreted so the evaluation of a specific product development effort travels in time along the actual progress of that development effort. Nixon lists changes in the nature of information concerning a project changing during the progression from informal to formal, implicit to explicit, qualitative to quantitative, subjective to objective, strategic to operational feasibility, risk to payback period, opportunity cost to cash flow and option value to contribution margin. Taipaleenmäki (2004) suggests that in product development, '*management of change and the controlled adjustment of the plans, targets and product specification*, regardless of how minor it seems, are important in order to keep the [product development] program focused and on track' (p. 115, emphasis in original).

Ask's teaching case (as cited in Taipaleenmäki, 2004, p. 44) suggests that changes in cost control systems in NPD are driven by overspending, high product costs, intra-industry benchmarking, changes towards more process-oriented organisations, internal requirements, distrust in previous cost control and personal interest toward target costing. In addition, Ask's teaching case (as cited in Taipaleenmäki, 2004, pp. 44–45) cites powerful engineers' reluctance towards cost targets, adequacy of financial performance, inadequate organisational structure and personal interests in management accounting change as barriers to change in NPD. Continuing on the drivers of change, in Jørgensen and Messner's (2009) study of NPD, strategic change drove change in control systems and a top-management repair of the system, which led to an enabling formalisation. Similar results regarding the misfit between strategy and product development measures was empirically discovered by Hertenstein and Platt (2000), who see this misfit as a driver to introducing new performance measures. In Jørgensen and Messner's (2009; 2010) work, the

existing accounting calculations could not support reaching the organisational goals pursued after a strategic shift had taken place due to the emphasis placed on old targets. Consequently, engineers repaired the control system and complemented the existing calculation models by introducing additional spreadsheets to understand the drivers of product cost and the effect of module design on these costs (Jørgensen & Messner, 2009). However, Jørgensen and Messner (2009) warn that incremental control system repair efforts could prevent organisations from seeing the need for more radical changes in control. In summary, the current examination of PM dynamism in this doctoral thesis is instructed by the literature on MCSs (Table 5).

Table 5. Advice given by management control studies regarding PM dynamism drivers in product development.

Type of driver	*Drivers of management control change in general*	*Drivers of management control change, particularly in product development*
Environment	Markets, environment complexity, product life-cycle, problems with financial measures (Kasurinen, 2002)	(External) context (Burns, 2000)
Organisational complexity	Strategic choices (Chenhall & Langfield-Smith, 1998; Chenhall, 2003; Langfield-Smith, 1997; Sandino, 2007)	Fit with strategy, challenges to measure product development performance (Hertenstein & Platt, 2000; Jørgensen & Messner, 2009; 2010)
	External investors and CEO's experience (Davila & Foster 2005)	Power, politics, (organisational) context (Burns, 2000)
		Overspending, product cost control, benchmarking, process-oriented organising, internal requirements, personal interests; barriers: personal reluctance and interests, low priority of costs, organisational structure (Ask's teaching case in Taipaleenmäki 2004, pp. 44–45)
Single projects		Modularisation (Jørgensen & Messner, 2009; 2010)

Overall, the organisational complexities as recognised PM dynamism drivers is further strengthened (Table 5). In addition, the role of environment as an expected PM dynamism driver is supported. However, single-project level PM dynamism drivers were less frequent in this review; therefore, they are a possible area for contributions. The advice from management control literature regarding the loci of change in controls is summarised in Table 6.

Table 6. Advice given by management control studies regarding the examination of PM dynamism in product development.

	Management control change in general	*Management control change, particularly in product development*
Time-frame	Adoption of MCSs or controls takes place as events (Davila et al., 2009; Sandino, 2007)	There are adoption processes of MCSs or controls (Burns, 2000)
	There is a continuous reassessment and reconstitution of MCSs (Ahrens & Chapman, 2007)	
Loci of change	There is an interplay between formal and informal domains of control (Burns & Scapens, 2000; Lukka, 2007)	Control systems are continuously reassessed and repaired (Jørgensen & Messner, 2009; 2010)
	Different control domains and controls are interrelated in change (Malmi & Brown, 2008)	The nature of information varies according to the phase of product development (Nixon, 1998)
	There are additions, replacements or reductions of techniques and modifications to information output or operations of the management accounting system (Sulaiman & Mitchell, 2005)	Plans and targets are adjusted (Taipaleenmäki, 2004)

Management control change takes place in the forms of a more event-like, processual or continuous redefinition (Table 6). Based on the literature on MCSs in general and in product development, it seems fair to expect that the loci of PM dynamism will also be dependent on a time and place. Such an expectation is in line with previous research, which found that PM dynamism can be expected at the levels of (1) the extent to which PM is included in decision making (e.g. Burchell et al., 1980; Thompson & Tuden, 1959); (2) using PM (e.g. Henri, 2010; Malina & Selto, 2004); (3) selecting an appropriate set of measures (e.g. Bourne et al., 2000; Wisner & Fawcett, 1991); and (4) in the components of single measures, such as targets (Bourne et al., 2000).

2.2. Summary of the literature review

Based on the above literature review, some expectations can be posed about PM dynamism in product development. In particular, it seems valid to expect that PM dynamism is driven by environmental, organisational-complexity-related and single-project-related uncertainties; at multiple loci; and through MCS dynamism efforts of top management as well as employee repair interventions and interplay. These aspects, however, require more examination. Consequently, the following three-dimensional framework can be proposed for this doctoral thesis (Figure 2).

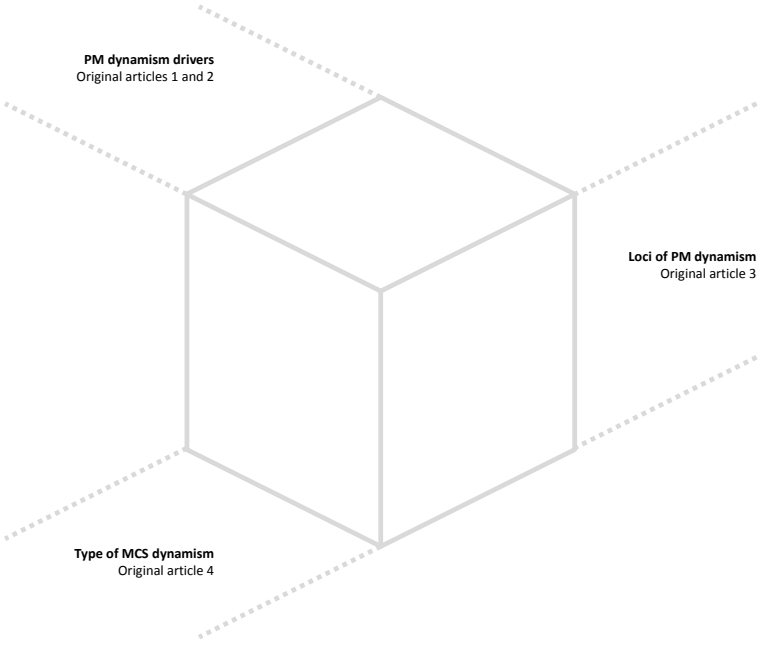

Figure 2. An integrative framework for analysing PM dynamism.

As shown in the integrative framework, the research questions in this doctoral thesis each address one dimension of the cube. In the first and second original articles, PM dynamism drivers in product development are examined based on interview data. Based on that interview data, I present empirical evidence to supplement the previous research on the possible sources of uncertainty concerning product development project portfolios and thereby try to advance knowledge on PM dynamism drivers. In the third original article, I discuss the loci of PM dynamism by creating a level structure for PM dynamism and further contemplating the locus of formal and informal change in light of ad hoc measurement. In the fourth original article, an MCS repair is discussed based on data collected in a longitudinal interventionist case study at a machinery manufacturing company.

3. RESULTS OF THE ORIGINAL ARTICLES

3.1. Perspectives to product development project portfolio uncertainties as PM dynamism drivers

The first and second original articles examine two separate sides of the same phenomenon, i.e. product development project portfolio uncertainty. In the first original article, 'Management control of project portfolio uncertainty: a managerial role perspective', project portfolio uncertainties are studied from the viewpoint of different managerial roles in product development. In the second original article, 'Identifying, framing and managing uncertainties in project portfolios', framing the uncertainties into threats or opportunities guides the inquiry. From the viewpoint of the integrative framework that summarised the literature review of this doctoral thesis, the first and second original articles provide knowledge on the uncertainties faced in product development (Figure 3).

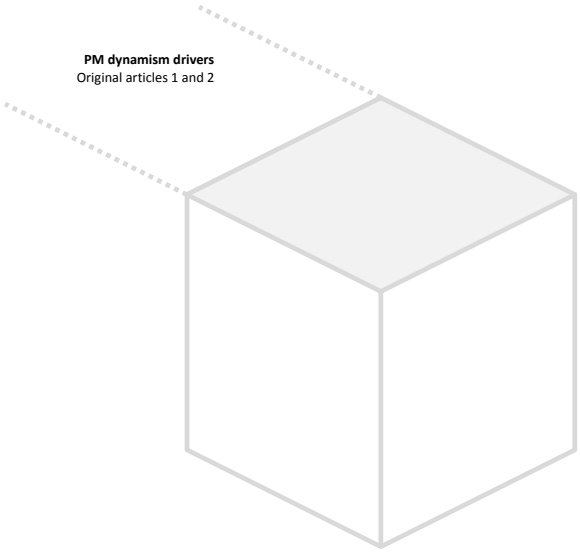

Figure 3. The side of the integrative framework addressed by original articles 1 and 2.

The results of the first and second original articles indicate that in addition to organisational complexity and the environment, product development project portfolio uncertainty also stems from single projects. Further, product development project portfolio uncertainty management seems to be not only a task of rationality but also political behaviour, in particular. The results of each article are presented below in more detail.

The purpose of the first original article was to examine which kinds of project portfolio uncertainties different managerial roles identify and how these managerial roles identify means of managing those uncertainties. The roles of a 'Portfolio manager (business)', 'Portfolio manager (financial)', 'Program manager' and 'Project manager' were examined by drawing from interview data, particularly from machinery manufacturing companies. The role division was based on work done by Blomquist and Müller (2006) and Rabino (2001). Uncertainties were categorised as environmental, organisational-complexity-related, or single-project-related. Means of managing uncertainty were categorised under the MCS package by Malmi and Brown (2008).

According to the results, product development is a context in which managers lack comprehensive tools to deal with project portfolio uncertainty. This conclusion is based on the finding that managers seem to identify more numerous sources of product development project portfolio uncertainty than the means of managing those uncertainties. Table 7 summarises the results of the first original article regarding the sources of product development project portfolio uncertainty. It seems that managers identify product development project portfolio uncertainties quite uniformly across the sources and roles. The numbers in the columns under each managerial role represent clustered sums of companies in which grouped sources of uncertainty were identified. More detailed data can be found in the Appendix of the first original article.

Table 7. Sources of product development project portfolio uncertainty in machinery manufacturing.

Source of uncertainty	*Sum*	*Portfolio manager (business)*	*Portfolio manager (financial)*	*Program manager*	*Project manager*
Environment	**48**	**10**	**17**	**10**	**11**
Society	23	5	7	5	6
Markets	18	3	7	5	3
Industry	7	2	3		2
Organisational complexity	**47**	**9**	**12**	**12**	**14**
People	14	4	2	4	4
Company	7	1	4	1	1
Inter-project relations	26	4	6	7	9
Single projects	**44**	**9**	**14**	**12**	**9**
Project characteristics	2			1	1
Evaluation	8	2	2	1	3
Time	10	1	3	3	3
Cost	7		4	2	1
Scope	17	6	5	5	1
TOTAL		**28**	**43**	**34**	**34**

Furthermore, the original article shows that cybernetic controls, i.e. measurement systems, are not recognised as often as a means of managing uncertainty as planning, cultural and administrative controls are. Cybernetic controls were identified by interviewees in the portfolio manager (financial) and project manager roles. Based on the results, the original article posed a number of propositions for further research to test and refine.

The first original article made at least four contributions in its context (project portfolio management literature). First, the article provided further empirical evidence of the sources of (product development) project portfolio uncertainty and advanced knowledge of single-project-related uncertainty in particular. Second, the article examined the balance between different management controls in managing (product development) project portfolio uncertainty. Third, the article furthered knowledge on the roles of different managers in (product development) project portfolio management. Fourth, by combining the sources of project portfolio uncertainty, the managerial roles and MCSs identified in the previous literature, the article provided a framework for analysing project portfolio uncertainty management.

For this doctoral thesis, the first original article contributes a background for understanding the sources of product development uncertainty. By highlighting the rather equal emphasis of environmental, organisational-complexity-related and single-project-related uncertainties identified by managers in different roles, the article portrays PM dynamism as possibly occurring under the pressures stemming from single projects as well. This is, according to the literature review of this doctoral thesis, an area in

which accounting and management control literatures could be contributed to. However, as the first original article notes, the locus of reacting to uncertainty might well be elsewhere than in PM or cybernetic controls. This specific piece of findings further highlights the fact that PM dynamism is intertwined with broader MCSs and their change.

The objective of the second original article was to examine (product development) project portfolios via a framing perspective, i.e. whether the interviewed managers would see specific uncertainties as threats or opportunities. The framing perspective was built upon Dutton and Jackson's (1987) work. In some cases in our data, however, it was ambiguous which of the two categories, threat or opportunity, an uncertainty would fall into. In particular, the article explores the possible structural and political-cultural controls to supplement the common views according to which project portfolio management is a rational system of decision making (Martinsuo, 2013). The interview findings on management controls were re-categorised (cf., the management control systems package division, according to Malmi & Brown, 2008, in the original article 1) under the categories of 'rational' (strategic management, cost and financial management), 'structural' (organisational structure, operative and administrative management) and 'political and cultural' (competence, social influence, value-based management and leadership).

The contextualised accounts of interviewed managers, i.e. interview excerpts, formed a significant part of the results section of the second original article. In an important finding related to the subject of this doctoral thesis, two of these excerpts provide insight on cost and financial management as part of rational controls in managing product development project portfolio uncertainty. Although cost and financial management seemed to play a minor role in uncertainty management, the article provided input for the examination of PM dynamism in product development. One interviewee emphasised the need to gather project statistics to overcome (threatening) uncertainties concerning project resourcing:

> If we just could estimate and do resourcing more accurately … then portfolio building would be more efficient, and project execution as well. Even without statistical data, we have some hunch which is quite realistic, but that hunch is still more vague than if we had a couple of [past] projects as a basis to see that it always take[s] this much time.

From the viewpoint of this doctoral thesis, the interview excerpt could be interpreted so the organisational complexity of resourcing uncertainty could possibly be managed by increasing the amount of information collected from past projects. Whether this information collection would then lead to PM dynamism is outside the scope of the second original article. However, one could at least postulate that organisational complexities and inadequate resourcing data might act as PM dynamism drivers in addition to data collection from past product development projects. Another interviewee pointed out an uncertainty stemming from single projects (ambiguous, i.e. not interpreted as threat or opportunity):

> Surprises occur all the while because we haven't properly controlled project costs, for instance. It has been the exercise of the past year to properly look at them [project costs], and also ask those project managers about what they're planning there.

Cost control seemed to be adequate here, but it had changed during the past two years. Therefore, it seemed that single-project uncertainties drove dynamism of cost control and possibly acted as a PM dynamism driver. Overall, the second original article provided further information on the sources of product development project portfolio uncertainty by drawing from a wider industry background and more interviews than the first original article, which was about machinery manufacturing. Outside the scope of the second original article but from the same interview data, a further excerpt can be presented as supplementary evidence:[10] an interviewee brought up the need to look at firm-level figures rather than the

[10] This interview excerpt was presented in an earlier version of the paper presented in the 2013 European Academy of Management (EURAM) conference. Supplementing the interview data in the second original article here is an

value of one single project. This was interpreted to show financial management as a means of managing single-project-related uncertainty (again ambiguous in its framing):

> I believe that it is almost impossible to measure how much a single product development project has affected [business in total], and does it even matter? … The problem is how to measure things whose effects take place after several years. And many things happen during that time. There are many variables. I think I like to look at the firm-level figures.

Table 8 presents a summary of the results of the article. The framing of an uncertainty as threat or opportunity (or ambiguous) was seen to possibly connect to whether a rational, structural, or political or cultural control could be interpreted as a means to managing that uncertainty.

Table 8. Management of product development project portfolio uncertainties.

Source of uncertainty	*Rational (28)*	*Structural (8)*	*Political and cultural (8)*
Environment (75)	Varying by framing (8)	Dominated by policies and procedures (4)	Dominated by values (3)
Organisational complexity (76)	Varying by framing (11) (Financial management as a response to one uncertainty: a threat of resourcing [see the first interview excerpt above])	Dominated by policies and procedures (2)	-
Single projects (63)	Varying by framing (9) (Financial management as a response to two uncertainties: an ambiguous uncertainty of surprises from single projects [see the second interview excerpt above] and an ambiguous uncertainty of single project contributing to firm-level success [see the third interview excerpt above])	Varying, but not by framing (2)	Varying by framing (5)

Further underlining the intertwinedness of different controls responding to uncertainties and therefore possibly PM dynamism occurring within an MCS, some interviewees connected financial measurement or measurement to values in the second original article.

> It [the demand] changes along the global economy, and I understand this well, and I am one of those making these decisions when it is tight … of cutting near-future investments. But I wish, speaking of product development, that we would not operate only on the business cycle of a public company, but … [we] would think of things further ahead in the future … I wish and believe that we have the perseverance and sense.

> You should understand that if you are not taking risks, and really fail, then you do not achieve anything. There is no such ideal world, in which you would always magnificently succeed everywhere, and do the right choice. This is such a complex world that you cannot do that. You have to fail in order to learn. And with the measurement of today, there is really no measure for what is the value of a failure. That is kind of interesting.

In these interview excerpts, the interviewees revealed the intertwinedness of financial management or measurement and the values or the culture of their companies. In the first excerpt, the interviewee noted

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attempt to provide a fuller picture of the three mentioned means of financial management in responding to product development project portfolios.

that demand uncertainty could not possibly drive product development investment decisions in their company, but they could have the perseverance to think of the long-term rather than the short-term success. Although this excerpt only has an implicit connection to PM dynamism, it could be interpreted as presenting market fluctuations as a PM dynamism driver since there seems to be a need to at least change the emphasis of certain measures in decision making. In the second interview excerpt, there is a more explicit linkage to PM dynamism mentioned with regard to its operation within an MCS. The lack of a 'value of a failure' measure would not necessarily be a trigger for PM dynamism, i.e. in this case, for example, introduction of such new measure. Instead, the lack of such a measure could be solved by a culture that embraces failure.

The contribution of the second original article in its context, project portfolio management literature, was providing new knowledge about the practice of (product development) project portfolio uncertainty management. The article provided a conceptual framework of project portfolio uncertainties as threats or opportunities from different sources and the management of these uncertainties (by rational, structural and power-based/cultural control). This framework could be useful in further research. The results showed a bias towards framing uncertainties as threats and provided evidence of the low degree of control over the uncertainties when compared to the number of those uncertainties. The article further showed a need to further research the cultural-political aspects of project portfolio management. As a whole, the article drew attention to managers' interpretive processes in project portfolio management. The contribution of the second original article to this doctoral thesis is to enrich the viewpoint regarding the sources of product development project portfolio uncertainty. The article shows that rational controls, such as financial and cost management, were intertwined with firm values. Therefore, further evidence was provided on the intertwined controls within an MCS package. The cultural response to a lack of a (value of failure) measure was particularly highlighted.

These findings are based on a wide array of interview excerpts and an analysis of the data according to the proposed project portfolio uncertainty management framework. The few places where financial or cost management could be interpreted as a means of managing uncertainty were responding to organisational complexities (inter-project relations) and single-project-related uncertainties (evaluation, cost). In all, the article provides more detailed evidence of the possible intertwinedness of controls within MCSs (including PM, although PM was not the most frequently mentioned control).

Together, the first and second original articles help answer the first research question of the doctoral thesis, i.e. 'What are the PM dynamism drivers in product development?' Therefore, these articles provide an empirically grounded illustration of product development as a context in which PM dynamism can occur. In particular, by shedding light on product development project portfolio uncertainties and their management, these articles together have the potential to contribute to PM dynamism literature by (1) highlighting the importance of considering single-project-related uncertainties as possible PM dynamism drivers in addition to environmental and organisational-complexity-related uncertainties; and (2) suggesting that PM dynamism can take place as dynamism of cybernetic/rational controls within a wider MCS package. Consequently, via the first and second original articles, this doctoral thesis can make a contribution, especially to literature on MCSs, by providing evidence of the intertwinedness of different controls within a package (Malmi & Brown, 2008) and the literature on project portfolio uncertainty management (connecting to the discussions, e.g., by Blomquist & Müller, 2006; Martinsuo, 2013; Petit, 2012; Petit & Hobbs, 2010).

While drawing from the researchers' interpretations of different managers' accounts of the sources of product development project portfolio uncertainty, both articles make assumptions of uncertainties and their management. Malmi and Brown's (2008) framework of MCSs as a package does not provide conclusive definitions for each of the control types (administrative, planning, cybernetic, cultural, rewards

and compensation). Therefore, it is clear that the interpretations made have been subjective. For instance, an interviewees' account of future roadmap building was presented in the second original article:

> I think the best way to manage uncertainty is probably to have a long enough roadmap visible in the future. [And to know that with today's assumptions our workings will look like this.] It is clearly linked to having clear priorities … When things are in an order of importance, then it is quite easy to look at execution.

Text sections in the interview excerpt above were coded in Atlas.ti software according to (1) single-project-related uncertainty concerning inter-project relations as an opportunity rather than threat; (2) planning-type control by introducing the need to look at future roadmap visibility; and (3) an administrative type of control of strict prioritisation policies. Further, a text section in this excerpt was edited during the review process of the second original article (inside the square brackets above). This small addition to the interview excerpt was coded in the data analysis as a cultural control of valuing even uncertain figures. In all, instead of straightforwardly seeing the possible difficulty of categorising some of the interview findings under the control-type categories above as a weakness of the first and second original articles, one could see the possible ambiguity in data analysis as further noting the intertwinedness of different controls within an MCS package. Therefore, the above findings might strengthen the results of the two articles in light of this doctoral thesis. Altogether, the first and second original articles provide a partial answer to research question 1: 'What are the PM dynamism drivers in product development?' (Figure 4).

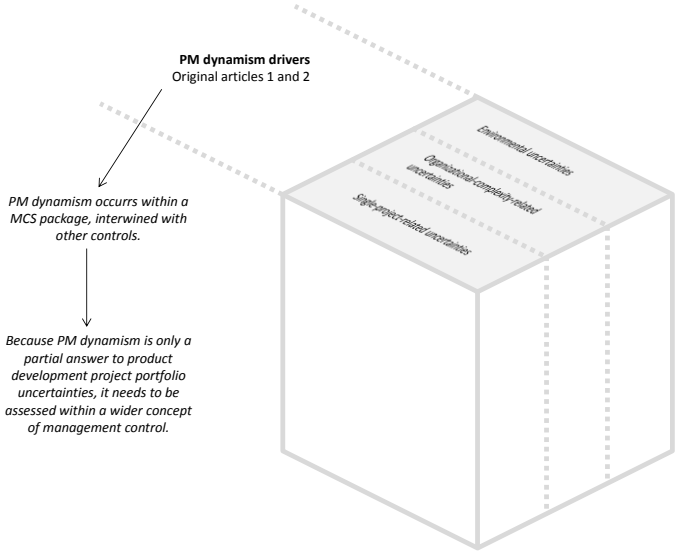

Figure 4. The answer to research question 1.

As Figure 4 shows and as has been stated before, product development project portfolio uncertainty can stem from environmental, organisational complexity and single project sources. I propose that these uncertainties can be managed through various types of management control, of which PM (or cybernetic controls) only comprise a part. Although the articles could enrich the literature on PM dynamism, especially by the inclusion of single-project-related uncertainties as a relevant driver for reaction, the reaction to these uncertainties might be outside the traditional scope of PM dynamism (emphasis, scope, targets). However, the results indicate that PM dynamism might be one relevant (even required) viewpoint that could partially contribute to understanding a broader variety of controls when responding to product development project portfolio uncertainties. Without the inclusion of PM dynamism, only an incomplete picture could be painted in the study of product development MCSs, particularly change and uncertainty response within them.

3.2. A framework for analysing performance measurement dynamism in product development

In this doctoral thesis, the third original article attempts to answer the second research question: 'How can PM dynamism be understood as a theoretical concept?' In addition, the third original article is visually positioned to the entity of the doctoral thesis in Figure 5.

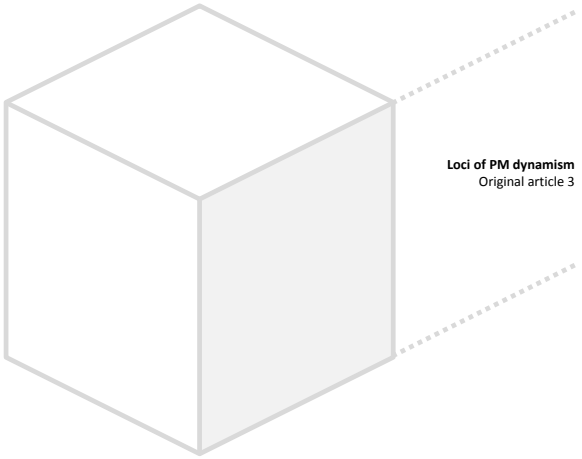

Figure 5. The side of the integrative framework original article 3 addresses.

The third original article is built upon the understanding that PM systems need periodical revision (e.g. Bourne et al., 2000; Henri, 2010; Kennerley & Neely, 2003; Kennerley & Neely, 2002; Wisner & Fawcett, 1991), but there still seems to be a need for longitudinal, qualitative studies to capture PM dynamism that might take place over longer (i.e. more than 12 months) periods (Henri, 2010). The article is built upon a literature review, upon which a level structure of PM dynamism is proposed (Table 9). From the viewpoint of this doctoral thesis, this level structure of PM dynamism will provide a way to further our knowledge on the theoretical concept of PM dynamism. In the third original article, the framework is illustrated from a corporate governance viewpoint using an interventionist case study in a geriatric healthcare provider. In the article, I conducted a PM system development project as an interventionist researcher at a company referred to here as 'Healthcare Inc.' The company had some initial ideas of a balanced scorecard and already had some measures in use. During the interventionist case study, the company's continuing PM needs were examined and a set of spreadsheet-form performance evaluation tools were developed. Theoretical underpinnings in the article are drawn from the idea that PM dynamism occurs in a wider context of management control change through changes in formal and informal control mechanisms (Burns & Scapens, 2000; Lukka, 2007).

Table 9. The level structure of understanding PM dynamism as a theoretical concept.

The level of PM dynamism	*The elements of PM dynamism*
The role of PM in the control package	The dynamism of relying on measures in decision making (or not) and to what extent
The use of measures	The dynamism of emphasising measures
	The dynamism of measurement attributes
	The dynamism of measurement uses
The selection of measures	The dynamism of the PM scope
The components of single measures	The dynamism of measure alarm limits
	The dynamism of measure targets

Considering PM dynamism not only as the change in measures, selection of measures and components of a single measure but also as the role of PM in the control package positions the article in the actor's approach. In particular, the article shows the possibility of PM dynamism not only as intentionally carried-out processes or choices but also as a phenomenon that might subconsciously occur in actors' decision making. In addition, conversely to some contributions that have emphasised the processes through which PM dynamism takes place (Kennerley & Neely, 2003), the third original article contributes to literature on PM dynamism by elaborating on the possibility that certain ad hoc measurements could supplement a more static PM system instead of acting as a barrier to change (Kennerley & Neely, 2003). In particular, a special requirement for PM was mentioned in the interventionist case study at Healthcare Inc., i.e. some measures (employee satisfaction) needed to take place regularly but without predetermined content (every year the problems could be different, thus requiring the measure to be ad hoc). Following Lukka (2007), informal control mechanisms, such as non-process or ad hoc measures, might guard a more static PM system from change pressures. Therefore, the article continues the line of inquiry contributed to by authors such as Vaivio (1999), Kolehmainen (2010) and Fiorentino (2010).

In sum, the third original article contributes the provision of a theoretical understanding of the PM dynamism concept to this doctoral thesis. As an answer to research question 2, 'How can PM dynamism be understood as a theoretical concept?', the empirically grounded conceptualisation of PM dynamism in the third original article offers a lens through which PM dynamism in product development can be examined further (Figure 6).

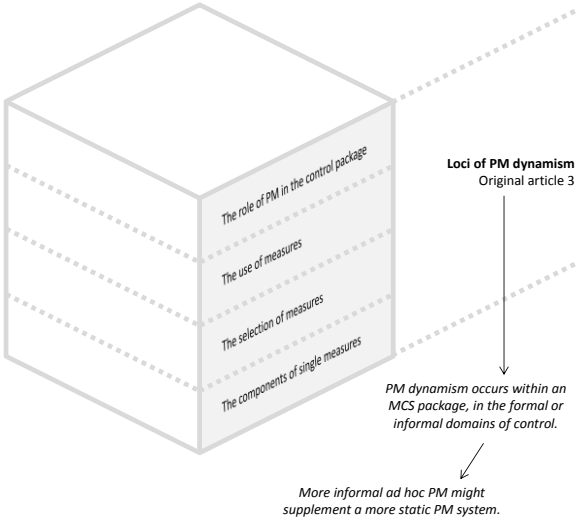

Figure 6. The answer to research question 2.

As Figure 6 shows, I propose that the loci of PM dynamism are on four levels, which the third original article presented. Furthermore, it seems intellectually valid to propose that PM dynamism can occur not only as formal change processes but also as ad hoc PM that could supplement a more static PM system. In light of the first and second original articles' findings, it seems plausible that uncertainties stemming from the environment, organisational complexities and single projects could trigger change at any of the proposed levels of PM dynamism.

3.3. PM dynamism as a part of repairing MCSs in product development

In this doctoral thesis, the fourth original article is leveraged to provide an answer to research question 3: 'What are the types of management control change through which PM dynamism occurs in product

development?' The article especially makes an attempt to understand PM dynamism contextualised in the longitudinal dynamics of repairing a control system in a product development department within a machinery manufacturing company, OEM. The article draws conclusions based on an interventionist case study that took place in 2009–2012. However, because time has passed since the fourth original article was initially written, this doctoral thesis as a whole has the possibility draw conclusions based on an even more longitudinal case study of the machinery manufacturing company in question (2009–2014). This augmented data set also makes it possible for me to build upon the more elaborate analyses carried out after writing the fourth original article. In particular, the further analyses have focused on the dynamics of repairing the product development MCS in the machinery manufacturing company.

At the beginning of the study, the company had previously announced an NPD project model. During the later phases of the study, the company was in the process of implementing and refining the project model and learning how to use cost information in product development projects. The position of the article in the entity of this doctoral thesis is visualised in Figure 7. Based on that data, the cost target of the new product in the case NPD project was viewed rigid, although there was high uncertainty regarding the basis of that cost target.

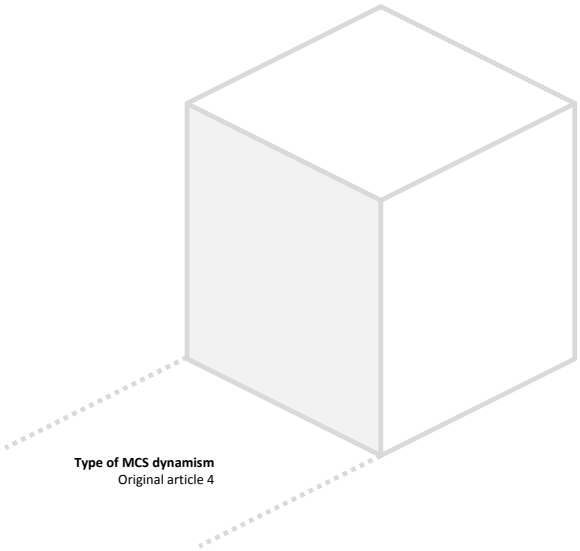

Figure 7. The side of the integrative framework original article 4 addresses.

The fourth original article shows the interplay between the top management, middle management and local employees in repairing a control system and providing more enabling accounting information for the needs of the product development department. In particular, the analysis with the augmented data set following the article draws from the need to pay attention to how enabling accounting information is created instead of coercive types of formalisation (Adler & Borys, 1996; Jørgensen & Messner, 2009). To draw conclusions regarding PM dynamism in product development, further analysis of the case study findings is needed. Therefore, the findings of the interventionist case study with the augmented data set (2009–2014) are discussed in more detail below in light of the integrative framework proposed in this doctoral thesis. In particular and in light of the results, I discuss the sources of PM dynamism, the loci of PM dynamism and the type of MCS change PM dynamism was a part of.

In the studied project, there was an NPD agenda to develop a new machinery generation for OEM using a newly-implemented project model with specified stages and gates. There had been problems related to the reliability and the performance of the previous machinery model. This led to initiating the case NPD project, which would provide OEM with an entirely new machine generation and a testament to OEM's engineers' skills. A visible characteristic of the case NPD project was the estimated production costs as a measure or determinant of project success. Naturally, the project's costs, timing and technology-related

product performance, safety, etc. were also measured. However, I focus here on the product cost, because data was collected particularly on product costs during the interventionist case study.

The middle management at OEM were especially worried about the large number of assembly hours that had been necessary when constructing the previous machinery model and the costs of product warranties and unexpected spare parts. A product cost target for the case NPD project was calculated as 'XX %' compared to the previous model [*dynamism of the PM scope and the components of single measures*].[11] This cost target soon became the measure to determine whether the NPD project had done well or not, i.e. whether the project had reached its profitability-related performance target and shown an acceptable absorbed cost estimate [*dynamism at the level of emphasising measures; due to environmental uncertainty of markets and organisational complexity of people and company when deciding the studied product development department would carry out the development work*]. In practice, the target cost level represented the desirable profit margin combined with the expected price level of the machinery. Quite importantly, the cost target was not directly derived from the customer value but from the price level acceptable for the customer and the roughly estimated cost-saving potential of the previous machinery. In other words, there was relatively high uncertainty in the foundations of the initial cost target [*single-project uncertainty of project evaluation*].

The development of the new machine generation progressed as time went by. Occasionally, as a new product structure was designed and fed to product data management systems, a new cost estimate was calculated based on batch production material cost and assembly hour estimates. However, in the late phases of prototype building, it seemed that the explicit cost target had been exceeded multiple times with the first produced pieces of machinery. This excess was somewhat unexpected since cost evaluations had been based on estimates considering batch production and not the prototypes. The product development managers at OEM shifted focus from the aggregate product cost target (-XX %) to smaller sub-targets, such as direct assembly costs and material costs [*new subassembly targets widened the scope of measurement, dynamism of target setting and including certain measures in decision making*]. To accomplish these sub-targets, middle managers and the local product development managers made a repair together to the MCS. This repair included creating a task force to find ways to reduce assembly costs [*representing dynamism of administrative controls as a change organisational structure, although an informal one*]. This repair was visualised as an informal measure and a production ramp-up calculation that showed the progress of the case NPD project toward the initial cost target using the actual versus target costs for each produced piece of machinery [*ad hoc PM scope dynamism, stemming from the single-project-related uncertainty of costs*]. The middle managers and local product development managers also set quarterly targets for realistic progress in cost reduction [*dynamism at the levels of components of single measures as targets and probably in the subconscious increase in the extent to which PM was included in decision making*]. Ad hoc calculations emerged, and the design took place through collaboration between different managers. In particular, the middle management and local product development managers adopted a new ramp-up calculation to steer NPD and facilitate reaching the aggregate level product cost performance target.

In the case NPD project, the formal PM was not, however, subject to dynamism because organisational pressures stemmed from profitability targets. The product cost target, -XX %, remained unchanged, although it was seen as unrealistic. Conversely, the informal domain of control allowed changes to occur in the form of the task force when formal PM was static. Although the targeted product costs were not reached, the outcome of the case NPD project was a new and technically superior piece of machinery, when compared to the previous generation. In the later phases of the case NPD project, some of the

[11] A '-XX %' is used here for reasons of confidentiality, and because the figure itself is not important for this doctoral thesis. Examining the implications of using a rigid product cost target does not require exact figures.

project stakeholders acknowledged that they had learned a lot during the project about how to set targets and manage a product development project.

When a subsequent project was launched, a number of further product development MCS repairs were made. These further repairs were, in particular, outside the scope of the fourth original article but studied after writing the article. When coming to the subsequent project, a local NPD management intervention was made to halt this project to revise its target setting. During this time, it was possible to revise the product cost target of this project and decrease the risk of setting an unrealistic product cost target in this project. A more realistic cost target was sought, which required a cultural change and coercive rules to reset the responsibilities within the project that could be used to set target costs for subassemblies [*dynamism of target setting and using PM intertwined with administrative controls of policies and organisational structure*]. The local NPD managers also redefined the project model in conjunction with the middle management.

The product development department at OEM had learned from the previous case NPD project to repair the control system in the subsequent NPD project. This MCS repair took place in conjunction with the middle management and the local NPD management. Intertwinedness within the MCS package was witnessed within the two studied projects. The stability of cybernetic controls was reflected in other elements of the MCS package. For instance, the stability of PM (seen in the product cost target remaining unchanged) pushed tightening administrative controls in the form of a new task force. In the case NPD project, the managerial practices could be changed after introducing ad hoc calculations to support product ramp-up. The culture is naturally of fundamental character in any context, and cultural controls can act as a 'bullet-proof vest' for product developers to carry out their work that takes place over many years. Quarterly reports demand efficiency, but product developers need to embrace perseverance in order to maintain sovereignty when faced with a changing environment. In such a case, the dynamism of the extent to which PM dynamism is relied on in decision making is crucial. Table 10 summarises the findings regarding PM dynamism in the case NPD project and the subsequent project. As illustrated in the MCS repair during the two projects, PM dynamism did not take place only at the project level, but the same problems were solved in portfolio-level repair of learning from one project to the next.

Table 10. Summary of the findings on PM dynamism in original article 4.

	2009–2011 (the data set of original article 4)	*2011–2012 (the data set of original article 4)*	*2012–2014 (the augmented data set)*
The level of PM dynamism	*The case NPD product development project*	*The production ramp–up of the product developed in the case NPD project*	*The subsequent product development project*
The role of PM in the control package		The role of aggregate product cost measurement probably decreased as the sub targets gained emphasis.	
Using PM	The emphasis of product cost measurement increased.	The emphasis shifted, especially towards quarterly target costs. Due to the focus shifting from batch production estimates to actual accrued costs, cost PM definition changed.	The product cost target became a subassembly target costing driver.
PM scope		An ad hoc ramp-up target cost was introduced, and subassembly-level evaluation of costs was initiated (within the interplay of top management and local NPD management).	
Components of single measures	A new '-XX %' cost target was set (by middle management intervention).	Product cost performance by a product cost target was supplemented with sub-targets and a quarterly progress plan.	A new basis for cost target setting was defined.

The analysis following the fourth original article contributes to Jørgensen and Messner's (2009) line of inquiry by addressing the dynamics of repair within an MCS. In addition, this analysis connects to literature on enabling accounting—e.g., Wouters and Roijmans (2011) and Jordan and Messner (2012)—by discussing the interplay of top management and local management interventions as well as the local development of enabling accounting information. In light of the theoretical concept of PM dynamism, the fourth original article and the following analyses provide an avenue to discuss the loci of PM dynamism in an actual product development setting, in time and space and longitudinally in a continuum from a product development project to another. Figure 8 illustrates the contribution the fourth original article makes to this doctoral thesis in answering research question 3.

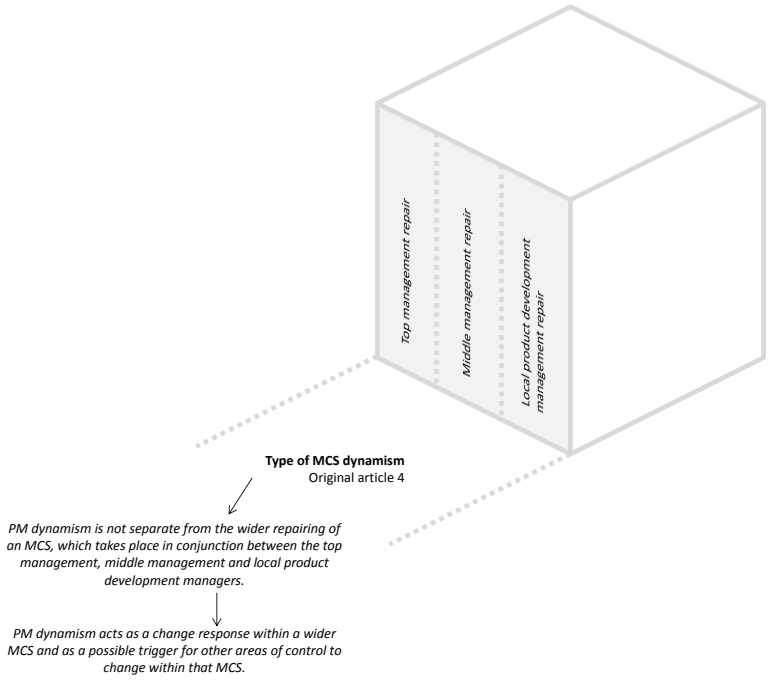

Figure 8. The answer to research question 3.

As shown in Figure 8, the fourth original article attempts to answer research question 3: 'What are the types of management control change through which PM dynamism occurs in product development?' It seems that a product development MCS can be repaired by collaboration between top management, middle management and local product development management (Jørgensen & Messner, 2009). The fourth original article proposes that more enabling accounting could be developed in this repair. This viewpoint connects to the perspectives regarding the sources of product development project portfolio uncertainty and the loci of PM dynamism presented earlier.

4. DISCUSSION AND CONCLUSIONS

4.1. Discussion of findings

4.1.1. Summary of the answers to the research questions

Figure 9 summarises the answers to the research questions of this doctoral thesis. PM dynamism is defined as changes in measurement components, scope, use and inclusion of PM in decision making; the notion can occur formally or informally. The loci of PM dynamism are not only dealt with by changes in cybernetic controls (Malmi & Brown, 2008) but also by different types of control mechanisms intertwined in an MCS, moderated by the framing of a change driver as a threat or opportunity and the managerial role or the one who identifies those drivers. PM dynamism has the potential to repair product development MCSs through cooperative management interventions and interplay between organisational levels. However, because PM dynamism operates within an MCS package, it may act as a vehicle to product development MCS repair. However, it is not a panacea for surviving under circumstances characterised with high uncertainty. Moreover, it is possible that PM dynamism does not only occur within product development projects but also as more longitudinal, project-portfolio-wide dynamism. PM dynamism might take place in a product development project portfolio because of difficulties changing the pre-set targets during one project and, in line with previous research, because other areas of MCSs shield PM from change pressures. PM dynamism drivers stem not only from environmental and organisational-complexity-related sources but also from single-project-related issues. The results of this doctoral thesis indicate that at the product development portfolio level, the many uncertainties stem from the environment (society, markets, industry), organisational complexity (people, company, inter-project relations) and single projects (project characteristics, evaluation, time, cost, scope).

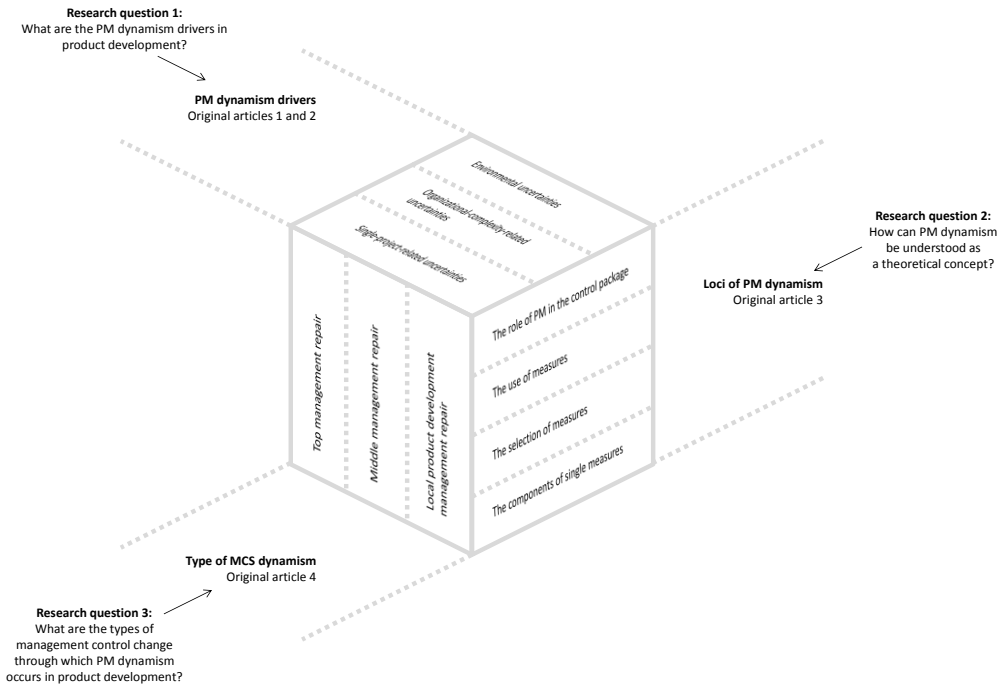

Figure 9. Answers to the research questions of the doctoral thesis.

4.1.2. Supplementing accounting and control literature with single-project-related uncertainties

According to the literature review made in this doctoral thesis, accounting and control literature on PM emphasises PM dynamism drivers of environment and organisational complexity (Davila, 2000; Ferreira & Otley, 2009; Henri, 2010; Hudson et al., 2001; Kaplan & Norton, 1993; Kennerley & Neely, 2002; Kolehmainen, 2010; Waggoner et al., 1999; Wisner & Fawcett, 1991), possibly leaving room for contributions of single-project-related aspects driving PM dynamism. In the project portfolio management literature, single-project-related uncertainties are noted to affect project portfolios (Abrantes & Figueiredo, in press; Nobeoka & Cusumano, 1995; Nobeoka & Cusumano, 1997; Petit, 2012; Petit & Hobbs, 2010), as uncertainty stems from project characteristics, evaluation, time, cost and scope. However, the relationship of single-project-related uncertainties and PM dynamism seems unclear. Examining the relationship of certain phenomena could be seen as a theoretical contribution.

In this doctoral thesis, the relationship between the PM dynamism drivers and the loci of PM dynamism (or other control mechanisms) is examined. The findings of this thesis, particularly the fourth original article and its augmented data set, support the idea that single-project-related uncertainties (such as modularisation in Jørgensen & Messner, 2010) are a relevant viewpoint to PM dynamism drivers in addition to project portfolio management. The fourth original article shows single-project-related uncertainty stemming from product evaluation. In the case NPD project, the set product cost target remained unchanged but ad hoc calculations were implemented to facilitate reaching the target and to provide a viewpoint of a quarterly progress plan for reducing product costs. The emphasis of product cost measurement shifted from total manufacturing cost to evaluating subassemblies against quarterly targets. In the subsequent NPD project, OEM began to use the product cost target as a basis of subassembly target costing. The formal target cost could not be changed but informal efforts to respond to change emerged.

It seems that within a project portfolio PM dynamism might more easily occur within the portfolio rather than within a single project at least when formal PM systems are in question. This was the situation especially in the fourth original article and its augmented data set. Uncertainties in the case NPD project drove PM dynamism but PM dynamism could occur mainly in using PM and the role of PM in the control package. Therefore, I suggest that the relationship between single-project-related uncertainties as PM dynamism drivers and the loci of PM dynamism could be the following: informal PM dynamism occurs within a single project and formal PM dynamism can more easily occur within the portfolio. This suggestion is understandable; however, if this is true more generally, the informal domain of control is critical to PM dynamism in managing project business. This criticality should not be disregarded by researchers or practitioners.

The above conclusions are based on the anecdotal evidence from the paradigmatic case of the OEM and they might produce examples of new theoretically sound ideas (cf. Flyvbjerg, 2006). Single-project-related uncertainty driving PM dynamism comes hence with implications to research. Academic researchers of PM dynamism might have to take a closer look at the single-project-level needs for PM dynamism. Although this finding is not entirely new (cf. Driva et al., 2000), it seems that the literature on PM dynamism could be strengthened in this regard. Single-project-related uncertainties might shift the emphasis of PM dynamism toward a more micro-level (or project-level) PM, which could supplement the organisation-level PM system that addresses changes, e.g., in strategy, technology and legislation. Showing the inadequacy of PM to support NPD work in single projects might hence require researchers to address issues such as single-project-level PM dynamism, PM dynamism outside the organisation-level PM system and the ability of organisations to respond to PM dynamism drivers stemming from single projects. These issues are addressed in this doctoral thesis but further research could examine the extent to which single-project-related PM dynamism exists in organisations in different contexts.

4.1.3. Discussing PM dynamism as part of an MCS repair

All the original articles show the necessity of discussing PM in the broader context of management control, which is well in line with previous research and provides what has been sought: an account of the intertwinedness of the controls within real-life MCS packages (Malmi & Brown, 2008). This doctoral thesis is one attempt to operationalise this research gap by providing empirical evidence of the possible consequences of such intertwinedness situated in longitudinal change. As shown by this doctoral thesis, PM dynamism represents a sound notion for examining the intertwinedness within an MCS package. The empirical results in the fourth original article and the following analyses suggest that the intertwinedness of MCSs may be related to relatively static formal PM, which can result in greater influence of and dynamics within other control mechanisms. Based on the results of this doctoral thesis, I argue that PM dynamism is likely to occur simultaneously with the dynamics of other elements of the MCS package. It is quite clearly visible, in the first, second and fourth original articles that PM only plays a partial role in what is a response to change pressures. Therefore, PM dynamism was a means to manage uncertainty in tandem with other controls, particularly those of values and culture. Based on one of the interview excerpts in the second original article, it was even proposed that a lack of a measure could be compensated by a culture that embraces failure.

More particularly, the fourth original article and its augmented data set provided a basis for discussing PM dynamism together with MCS repair. The interventionist case study of OEM in this doctoral thesis supported the idea that single-project-related uncertainty is a PM dynamism driver; however, it is not only PM in which dynamism occurs or is carried out. For example, in the case NPD project, administrative controls were seen: a task force for product cost reduction was used once the product cost target could not be altered. Moreover, the response to a change pressure might lead to repairing an MCS, in interplay of the top management, middle management and local NPD project management. In particular, these findings add to the accounting and control literature that emphasises the importance of top management intervention in repairing an MCS (Jørgensen & Messner, 2009). This doctoral thesis, in particular, reveals the dynamics of repairing an MCS with various managers in interplay at various organisational levels, during local NPD accounting development. Based on the evidence gathered for this doctoral thesis, I suggest that researchers of MCS might have to take PM dynamism into account when discussing MCS change. If an MCS repair is studied, researchers might find benefit from combining the loci of PM dynamism with the notion of repairing the intertwined controls within MCS packages.

4.1.4. Taking the actor's approach to PM dynamism

Although the term MCS implies that a *system* is in question, MCS research should be open to informal attempts to repair an MCS. In product development, formal MCSs do not necessarily entail the multitude of formal and informal controls present in some other contexts. This doctoral thesis stresses the need to find dynamism where formal systems of PM are not necessarily in place. PM dynamism may occur (passively), especially if the actor's approach is taken to PM dynamism rather than a systems approach. For example, actors change their interpretations of a performance measure. PM dynamism may be used (actively) when actors, e.g., select the scope of their PM, alter targets and place emphases on certain measures. Formal product development project control and steering procedures can be supplemented with inadequate or incomplete processes of including a product cost target to decision making (such as in the fourth original article), which can lead to, for example, situations of unrealistic target setting.

Contrastingly, previous research on PM dynamism emphasises the need for PM systems to be dynamic (Bourne et al., 2000; Braz et al., 2011; Ghalayini & Noble, 1996; Kennerley & Neely, 2003; Kennerley & Neely, 2002; Lebas, 1995; Nanni et al., 1992; Waggoner et al., 1999; Wisner & Fawcett, 1991), possibly disregarding the need for informal domain of control to guard the formal from pressures to change

(Lukka, 2007). In other words, literature on PM dynamism largely disregards the need to consider the actor's approach (presented in Cinquini et al., 2013).

This doctoral thesis makes an attempt to take the actor's approach to PM dynamism in product development. Here PM dynamism is a concept that is moulded by a decision maker's traits. PM dynamism is not necessarily dynamism of *systems* only, but also of certain actors' interpretations of PM. This understanding is in line with literature on management control change that sees management control change as a continual process in general (Ahrens & Chapman, 2007; Burns & Scapens, 2000; Lukka, 2007) and in product development (Burns, 2000; Jørgensen & Messner, 2009; 2010). Ad hoc PM as a supplement to more rigid PM system could be one answer that provides tools for researchers to provide subjectivity to PM and address the importance of fast reaction to PM dynamism drivers (Burns & Scapens, 2000; Driva et al., 2000; Fiorentino, 2010; Kolehmainen, 2010; Lukka, 2007; Vaivio, 1999). The originality of this doctoral thesis is that it explicitly notes the possibility of ad hoc measures supplementing a more rigid PM system; therefore, the thesis provides a supplementary viewpoint to PM dynamism as dynamism of PM systems or systematised change within PM (e.g. Kennerley & Neely, 2003). If researchers take the actor's approach to PM dynamism, they are expected to be confronted with a variety of loci of PM dynamism outside PM systems. Conversely, if a system's approach is taken, actor-level PM dynamism might not be addressed with equal emphasis. Importantly, either of the viewpoints, actor's or systems, should not be seen to be competing against the other; rather, this doctoral thesis finds these approaches to be supplementary to each other.

It could be beneficial for the accumulation of knowledge for researchers to address the variety of ad hoc performance measures in use in a variety of organisations. If such knowledge could be acquired, the practitioner audience of product development literature would also possibly gain useful tools to develop their PM. Moreover, discussions on PM dynamism while taking the actor's approach could likely bring the discussions of PM dynamism and management control change closer to each other. This doctoral thesis is one such attempt, but room for further research exists, particularly for explicitly examining the Cinquini et al. (2013) division of 'facts, possibilities, values and communication' (p. 364) in relation to the loci of PM dynamism. In this doctoral thesis, the actor's approach was found useful in taking distance to the system-related discussion but the division above was not explicitly addressed. Moreover, based on the results of this doctoral thesis, I suggest that in contexts where formal PM systems or processes are not adequate in supporting work (such as in OEM), it is expected that a researcher confronts change responses outside those systems or processes. Perhaps the systems approach to PM dynamism becomes an increasingly relevant viewpoint once sophisticated PM systems are in place. Further research might hence address the linkage between PM dynamism and PM maturity; such research could take either the systems approach or actor's approach or use a combination of the two approaches.

4.1.5. Implications of PM dynamism in product development

PM dynamism would be needed in the context of product development (Bremser & Barsky, 2004; Driva et al., 2000; Hertenstein & Platt, 2000; Karlsson et al., 2004). Previous literature acknowledges the need to implement new measures or delete obsolete ones in product development (Bititci et al., 2000; Bourne et al., 2000; Bremser & Barsky, 2004) and addresses the need for PM to be emphasising measures according to timely needs (Hauser, 2001; Hertenstein & Platt, 2000). Also, the use of more long-term and project-specific measures has been noted (Driva et al., 2000). Altogether, this doctoral thesis builds on this background to provide an in-depth understanding on the concept of PM dynamism in product development. In addition to the previous viewpoints above to PM dynamism in product development, this doctoral thesis suggests that PM dynamism also comprises the informal side of PM, e.g., the interpretations of a performance measure (the cost measure in the case NPD project in the fourth original article). PM dynamism in product development comprises both the active and passive alterations to PM. In some cases, PM dynamism (passively) 'happens' from the viewpoint of an actor (e.g. the top

management's emphasis); sometimes the actor (actively) 'carries out' an act that represents the phenomenon called PM dynamism, e.g., by changing the targets, PM scope, emphasising measures or the extent to which decision making relies on product development PM. Considering PM dynamism in product development to occur at those multiple levels which this doctoral thesis presents, requires at least noting that an actor is at the centre of an act that represents PM dynamism. Reliance on PM in decision making and emphasising measures are only partially addressed if only the systems approach is taken. Distrust in previous cost control shown in Ask's teaching case (as cited in Taipaleenmäki, 2004, pp. 44–45), for example, might drive PM dynamism but, as a problem, does not necessarily get solved only by implementing new systems. Attaining a new trust in cost control might require building a new culture. This is where this doctoral thesis and the prior studies that take the systems approach to PM dynamism clearly agree: an organisation that wishes to maintain the relevance of their PM over time will have to align their 'process, people, infrastructure and culture' (Kennerley & Neely, 2002, p. 1240). However, this doctoral thesis will contribute to this literature by noting the necessity of looking at PM dynamism beyond the systematised PM evolution (cf. Kennerley & Neely, 2003).

If future researchers take the route of PM dynamism in studies of product development (or the other way around) several implications are likely. First, this doctoral thesis shows that in product development, single-project-related uncertainty (in addition to environmental and organisational-complexity-related uncertainty) is a possible PM dynamism driver. However, PM dynamism might not necessarily occur within projects but portfolios of projects, depending on loci of PM dynamism that is a topic of interest. Once a product development project is initiated, there might not be room for change in the formal PM system, but, when needed, a change response might require, e.g., re-interpretation or re-emphasising measures or implementation of ad hoc measures. Hence the systems approach to PM dynamism might become a particularly relevant viewpoint at the level of product development project portfolios. Second, PM in product development systems might not be as sophisticated as PM systems in some other contexts, and, therefore, the actor's approach to PM might provide richness to accounts of PM dynamism in product development. Third, PM dynamism may occur interwined with MCS repair, which makes it necessary to not delimit studies of PM dynamism in product development (and possibly in other contexts as well) from examining the relationship between PM dynamism between other elements of MCSs.

In addition to the future research avenues presented above and in each of the original articles, future research could, in light of the work done in this doctoral thesis, explicitly address some of the previous product development PM frameworks. One such framework that could be further analysed is one by Davila and Wouters (2007), which includes the measurement objects of a product development project: the project portfolio, the R&D function, and the level of innovation. Moreover, the scant attention paid to single-project-related uncertainties and ad hoc PM as drivers or characteristics of PM dynamism requires further attention. Research could also provide meaningful understandings of context-situated PM dynamism by studying PM dynamism in other contexts than the product development context studied in this doctoral thesis or the manufacturing context that has been examined in a variety of studies.

4.2. Contribution

The previous literature on PM dynamism in product development is thin. Product development is an uncertain context due to unexpected developments in markets and technology. If there is inadequate knowledge of PM dynamism operating in product development, steering product development with the timely objectives of the whole organisation might be hampered. This problem would potentially cause organisations to develop new products that could not fit their strategy or not reflect timely objectives through the product development process, possibly leading to decreased competitive advantage and lower profitability. However, some contributors, such as Kolehmainen (2010) and Braz et al. (2011), have discussed PM dynamism from a contextually-oriented descriptive perspective, which could provide an

understanding of how PM dynamism is portrayed in reality. In addition, this doctoral thesis portrays PM dynamism within organisational life.

This doctoral thesis is an attempt to provide an understanding of the theoretical concept of PM dynamism, the loci of PM dynamism, its drivers and its role in the dynamics of repair of the intertwined controls within an MCS by elaborating on Malmi and Brown's (2008) and Jørgensen and Messner's (2009) findings. This doctoral thesis adds to the coherence and reliability of the conclusions drawn from MCSs (as a direct answer to, Malmi & Brown, 2008) through its contextually situated accounts of MCS intertwinedness, particularly in the first, second and fourth original articles (and the further analyses augmenting the scope of the fourth original article). In these articles, neither PM dynamism nor other mechanisms of control took place in isolation, but they were intertwined. Through its thorough, empirically grounded analysis on the loci of PM dynamism in product development, this doctoral thesis connects to the calls for research on PM dynamism in uncertain and changing contexts (Bourne, 2008; Franco-Santos et al., 2012; Henri, 2010) and through longitudinal, qualitative research (Henri, 2010). This doctoral thesis is also an attempt to provide empirical evidence on the implications of taking an actor's approach to PM dynamism (Cinquini et al., 2013), which is an approach that has not been adequately seen in studies on PM dynamism.

Furthermore, research on PM dynamism in product development is connected to fulfilling long-term business objectives through product development performance (Brown & Svenson, 1988; Hertenstein & Platt, 2000), which makes this doctoral thesis relevant for the academic audience interested in product development accounting. In particular, this doctoral thesis contributes to the literature on NPD accounting and control (e.g. Davila, 2000; Jørgensen & Messner, 2009; 2010) by emphasising the single-project-related sources of product development uncertainty that might trigger PM dynamism within an MCS and showing how the dynamics of repairing an MCS can take place in the context of product development. The importance of single-project-related uncertainties also contributes to the literature on project portfolio management (e.g. Blomquist & Müller, 2006; Martinsuo, 2013; Petit, 2012; Petit & Hobbs, 2010). The role of political or cultural controls in supplementing a more rational project portfolio management can also be seen as a contribution that will support previous suggestions in project portfolio management research (Martinsuo, 2013). In addition to rational decision processes (which I consider formal PM dynamism to be part of but informal and unintentional PM dynamism to be excluded from), product development project portfolios are also managed in bargaining and negotiation as well as structural reconfiguration. These findings support previous project portfolio management studies (such as Martinsuo, 2013). In particular, bargaining and negotiation imply local mechanisms to adapt to change pressures in product development, i.e. issues that are seen in the first original article (cultural controls), the second original article (political or cultural controls), the fourth original article and the further analyses that followed (repairing an MCS in different managers' interplay).

This doctoral thesis provides a background for understanding which kinds of drivers exist for PM change in product development when different managerial roles are studied. This thesis underlines the need for different managerial roles to cooperate in product development project portfolio management; a variety of different controls are used in this cooperation (Beringer et al., 2013; Blomquist & Müller, 2006; Jerbrant & Gustavsson, 2013). As a key contribution, the results of this doctoral thesis indicate that that a variety of sources of uncertainty are present in the product development context. The cybernetic controls are seen as a means of managing project portfolio uncertainties in the roles of financially oriented portfolio manager (i.e. business controller), program manager (i.e. research and development manager or director) and project manager. In addition to the managerial role perspective, this doctoral thesis problematises the project portfolio uncertainties from a different angle, i.e. the viewpoint of uncertainties as threats or opportunities. Individuals' perceptions of uncertainty moderate the means of managing uncertainty (e.g. Blichfeldt & Eskerod, 2008; Loch, 2000). The results indicate that biases exist towards seeing

uncertainties that are threats (rather than opportunities) and towards rational control mechanisms in managing those uncertainties.

Based on the literature review, I expected systematic processes of PM dynamism and more informal ad hoc measurement to collaboratively shape the intertwinedness of controls within the MCS package. However, few studies address ad-hocism as a supplement to a more static PM system (at least explicitly). Therefore, as one contribution to the literature on PM dynamism, the possible importance of ad hoc measurement is made explicit in this doctoral thesis. Ad hoc measurement is brought up as a possibility to introduce dynamism into a more static PM system. This finding was contrasted by previous research that largely relied on PM dynamism processes (e.g. Bourne et al., 2000; Kennerley & Neely, 2003; Kennerley & Neely, 2002) but is in line with strategic management (accounting) research (Fiorentino, 2010; Kolehmainen, 2010), literature on management accounting and control change (Burns & Scapens, 2000; Lukka, 2007; Vaivio, 1999) and literature on product development PM (Driva et al., 2000). Overall, the doctoral thesis shows that PM dynamism does not occur in isolation, but it deserves examination in relation to the wider concept of MCSs. PM dynamism is shaped by the context in which it is operationalised and by the intertwinedness of different controls in an MCS package.

4.3. Managerial implications

To address the lack of practical advice regarding 'purposeful management control' (Ahrens & Chapman, 2007, p. 24), this doctoral thesis attempts to give some advice in the form of managerial implications. In addition to the managerial implications presented in the original articles, the following highlights are presented based on the doctoral thesis as a whole.

Single-project-related uncertainties (project characteristics, evaluation, time, cost and scope) may act as one important driver for the management practices and systems to change. Hence, it is necessary for managers at different organisational levels to continuously pay attention to single-project-related uncertainties when appraising the purposefulness of management accounting practices and systems in place, including those that concern PM. The single-project-related uncertainties supplement the current view that environmental uncertainties (legislation, for example) and uncertainties stemming from within the organisation (strategy and internal politics, for example) will drive the need for management accounting practices and systems to change. An example of a single-project-related uncertainty (project evaluation) was presented in the case study of the fourth original article, in which a product development MCS was repaired.

The case study also shows that the continuous cooperation (interplay) of top management, middle management and local NPD management acts as a vehicle for improving the purposefulness of MCSs. This finding can be interpreted as a suggestion for managers at different organisational levels to continuously seek avenues for cooperatively repairing the MCSs in place. When changing PM practices or a PM system, managers should also consider PM in relation to other types of control and organisational steering mechanisms. Therefore, managers should carefully consider the effects on the overall MCS that a change in PM might incur. Although the findings imply that, in some cases, a change in PM might not be needed if some other control mechanisms have a more significant role in responding to a change pressure, managers should not be lulled into the sense that PM is not under continuous change. In fact, quite the opposite is true; managers should consider the possibility that PM may have already changed (in some specific situation) in its more informal, subjective, interpretive and ad hoc characteristics. Even a shift in emphasis of the extent to which PM has been relied on in decision making can represent a change in PM. This viewpoint is not to be disregarded by different managers at different organisational levels in different organisations.

4.4. Limitations

Although this doctoral research contributes to academic discussions by drawing from extensive empirical data, the contributions do not come without limitations. First, if another researcher or a group of researchers would address themselves to a similar set of research questions, their selection of approach (i.e. systems or actor's approaches, in Cinquini et al., 2013) would greatly affect the conclusions reached. If an actor's approach is taken to PM dynamism in product development, the subjective and more informal side of PM dynamism will probably be highlighted. Conversely, if PM dynamism in product development is addressed using a systems approach, the conclusions will probably address the need to change the formal PM systems used in product development. On a more practical level, even the choice of interviewees and companies in which research interventions were carried out shaped the results and the contribution of this doctoral thesis. The conclusion could have been different if different practical choices had been made, e.g., who was interviewed (particularly the sources and management of product development project portfolio uncertainties) and which company an interventionist case study was carried out in (particularly the loci of PM dynamism). Similarly, in this doctoral thesis, only literature on PM dynamism, PM dynamism in product development, MCS change, MCS change in product development and project portfolio uncertainty was addressed when drawing conclusions. By selecting a different set of background literature, the conclusions could have been different.

Second, the contextualisation of a PM system can only provide some information (not an exhaustive list) of why there was or was not sufficient PM dynamism in some cases to take care of PM's timeliness. This possible limitation of this doctoral thesis might be made less significant by the in-depth account of MCS repair in the fourth original article and the further analyses that followed. As Micheli and Manzoni (2010) state, 'In order to have comparability and generalizability of research findings, authors will have to clarify what type of PMS [performance measurement system] they are considering, rather than examining 'generic' performance measurement systems' (p. 469). The attempt in this doctoral thesis is to clarify the cost controls in the case NPD project and following project. By its contextualised, empirically grounded data and the analysis of the product development PM drivers in this specific context, the findings of this doctoral thesis could also be generalisable to some other product development environments.

Third, an interventionist researcher is confronted with data available for one time only. Although this problem could be considered a weak point of interventionist research, it also comes with a positive side. The data an interventionist researcher acquires is likely to be unique in its contextual richness and is therefore potential fuel for theoretically meaningful contributions—bearing in mind that when suboptimal[12] methods of accounting and control are implemented, an academic report should explicitly make it known that the conclusions on the usefulness of developed systems will be biased (Malmi & Granlund, 2009).

Fourth, the interpretive and subjectivist stance toward PM dynamism in this doctoral thesis also has profound scientific-philosophical implications. Some objective theorisation is made (for instance on the dynamics of repair), although data analysis was based on the researcher's interpretation (cf. Kakkuri-Knuuttila et al., 2008). For example, subjective interpretation was to a large extent made based on Malmi and Brown's (2008) work. It is possible that some other researcher could have interpreted the findings differently (e.g. through different frameworks or categorising findings differently because of the researcher's own subjectivist viewpoints) and therefore reached different conclusions. However, one should accept that once research is performed on social phenomena by individual researchers, some interpretation always occurs.

[12] Since it is nearly impossible to demonstrate that a practice is absolutely optimal, I would—for reasons of safety—call a method that developed in interventionist work 'suboptimal'.

EPILOGUE

PdM: …and that's why it is critical.

PjM: I see the point but not how it relates to me and my work.

PdM: Let me explain. The organisational needs come from above and the top management can make clear changes in what they value. And the product development engineers and you as the project manager, you are capable of creating new ways of working and interpreting the targets you are given. And I'm here in the middle working as a facilitator of developing the work that we do and how we control product development. You agree?

PjM: Yes.

BM: Yeah [nodding].

PdM: We must work more on what we measure and how we interpret that information we receive. I think it is not entirely the case that we just select the measures that are relevant to us. It's not just about a selection. The management control system, and the project steering are somewhat made better as we go ahead. You know. If the word better can be used here.

BM: I think this is the kind of timeliness of performance measurement that I was after.

PdM: Ehh… Those changes that you proposed [addressing the BM], I think you can't do them alone. The same goes with the problems with performance measurement at the level of a product development project [addressing the PjM]… Those problem points are linked to the product development steering. Those policies. Those decisions. That practice… And this travels in time. I mean, what we decide now might not help us for very long. But it might be proper for some time and I'm glad we've started discussing this issue.

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The first original article:

Korhonen, T., Laine, T., & Martinsuo, M. (2014). Management Control of Project Portfolio Uncertainty: A Managerial Role Perspective. *Project Management Journal*, *45*(1), 21–37.

The second original article:

Martinsuo, M., Korhonen, T., & Laine, T. (2014). Identifying, framing and managing uncertainties in project portfolios. *International Journal of Project Management*, *32*(5), 732–746.

The third original article:

Korhonen, T., Laine, T., & Suomala, P. (2013). Understanding performance measurement dynamism: a case study. *Journal of Management & Governance*, *17*(1), 35–58.

The fourth original article:

Laine, T., Korhonen, T., & Suomala, P. (2012). Exploring the possibilities of enabling accounting in NPD projects. *8th Conference on New Directions in Management Accounting, December 12–14, 2012, Brussels, Belgium*.

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ISBN 978-952-15-3303-7
ISSN 1459-2045