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Governing product co-development projects: The role of minimal structures

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ABSTRACT

In this paper we study the governance of product development projects in which multiple parties with diverse technical knowledge together co-develop new products and bring them to market. We use a minimal structures framework which consists of economic, institutional, social and technical structures. We investigate how these structures provide the firmness and flexibility needed to stimulate creativity and, at the same time, coordinate the various parties who are contributing to the product co-development project. In addition, we use the concepts of temporal embeddedness and a-temporality drawn from the literature on temporary organisations. In a case study of product co-development we observe that, while the social and technical structures govern the day-to-day product development activities, the economic and institutional structures provide the context for the project and also govern the relationships between the collaborating organisations. Although management accounting and management accountants are not directly involved in the day-to-day management of the product development process, accounting-based information is used to set the boundaries for the project. We discuss how these boundaries can provide both the firmness and the flexibility needed to promote the creativity and innovation which are needed in new product co-development projects. We suggest that these boundaries can be either broad or narrow and either permeable or impermeable, thereby creating different forms of flexibility.

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1. Introduction

Recent years have seen increasing inter-organisational collaboration in new product development as even large OEMs (original equipment manufacturers) do not possess all the necessary expertise in-house for developing new products, especially complex products where a wide range of expertise and different forms of knowledge are required

– e.g., in the electronics, biotechnology and even pharmaceutical industries (Chesbrough, 2003; Faems et al., 2005; Hagedoorn, 2002). Consequently, OEMs are increasingly outsourcing specific elements, or in some circumstances all elements, of the product development process to specialist companies which have the necessary expertise and knowledge. For instance, in developing modern hi-tech electronic products expertise in electronics alone may not be sufficient, but will need to be combined with expertise in electrical, mechanical, and control engineering as well as applications software. Increasingly, smaller specialist companies, which have specific expertise in such areas, are becoming more directly involved in product development

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projects (Alvarez and Barney, 2001; Kalaighnam et al., 2007). For example, rather than the more traditional forms of outsourcing in which suppliers undertake specific and clearly defined tasks in a product development project of an OEM, they are becoming 'co-developers'. In other words, rather than giving them a specific task to undertake, an OEM may ask specialist companies with relevant expertise to become an integral part of the product development process. Furthermore, in other instances smaller specialist companies can be the initiators of co-development projects in which they collaborate with OEMs whom they approach. An important feature of all co-development projects is that the co-developers are responsible for the development of the entire product, not just for their specific task. In such cases, as the product development is undertaken by parties drawn from different organisations, the management of the project needs some form of inter-organisational control (IOC), as well as forms of project control.

In this paper we will study product 'co-development' in which the parties contributing to the development are drawn from multiple organisations. The collaboration between these organisations can be described as taking place within an inter-organisational temporary organisation. According to Janowicz-Panjaitan et al. (2009a: p. 2) an inter-organisational temporary organisation is generally defined as "A group of two or more non-temporary organizations collaborating toward the accomplishment of a joint task with the duration of the collaboration explicitly and *ex ante* fixed either by a specific date or by the attainment of a predefined task or condition."¹ In our case the temporary organisation is set up specifically for the co-development of a new product, using dedicated staff drawn from a number of separate organisations. Although they remain employees of their respective organisations, these dedicated members of staff work within a project-based organisation² on the co-development of the specific product. In such a project-based organisation (see Kenis et al., 2009) the parties come together, interact in the development of a new product, and then subsequently disband (Morley and Silver, 1977).

There is an extensive literature on IOC which has looked at various types of inter-organisational relationships, including joint ventures, strategic alliances, supply chains, and so on. However, relatively little research seems to have been conducted specifically into the management control of inter-organisational new product co-development projects, although there are various studies which have explored the management control of new product development within organisations (i.e., in-house product development), and some which have

Fig. 1. Temporary organisation in a complex network.

studied the outsourcing of specific product development activities. In reviewing the literature on accounting in inter-organisational settings, Lind and Thrane (2010) classified five types of, what they called, network settings. In each classification they identify a focal organisation, as accounting research tends to focus on the relationships between one organisation (the focal organisation)³ and other organisations in the network. Fig. 1 illustrates Lind and Thrane's fifth setting, which is a complex network of independent organisations. But rather than studying one (focal) organisation, we are concerned with the organisations which comprise the temporary organisation. This is indicated by the organisations within the dotted circle in Fig. 1. As such there are two important levels which need to be distinguished: (1) the temporary organisation in which the product development takes place; and (2) the (inter-organisational) relationships between the organisations which contribute to the project. New product development in such a temporary organisation has many characteristics of *in-house* new product development (i.e., within the temporary organisation), but we cannot ignore the inter-organisational relationships between the contributing organisations. Our aim in this paper will be to contribute to the understanding of management control (although, as we will explain later, we prefer to use the term 'governance') of such inter-organisational co-development projects.

Although most studies of product development look at projects undertaken within individual organisations, there are a few studies which examine innovation in the context of buyer–supplier relationships (e.g., Mouritsen et al., 2001; Dekker, 2004) and some which look at buyer–supplier relationships in product development projects (e.g., Cooper and Slagmulder, 2004; Agndal and Nilsson, 2009). Whereas these studies focus on the use of specific management accounting techniques, such as inter-organisation cost management and open book accounting, in this paper we want to take a more holistic view of the governance mechanisms which are used to manage inter-organisational product development projects. The accounting literature has recognised that management accounting and

¹ Following Janowicz-Panjaitan et al. (2009a), we will use the term 'temporary organisations' to refer to such *inter-organisational* temporary organisations.

² According to Sydow et al. (2004: p. 1475), "Project-based organizations refer to a variety of organizational forms that involve the creation of temporary systems for the performance of project tasks". For example, the term can be used to describe organisations which arrange most of their (internal or external) activities in the form of projects or, as in our case, a specific project which is undertaken through the collaboration of parties drawn from multiple organisations.

³ This is often an OEM or other dominant organisation, but sometimes it could be an organisation to which certain activities have been outsourced by such an organisation.

management controls can both constrain and enable innovation at the same time, but we will study how they do this by examining how they fit within the structures which govern relationships between the organisations contributing to the product development project.

In an earlier paper, where we studied lateral relationships (in both intra- and inter-organisational contexts), we argued that in such contexts management control can be a problematic concept as it implies a relationship between a superior and a subordinate. In lateral relationships, particularly in an inter-organisational context, there are not usually superiors and subordinates. Consequently, we preferred to talk about the governance of lateral relationships, as they are relationships between equals who have to 'control' or more appropriately 'govern' themselves (van der Meer-Kooistra and Scapens, 2008; see also Nooteboom, 1999). In that paper we discussed the role of economic, institutional, social and technical structures in the governance of lateral relationships. Management accounting and management control can be part of the governance structure, but using the concept of governance enabled us to go beyond the notion of (hierarchical) control and to discuss the governance of lateral relationships.

In that paper we drew on the concept of minimal structures,⁴ arguing that "minimal structures are needed to 'regulate' lateral relationships, but these structures must leave room for manoeuvre to enable the parties to react to new situations as they arise" (van der Meer-Kooistra and Scapens, 2008: p. 366). We referred to this combination of structure and room for manoeuvre as combining 'firmness and flexibility'.⁵ In this paper, we will argue that the structures needed to govern inter-organisational product development projects need to provide both 'firmness and flexibility' and consequently we will again draw on the concept of minimal structures. As we will be studying product development in a project-based (temporary) organisation, we will explore how the influence of the different elements in the minimal structure, which governs the relationships between the collaborating parties, shifts as the project progresses.

It is important to recognise that in this paper we are looking at a specific type of product development project; i.e., projects in which the object is to develop a new product and take it to market – i.e., to *commercialise it*. In such projects there will usually be available technology, or technologies, which must be mobilised to develop a specific (marketable) product. Although we are not studying 'pure' research or the development of a new technology (such as studied by, for instance, Quinn, 1985; Murphy and Kumar, 1997; Kim and Wilemon, 2002; and in accounting by Miller and O'Leary, 2007; and Revellino and Mouritsen, 2009), there will be many technical and technological problems to be solved and, consequently, creativity and innovation are essential features of such product development projects. We suspect that many organisations will

undertake such forms of product development, although they will not all involve multiple parties. However, as we indicated above, collaboration between multiple parties with diverse technical knowledge seems to be increasingly common, especially in hi-tech industries; hence our interest in new product co-development projects.

Our preliminary research question was: how do minimal structures govern product development projects in a context where the parties involved in a project are drawn from multiple organisations? As already mentioned, we use the notion of governance (rather than management control) because we want to look beyond the (hierarchical) management controls normally associated with the control of product development projects, and to explore how the lateral relationships between the various parties are governed. In other words, as well as studying the 'control' of product development at the project level, we also want to study how collaborating parties drawn from multiple organisations govern their relationships with the 'co-development' project and with each other. The types of management controls typically used in hierarchically controlled product development projects may still be used, but they should be seen as elements of a minimal structure. We will show how certain elements are used to 'control' the activities of the project team, while other elements govern the relationships between the organisations. Furthermore, we will argue that a minimal structure, in addition to comprising elements which are put in place when a project is set up, will also include elements which are already in place due to ongoing relationships between the parties and other institutional arrangements, as well as elements which have to develop as the project progresses.

In this paper we study the co-development of a new product in a project-based (temporary) organisation. Although they did not inform our research design, we found that concepts from the literature on temporary organisations, specifically 'temporal embeddedness' and 'a-temporality', were particularly useful in analysing our case. These concepts are outlined in the next section, along other theoretical concepts which inform our study. The subsequent sections are then structured as follows. Section 3 outlines our research method and provides some background to the product development project we studied, while Section 4 describes the minimal structure in that case and how the influence of the different elements which made up the minimal structure shifted as the project progressed. Section 5 discusses the implications of our case study and Section 6 draws some conclusions.

2. Theoretical background

2.1. Management control and research and development

The early research, which looked at management accounting and control in the context of research and development, discussed the dysfunctional effects of formal control systems in such settings (see for example, Rockness and Shields, 1984; Abernethy and Brownell, 1997). However, Ouchi (1979) pointed out that clan controls are preferred to more formal control mechanisms in such settings, and Tushman and O'Reilly (1997) proposed that in

⁴ The nature of minimal structures will be discussed in more detail in Section 2.3.

⁵ This is similar to the notion of 'constraining and enabling' mentioned earlier.

complex and uncertain settings the use of social controls can facilitate the autonomy needed to allow employees to innovate. Furthermore, [Brown and Eisenhardt \(1997\)](#) argued that there is a need for some limited structure to balance the freedom to innovate, so that the situation “is neither so structured that change cannot occur nor so unstructured that chaos ensues” (p. 1). Their arguments led [Kamoche and Cunha \(2001\)](#) to propose a minimal structures framework, comprising a technical structure and a social structure, for the control of product development projects.⁶

The empirical accounting literature on the effects of management control on creativity and innovation in organisations provides somewhat mixed evidence. Whereas some studies show that appropriate forms of management control can provide a context in which creativity and innovation can be stimulated ([Bisbe and Otley, 2004](#); [Chenhall, 2003](#); [Ditillo, 2004](#)), other studies claim that management control can constrain the intrinsic motivation needed for creativity and innovation (see [Dunk, 2011](#); also [Adler and Chen, 2011](#)). However, these studies have tended to focus on the technical controls, rather than the social controls. [Davila et al. \(2009a\)](#), for example, identified seven different technical controls: project milestones, reports comparing actual progress to plan, budget for development projects, project selection process, product portfolio roadmap, product concept testing process, and project team composition guidelines. Furthermore they compared their understanding of management control in the context of product development with [Ditillo's \(2004: p. 402\)](#) definition of management control systems as “the design as well as use of coordination mechanisms based on the standardization of ... input, action, or results”. Interestingly, this broad definition goes significantly beyond notions of accounting-based control.

Later in the paper we will discuss the role of management accounting in the context of new product co-development. Although existing studies often define management accounting quite broadly, and sometimes use the terms of management accounting and management control interchangeably, in our later discussion of the role of management accounting we will be concerned with the largely financially based information normally produced by management accountants. We will argue that such management accounting information can set boundaries for the product development, while broadly based management controls can be part of the project's technical structure. Furthermore, we will argue that this technical structure has to be seen alongside the economic, institutional and social structures.

While many of the empirical accounting studies have examined product development *within* specific organisations, we want to focus on product development projects in which there are various parties drawn from multiple organisations. As such, we need to look at the processes of controlling (or in our terms governing) the

relationships between the various parties. Although, as we indicated in the Introduction, there is an extensive literature on IOC, relatively little research seems to have been conducted specifically into the management control of inter-organisational co-development projects, although there are some studies which look at outsourcing product development activities and buyer–supplier relationships (e.g., [Mouritsen et al., 2001](#); [Dekker, 2004](#); [Cooper and Slagmulder, 2004](#); [Agndal and Nilsson, 2009](#)).⁷ These studies are largely concerned with outsourcing and buyer–supplier relationships, and focus on the use of specific management accounting control mechanisms.

For instance, [Mouritsen et al. \(2001\)](#) described how open book accounting and target cost management/functional analysis were used in the outsourcing of production processes and product development processes, respectively. [Dekker \(2004\)](#), who studied a strategic alliance between the buyer and suppliers in the development of railway safety equipment, discussed control mechanisms in rather general terms, whereas [Cooper and Slagmulder \(2004\)](#) and [Agndal and Nilsson \(2009\)](#) identified specific inter-organisational cost management practices used in buyer–supplier relationships. The cases studied in both these latter papers included the outsourcing of some product development activities, but of the more traditional subcontracting form. Nevertheless, they have shown how cost management techniques can be used in inter-organisational product development. However, they do not study the governance of the relationships between the collaborating parties.⁸

So, although there is some research into inter-organisational product development, it is in the context of more traditional forms of outsourcing, rather than co-development. Furthermore, the focus is on management control mechanisms and the use of specific cost management practices, rather than the governance of the relationships between the parties. Nevertheless, an interesting feature of these studies, and also the studies of inter-organisational relationships more generally, is that they explore the interactions between trust and control (for examples see [Tomkins, 2001](#); [Das and Teng, 2002](#); [Langfield-Smith, 2008](#)). In inter-organisational settings it may not always be possible to apply formal control systems, and in such contexts it may be essential to build trust between the parties. However, the evidence on the relationship between trust and control is complex, suggesting that in some instances they are substitutes and in other instances complements (for instance, see [Dekker, 2004](#); [van der Meer-Kooistra and Vosselman, 2000](#); [Seal et al., 1999](#); [Vosselman and van der Meer-Kooistra, 2009](#)). Furthermore, whereas in certain circumstances the use of

⁶ We will return to their work below as it informed the notion of minimal structures which we used to study the governance of lateral relationships (see [van der Meer-Kooistra and Scapens, 2008](#)).

⁷ A further paper by [Miller and O'Leary \(2007\)](#) studied product development at an industry level. Although it examined the relationship between Intel and its various suppliers, its focus was on the role of ‘technology roadmaps’ as mediating instruments in envisaging the future, rather than the governance of the relationships between the collaborating parties.

⁸ A paper by [Mouritsen and Thrane \(2006\)](#) studied the role of accounting in the development of inter-organisational relations, but they focussed on the role of accounting mechanisms in the co-ordination of the network, rather than in the governance of specific co-development projects.

management controls can constrain the building of trust, in other circumstances management controls can help to create a context in which trust can be built. Here we can see a parallel with the relationship between management controls and innovation/creativity. As indicated above, some studies have shown that management controls can constrain innovation and creativity, while other studies have found that management controls can help to promote innovation and creativity. In both contexts (i.e., inter-organisational control and innovation/creativity) some controls will be needed to provide a structure for the relationship or the innovation, but at the same time these controls should not be so tight as to constrain the potential opportunities for the parties involved. Thus, in both contexts, although there is a need for structure (firmness), there is also a need for flexibility and here the role of trust can be important. As we will see later in our case, there is a need for both trust at the organisational level (i.e., between the collaborating organisations), and also trust at the individual level (i.e., between the individuals working on the project).

2.2. Minimal structures

In an earlier paper we developed the notion of minimal structures to provide the ‘firmness and flexibility’ which are needed in the governance of lateral relationships (van der Meer-Kooistra and Scapens, 2008). An interesting and relevant aspect of that work was that we took the idea of minimal structures from the product development literature. Kamoche and Cunha (2001) described product development as a creative process, and they drew a parallel with jazz improvisation in which the musicians do not have a specific score, instead they improvise and by working together they create something which is quite new. They argued that “All that jazz needs in terms of structure is a set of consensual guidelines and agreements which we conceptualize as ‘minimal structures’” (Kamoche and Cunha, 2001: p. 744). In product development (which is also a process of creating something new) there has to be room for manoeuvre, or flexibility, so as not to inhibit the creative process, but nevertheless the process cannot be unconstrained. So to balance ‘firmness and flexibility’ in the product development process, Kamoche and Cunha proposed a minimal structure “where appropriate levels of responsibilities, priorities and procedures are clearly defined and combined with wide zones of manoeuvre” (2001: p. 750). They showed how the combination of a social structure and a technical structure can together provide a structure to guide the product development process (firmness), while at the same time leaving sufficient room for creativity and innovation (flexibility). It is this combination of firmness and flexibility which is characteristic of a minimal structure.⁹

However, Kamoche and Cunha (2001) discussed product development within an organisation. Consequently, in their work all members of the product development team come from the same organisation where there is likely to be some form of hierarchical (organisational) control over the product development process as a whole. However, as we were (are) concerned with lateral relationships, i.e. relationships which could extend beyond the boundaries of a specific organisation, or where there is no specific hierarchical structure to control the relationships within an organisation, we argued that an economic structure and an institutional structure can also be part of the minimal structure. We proposed that all four structures (economic, institutional, social and technical) have a role in the governance of lateral relationships, especially those which involve inter-organisational collaboration. There will be economic aspects of the relationship between the organisations (such as the price for specific work and/or the sharing of benefits) and the relationship will be set within a broader institutional structure. Thus, the economic and institutional structures provide the setting in which product development processes take place and they should be considered part of the (minimal) structure, together with the technical and social structures which are concerned with the day-to-day activities of the product development process. If the combination of these four structures leaves sufficient room for manoeuvre – by balancing firmness and flexibility – they can be considered a minimal structure.¹⁰

The four structures (economic, institutional, social and technical), which can combine to form a minimal structure, are not intended to be empirical categories which would, for instance, uniquely classify the various types of governance mechanisms. Instead they are conceptual categories which sensitise us to the broad issues which need to be considered in understanding the nature of minimal structures and in studying the governance of lateral relationships. Whereas Kamoche and Cunha (2001) drew attention to the technical and social structures, the four structures which we proposed in van der Meer-Kooistra and Scapens (2008) drew attention to the need also to explore the economic and institutional structures which characterise the context in which the technical and social structures are set.

These four structures capture the various ‘elements’ which govern a product development project, and together they can be considered a minimal structure if they leave sufficient room for innovation and creativity to take place (i.e., if they balance firmness and flexibility). These elements include, not only control mechanisms, but also agreements, guidelines, recognised ways of working, shared values, etc., and also the boundaries set by, for instance, the economic and technical requirements of the product. For example, the economic structure would include the contracts negotiated between the parties which set out the financial terms on which they each contribute to the project, while the technical structure would include the

⁹ As indicated earlier, this built on the work of Brown and Eisenhardt who argued that there is a need for some limited structure which “is neither so structured that change cannot occur nor so unstructured that chaos ensues” (1997, p. 1).

¹⁰ If they leave no (or little) room for manoeuvre they would comprise a control structure (not a minimal structure), whereas if they allow (relatively) unconstrained freedom they are neither a control structure nor a minimal structure (as there is no structure at all).

technical specifications of the product which may be set out in the contract or in other agreements. However, the budgets allocated to the development of individual aspects of the product could be considered part of either the economic structure (as they are expressed in financial terms) or the technical structure (as they relate to technical aspects of the product). As indicated above, a classification in either the economic or the technical structure is purely for analytical convenience. What is important to recognise is that such budgets are elements of the minimal structure.

Budgets set the boundaries within which the individual aspects of the product development can take place. On the one hand, if the boundaries are too loose the product which is eventually developed may not be marketable at a price which will generate sufficient returns to recover the development costs. On the other hand, if they are too tight they could hinder creativity and the innovative nature of the new product might consequently be constrained. However, the boundaries set in this way may be permeable in certain well defined circumstances (see [Giovannoni and Scapens, 2014](#)). In other words, other mechanisms may be in place which will permit the product development to go beyond the economic and/or technical boundaries – for example, a supervising committee may be able to authorise developments which go beyond the boundaries set by the economic and technical structures.

If technical and economic structures allow the necessary space for creativity, there must be trust in the competences of the individual members of the project development team; i.e., trust in the technical skills of the individual team members in their respective areas of expertise and trust in their social skills to work together as a team. Developing and maintaining such trust requires a well-developed social structure. The social structure will include the competences and ways of working of the product development team, as well as their shared motivation and enthusiasm for developing an innovative new product. In addition, the institutional structure will shape the context within which the project team has to work and, as such, it may influence the way the team members work together. For example, the parties involved in a project may be part of a broader network of organisations which have worked together in the past and expect to work together in the future. In addition, in some industries (such as pharmaceuticals and medical products) there may be externally imposed regulations which govern various aspects of the product which is being developed.

Thus, to understand the role of (management) accounting in the governance of the relationships between the parties involved in product co-development projects, it is necessary to look at the four structures (economic, institutional, social and technical) and to recognise how they combine to form a minimal structure which provides both firmness and flexibility – i.e., which both constrains and encourages creativity/innovation at the same time. Focusing on accounting or other management controls in isolation from the other elements of the minimal structure is likely to give a misleading picture of their role in product development projects. In our case study we will explore the economic, institutional, social and technical structures, how their respective influence shifts over time, and the role

of accounting and other management controls within the minimal structure.

Although our focus in this paper is on inter-organisational collaboration in new product development, as we indicated above, such collaboration frequently takes place in project-based organisations, especially in high-tech industries. As such, a project brings together a team of experts from a number of different organisations, each contributing their own particular expertise to the product development project and often working together in a single location. Once the product is developed this team will disband, although some (or even all) of them may subsequently work together on other product development projects. As we will show below, the notion of a ‘temporary organisation’ captures the nature of such product development projects. Consequently, the next section will briefly outline some of the relevant issues in the literature on temporary organisations.

2.3. Temporary organisations

It is important to acknowledge that we did not design this research specifically to study temporary organisations. Our intention was to study the way in which minimal structures are used in product development projects to create space for creativity and innovation. However, in analysing the findings it became clear that the product development project we were studying had many of the characteristics of a temporary organisation.¹¹ Although there are various definitions of temporary organisations in the literature (for a review see [Janowicz-Panjaitan et al., 2009b](#)), [Morley and Silver's \(1977\)](#) definition seems to capture the key characteristics of the product development project we were studying. They define temporary organisations as organisations which are “limited in duration and membership, in which people come together, interact, create something and then disband” ([Morley and Silver, 1977](#): p. 59). Product development projects which involve multiple parties from different organisations fit this definition. Such product development projects are limited in duration and in membership, and the parties come together and interact to create the product, and then they disband.

In outlining “A Theory of the Temporary Organization”, [Lundin and Söderholm \(1995\)](#) set out four basic concepts – time, task, team and transition. Time relates to the temporality of the organisation, whereas tasks are the ‘things’ that require attention and team refers to the interpersonal relationships through which the tasks are undertaken. Finally, transition is the basic aim of the temporary organisation. In the case of product co-development projects, the collaborating parties come together for a specific period of *time* to undertake the *tasks* needed to develop a new product and they work together as a *team* with the aim of creating a marketable product (the *transition*). Thus, such co-development projects can be considered temporary organisations. Although we will not use these

¹¹ For an overview of the relevant literature see the book edited by [Kenis et al. \(2009\)](#) which reviews much of the research on temporary organisations.

concepts to structure our case analysis, later we will see the importance of time, task, team and transition in the case. Lundin and Söderholm (1995) also set out four sequencing concepts which they relate to the four basic phases of a project life-cycle; concept, development, implementation and termination. They go on to discuss these in terms of action-based entrepreneurialism, fragmentation for commitment-building, planned isolation and institutionalised termination.

The first two of these sequencing phases, entrepreneurialism and commitment-building relate to the bringing together of the ideas and parties which combine to form a temporary organisation. In a somewhat comparable set of sequencing concepts, Bakker and Janowicz-Panjaitan (2009) distinguish between the initiation, execution and completion phases. For them the initiation phase is when the ideas and collaborating parties come together; hence this phase combines the entrepreneurialism and commitment-building phases of Lundin and Söderholm (1995). This is when the temporary organisation comes into being (i.e., its birth). Bakker and Janowicz-Panjaitan's (2009) execution phase is when the team members collaborate in executing the various tasks required to achieve the aim of the temporary organisation. In other words, they work together in the project-based (temporary) organisation. This is comparable to Lundin and Söderholm's (1995) concept of planned isolation, which is "the execution phase in the life of the temporary organization" (p. 447). Bakker and Janowicz-Panjaitan's (2009) completion phase is comparable with Lundin and Söderholm's (1995) concept of institutionalised termination (i.e., its death). In our analysis of the co-development of new products we prefer to use Bakker and Janowicz-Panjaitan's (2009) initiation, execution and completion phases as they relate to (i) the coming together of the collaborating parties to initiate the project-based (temporary) organisation which then (ii) executes the product development until (iii) completion when the new product is available. In effect, there is the phase of setting up the temporary organisation, the phase in which the product is developed in the temporary organisation, and then the completion phase when the product has been developed and the temporary organisation is terminated. This distinction was particularly helpful in analysing our case as we observed that the relative influence of the various structures, which comprised the minimal structure, shifted as the project moved through the initiation, execution and completion phases.

In recognising that temporary organisations are dependent for their resources on non-temporary organisations, Bakker and Janowicz-Panjaitan (2009) discuss the concept of temporal embeddedness (see also Engwall, 2003; Lundin and Söderholm, 1995). This concept, which emphasises the importance of the wider context of the temporary organisation, was particularly helpful in analysing our case. Temporal embeddedness recognises that current actions are influenced by both the past and the future. For example, it is not only the history of their relationships, but also the expectation of their future relationships which will influence how the parties act in the present. Thus, parties contributing to a product development project will bring with them their histories of working together with the

other parties, including their experiences in other product development projects with the same parties and also with other related and unrelated parties. They will also have expectations regarding the future, including whether they expect to work on future projects with the same parties and also with other related and unrelated parties. As such, the concept of temporal embeddedness emphasises that although temporary organisations may only have a finite life, this cannot be separated from the past and future of the collaborating parties.¹² Thus, although the initiation, execution and completion phases of a product development project take place sequentially over time, they should not be considered a simple linear process, as each can be shaped by both the past and the future (cf. Sydow et al., 2004).

Furthermore, as a product development project is executed, the individuals directly involved need sufficient room for manoeuvre (autonomy) to enable them to be creative, and to use their own knowledge and capabilities to develop the product. At this time, the product to be developed becomes the 'task in hand' and the primary focus of attention.¹³ This can create a form of a-temporality (see Janowicz-Panjaitan et al., 2009c) which distances the project from its temporal embeddedness. In this way, the temporary organisation becomes the site for the collaborative activities, although it may not be 'a site' in the sense of a physical location. However, in the product development project we studied (see below) all the members of the project development team worked together in the same physical location, for at least several days each week. Working in such a close proximity encourages the individuals involved to become professionally and personally identified with each other and with the product being developed. This creates the project as something separate from the organisations which employ them. This can sometimes cause problems for these individuals, and especially for their employing organisations, as they have potentially competing interests – on the one hand the interests of the current product development project and on the other the interests of their employing organisations. Balancing these, at times, competing interests can sometimes be problematic in product development projects.

Although there is not a great deal of discussion in the literature about the co-ordination of temporary organisations (see Ness and Haugland, 2005), after reviewing the temporary organisations literature, Janowicz-Panjaitan et al. (2009b) concluded that temporary organisations "require more interpersonal and less formal processes of coordination ... [and] ... the trust that is necessary to assure sufficient information sharing for problem solving does

¹² The concept of temporal embeddedness is somewhat similar to the concept of path dependency in institutional theory, especially institutional economics (David, 1985; Nelson and Winter, 1982; see also Burns and Scapens, 2000), but whereas path dependency emphasises that 'history matters', temporal embeddedness recognises that the 'future matters' as well.

¹³ Sydow et al. (2004) refer to the project team becoming highly focused on the project and that "(b)eing focused means that you care less or not at all about things outside the project" (p. 1481). This is similar to Lundin and Söderholm's (1995) notion of planned isolation.

evolve despite the temporary nature of the project” (p. 69). Furthermore, Meyerson et al. (1996) argued that as temporary organisations have a finite and often quite short life span, if the relationships require trust to be built, it has to be built quickly and they introduced the concept of ‘swift trust’. As we will see later, although in the product development project we studied there was a need to build trust (and to build it quickly), the basis for this trust can be located in the temporal embeddedness of the relationships. For instance, the collaborating parties may have worked together in the past, or expect to work together in the future. However, although the same organisations may have been involved in previous projects, if different individuals are involved it will still be necessary to build interpersonal trust. This may be easier if the organisations involved have a shared history and expect to work together in the future. These ideas from the literature on temporary organisations will help us to explore how a minimal structure can govern a product development project in which the parties are drawn from independent organisations.

In the remainder of this paper we will use a case study to explore how a minimal structure can govern a product development project in which there are parties drawn from different organisations. As this project was undertaken in a project-based organisation (i.e., a temporary organisation), the concept of temporal embeddedness will be useful for understanding the context of the project, including its economic and, especially, its institutional structures. However, recognising the a-temporality of the project will also help in understanding how the social and technical structures become more important as the project is executed, while the economic and institutional structures move to the background. In some ways, this is similar to an intra-organisational product development project, as the product development takes place within the project-based (temporary) organisation. Nevertheless, for the collaborating organisations the temporal embeddedness of the project continues to be important, and influences the way in which they interact with each other and with their staff working on the project. So as well as studying the ‘control’ of the product development at the project level, we also wanted to study how the collaborating parties governed their relationships with the project and with each other.

By combining the minimal structures framework and concepts from the temporary organisations literature we can refine our preliminary research question (set out earlier). In analysing our case study we will address the question of how the temporal embeddedness of the project and the subsequent a-temporality influenced the relative importance of the economic, institutional, social and technical structures, which comprised the minimal structure for the project, as the project progressed through the initiation, execution and completion phases. In so doing, we will explore the role of accounting and management controls within the minimal structure.

In the next section we will introduce the case and outline our research methods. The subsequent section will then describe the minimal structures which governed the project.

3. Research methods

As we wanted to study the governance of a product development project in which the contributing parties were drawn from multiple organisations, we were not only concerned with the control of the team of individuals who were working on the project day-to-day (although this was important), we were also concerned with the roles of the various parties (organisations – or at least the representatives of those organisations) who were involved in the governance of the project, and with the relationships between the individuals working on the project and their parent organisations.

We studied a project which brought together a number of different organisations in a particularly innovative way.¹⁴ In contrast to the more traditional organisational form, whereby an original equipment manufacturer (OEM) outsources specific, and well defined, aspects of the product development to subcontractors who receive an agreed fee, in this case the principal suppliers were co-developers and they shared the potential risks and rewards of the project. This project involved the development of a desktop electron microscope. Although the technology for such a product was available in the laboratory, it had to be developed into a marketable product – i.e., commercialised. This product ultimately became known as the Phenom. The major parties involved in the Phenom project were:

- FEI: US-owned OEM (a risk-reward party¹⁵);
- NTS mechatronics: project leader (a risk-reward party);
- Sioux: software developer/supplier (a risk-reward party);
- Benchmark: electronics developer/supplier;
- Van Berlo Studios: product design.

We conducted a preliminary interview with the leader of the project team in 2009 to obtain an overview of the project and to identify the major parties to be interviewed and then a further 8 interviews (with 9 people) in 2010 (see Appendix I); the average length of each was 1 h 20 min (but they varied from 72 min to 152 min). We interviewed a team leader or another senior person from each of the major parties – these were people directly involved in the day-to-day activities of the project. In addition, we interviewed the senior manager from each party who was responsible for supervising the party’s contribution to the project – these were the people who acted as the interface between the project (i.e., the temporary organisation) and the contributing organisations.¹⁶ The total number of

¹⁴ This case study was part of a broader project in which we studied three product development projects. However, here we have selected this case (the Phenom case) as it most closely meets our requirements for this paper. In one of the other cases the project took place largely within a single multinational organisation, although there were some external parties, and in the third case the project was undertaken within a ‘spin-off’ company which was set up specifically to develop the new product. Nevertheless, these two other cases provided useful background and contextual information which informed our research into the Phenom case.

¹⁵ The significance of the risk-reward parties is explained below.

¹⁶ We only interviewed one person from FEI. This was the Vice President responsible for New Business, who had the overview of the project on behalf of FEI and closely liaised with the project leader (who was from

people involved in the project's day-to-day activities varied between 10 and 30, and each of the major parties contributed, on average, 6 staff members to the project. In addition, there were a number of more minor suppliers of components and services, whom we did not contact, as their roles were simply to supply specific items and so they were not directly involved in the co-development of the Phenom.

Most (but not all) of the parties were located in the southern part of the Netherlands, specifically the region around Eindhoven. This is a region where there is a concentration of high-tech companies, and in 2011 it was awarded the title "Intelligent Community of the Year" by the Intelligent Community Forum (see www.brainport.nl/en). The regional development agency supported the Phenom project as a way of encouraging smaller high-tech companies in the region to work together and thereby develop the expertise of the region.

As indicated above, in each of the main parties contributing to the project we interviewed both a representative of the contributing organisation and a senior individual who was directly involved in the day-to-day activities of the project. In this way we were able to explore the lateral relationships between the organisations, and the governance of the project, using our minimal structures framework. This framework sensitised us to the need to consider the four structures – the economic, institutional, social and technical. Informed by this framework, we developed a series of questions which we wanted to cover during the interviews (see Appendix II). However, we did not explicitly design/organise the questions in terms of the four structures. Instead, being informed by our minimal structures framework, we asked questions about the contract and other economic relationships, the institutional arrangements, as well as the technical details of the product being developed and the social relationships within the project teams. These specific questions (as set out in Appendix II) were not necessarily asked in these terms of every interviewee, but rather they identified the general issues to be discussed in the interviews.

All the interviews were conducted by both researchers and, whenever possible, after each interview we discussed (and recorded) our impressions and the ideas emerging from the interview.¹⁷ When this was not possible we would have our discussion later on the same day. The recordings of these discussions provided an important database of our emerging understandings of the cases, and this helped us to form our views of the minimal structures in the case. We did not have all the recordings transcribed, and instead

when all the interviews for the project were completed we independently re-listened to the recordings and made detailed notes and referenced the sections of the recordings which described the key elements of the project and, in particular, we set out our understandings of the economic, institutional, social, and technical structures, and how they combined to form a minimal structure for the project. Although the interviewees from each of the contributing organisations described the Phenom project from their own perspective, we checked that we had received a coherent picture of how the project was co-ordinated and managed on a day-to-day basis. We then identified the particular issues that concerned the senior representatives of the contributing organisations and we noted that there was considerable similarity in the issues which they believed could create potential problems when their employees worked on projects with (and in) other organisations, and in how they attempt to deal with such problems. After comparing our notes and agreeing our understandings of the case,¹⁸ a report setting out the main elements and phases of the product development project and our understanding of the minimal structure which governed it was produced. This report was then sent to the Phenom project leader, who made some minor comments. In the following section we will describe the minimal structures during the initiation, execution and completion phases of the Phenom project. Subsequently, in Section 5 we will discuss what the case tells us about the governance of product development projects when the parties are drawn from different independent organisations.

4. The Phenom project

As already indicated, the Phenom case was very innovative, both in terms of its technology and in terms of its organisational form. Although the Phenom was developed for, and ultimately sold by an OEM, a US-owned company (FEI), which markets the larger types of electron microscopes, the co-development was an initiative of, and supported by, the regional development agency. Below we will describe the minimal structures by looking at the initiation, execution and completion phases of each project, but first we will provide some background.

NTS). However, there were no other people from FEI who were continuously involved in the project on a day-to-day basis, although FEI system architects were involved in the early stages.

¹⁷ In addition, again whenever possible, before each interview (or at least before each group of interviews on the same day) we discussed what we wanted to obtain from the interview(s) and how it (they) could develop and deepen our understanding of the case. These discussions were also recorded. Furthermore, in periods between the interviews and also after the interviews were completed we regularly discussed and recorded our emerging views of the cases and how they extended our understanding of the governance of the product development project.

¹⁸ As might be expected, given the frequent discussions of our emerging understanding of the case, there were only very minor differences at this stage and these were easily resolved.

4.1. The background

The Phenom is a desktop electron microscope which provides images at a very high magnification. Whereas conventional electron microscopes are much larger, filling a small room, and costing hundreds of thousands or even several million Euros, the Phenom sits on a desk and was designed to sell in the tens of thousands of Euros. Furthermore, whereas it can take several weeks, even months, to train an operator to use a conventional electron microscope, someone can be trained to use the Phenom in less than a day. Of course, the magnification of the Phenom is not as high as a conventional electron microscope, but it is higher than a competing optical microscope. As such, it could be used, for instance, in a quality control department, or for teaching in a college or university. Thus, the market for the Phenom is rather different to the market for conventional electron microscopes which are usually bought by research institutes with large budgets for scientific work.

The regional development agency in the southern part of the Netherlands helped to promote this co-development project as a way of increasing the added-value of local hi-tech electronics, mechatronics and software companies. Instead of the OEM developing the product itself and outsourcing specific tasks to subcontractors, the suppliers became co-developers. In this case the OEM had the development of a desktop electron microscope on its list of potential projects and had previously purchased the rights to the necessary technology from Philips Technology Division, which had developed it. However, it did not have the capacity at that time to develop it into a marketable product. So when the regional development agency began promoting co-development projects, the OEM suggested this project, as the bulk of the development work could be undertaken by the suppliers – as co-developers.

4.1.1. The parties

An American company, FEI, which manufactures and sells conventional electron microscopes, was the OEM. It was to be responsible for selling the Phenom when the product was developed, and it contributed the basic technology, which it had acquired from Philips Technology. At the start of the product development process the technology had been shown to work in a laboratory setting, but it needed to be developed into a marketable product – i.e., commercialised. To undertake this development required a range of engineering skills, principally in electronics, mechatronics, electron optics and software, along with design skills.

FEI (as the OEM), NTS (the mechatronics developer) and Sioux (the software developer) shared the risks of the project. They adopted a risk-reward model which was proposed by the regional development agency. This meant that NTS and Sioux were to be paid for their development work through a share of the profits from FEI's sales of the Phenom. Another co-developer, Benchmark (the electronics developer) was unwilling to share the risks in this way, and instead it undertook its development work for a fixed fee which was agreed in advance. As such, Benchmark was exposed to some development risk (i.e., if its development cost was more/less than the agreed fee, it would make a

loss/profit on its development work). NTS and Sioux, however, took both development risk (as they agreed to do a specific amount of development work – which could be more/less than the work which was eventually undertaken) and market risk (as they would recover the cost of the agreed development work only if the product itself was profitable). Once all the agreed development costs had been recovered, the three risk sharers (FEI, NTS and Sioux) would share the continuing profits from the Phenom, although it would continue to be sold by FEI – or at least that was the original plan. In addition to the co-developers mentioned above, there was also Van Berlo Studios, a design agency, and a number of other small suppliers who developed specific components for the co-developers and were paid agreed fees for the development work they undertook, but they did not share the risks of the project.

The Phenom was a significant project, especially for two of the risk sharing parties. As mentioned above, FEI had acquired the technology and had the development of a desktop microscope on its list of potential projects. However, as it had many opportunities for developing its conventional electron microscopes, it was reluctant to use its own capacity to develop such a new product. Furthermore, according to the VP, New Business of FEI, outsourcing all the development work in the traditional way would have had such “*a huge impact on our bottom line*”¹⁹ that FEI was unwilling to “*commercialise it unless other companies were willing to do it with us*”. When the regional development agency proposed a co-development project based on a risk-reward model, FEI enthusiastically suggested this project as much of the development work would be undertaken by the co-developers and this significantly reduced its exposure by passing a substantial part of the development cost and risk to NTS and Sioux. For these two risk-sharing parties the project was very significant. For example, NTS had previously discussed the possibility of taking part in co-development projects, as this would enable it to become a systems supplier (rather than a subcontractor) and thereby it could derive more value from the development process. It had also had some preliminary discussions with FEI about the Phenom project, and about the possibility of becoming a co-developer, but it required the intervention of the regional development agency and their proposed risk-reward model for the project to go ahead. For NTS, and also for Sioux, the project was very important and carried considerable risk – if the project had been unsuccessful they would not have been paid for their substantial development work. Furthermore, it was the first time they had entered into such a risk-sharing agreement, and in retrospect NTS considered the risks to have been higher than they would want to take in the future.

4.1.2. The timeline

The regional development agency organised preliminary discussions in the autumn of 2004, and the project's ‘kick-off meeting’ was held in April 2005, after which operational teams were set up and the design process began.

¹⁹ When the words of interviewees are used in this section they will be shown in *italics*.

Table 1
Key dates in the Phenom project.

Autumn 2004	Preliminary discussions between FEI, NTS and Sioux.
January 2005	Start of discussions about the contract between FEI, NTS and Sioux (FEI and Benchmark established a separate contract).
April 2005	Start of the Phenom project; the overall project team started to draft the specifications of the product.
May 2005	Establishment of the operational teams (mechanical team, software team and electrical team).
November 2005	Final design of the mechanical/optical product, the Alpha model.
Early 2006	Testing of the reliability of the mechanical/optical product.
February 2006	FEI, NTS and Sioux sign the contract.
May/June 2006	Beta products are completed and sent to the Beta customers' sites; they use/test the product and give feedback.
End 2006	End of the testing phase.
April 2007	First release of the product.
May 2007	FEI formally accepted the product.
2009	Establishment of Phenom World for the marketing and sales of the product.

However, although discussions were taking place about the contract, including the risk-sharing agreement, the formal contract was not signed until February 2006. Nevertheless, a complete design for the product was delivered in November 2005, and the testing phase then began. This testing was completed by the end of 2006 and the Phenom was launched onto the market early in 2007, with FEI formally accepting the product in May 2007. This timing was unfortunate as the economic downturn started just as the Phenom came to the market, and its sales were initially very disappointing. However, after setting up a new company, Phenom World, in 2009 to market the Phenom, its sales began to grow very satisfactorily. Below we will describe the initiation, execution and completion of the Phenom project. To provide a guide through these phases the key dates are set out in Table 1.

4.2. The initiation

Temporal embeddedness was an important feature of the Phenom project as it brought together a number of parties who belonged to a wider network. Sioux, NTS and Van Berlo Studios had previously worked together on other product development projects. However, although they had not previously worked with Benchmark, as it was not located in the Eindhoven region,²⁰ Benchmark had previously worked for FEI. As such, they were part of a wider network of organisations which regularly worked together on the development of new projects. Thus, although the parties had not previously worked together in this form of risk sharing arrangement, their relationships were temporally embedded – they had worked together in the past and, importantly, as we will see below, they expected to work together in the future.

This temporal embeddedness was at the organisational level, not at the level of the specific individuals who were to work day-to-day on the project – as we will see later a social structure was needed for interpersonal trust to be developed. Nevertheless, the temporal embeddedness of the relationships between the organisations created trust at an institutional level and coordinated expectations and interactions between the organisations involved – [Bachmann and Inkpen \(2011\)](#) refer to this as institutional-based trust (see also [Bachmann, 2001](#); [Luhmann, 1979](#); [Zucker, 1986](#)). This institutional trust, which can be regarded as an element of the institutional structure, created the context in which the risk-reward model (an element of the economic structure) was negotiated between the parties and the technical specifications for the product (an element of the technical structure) were developed jointly by the parties.

The contract for the Phenom project was not signed until almost a year after the product development had started. Furthermore, many of the technical details and specifications of the product had to be worked out during the product development process. Thus, at the start of the project there was considerable flexibility in both the economic and technical structures. The general nature of the risk-reward model had been agreed and the general nature of the product to be developed had been specified, but the details had still to be worked out. So although they provided a structure for the project, there was considerable flexibility. This flexibility was facilitated by the temporal embeddedness of the project and the wider institutional structure – i.e., the network of suppliers and OEMs who regularly worked together on such projects. In other words, the flexibility in the economic and technical structures was made possible by the institutional structure. As such, the economic, institutional and technical structures together provided the minimal structure which was needed to initiate the project. As already mentioned, the social structure had to develop as the project got under way – as we will see later.

The temporal embeddedness of the project arose from both the experiences of the parties having worked together in the past and their expectations about working together in the future. As the Phenom project leader (from NTS) pointed out:

Our managing director at that time and the managing director of Sioux knew each other very well. And we are still co-operating.

And the CEO of Sioux confirmed:

Sioux and NTS had a lot of experience with supplying services to FEI in a bilateral way. We both work for the same companies. Sioux and NTS provide complementary services and they fit well together. People from Sioux and NTS know each other and they like each other. We do things in the same way. After the development of the Phenom, Sioux and NTS were involved in another new product development project.

NTS and Sioux saw the Phenom project as a way of demonstrating their capabilities as systems suppliers,

²⁰ It was located further north in The Netherlands.

which they anticipated would lead to more such work in the future, not necessarily with FEI but with other OEMs within their wider network. Particularly for NTS and Sioux, a successful outcome on this project would strengthen their positions within the network and for them their reputation within the network was just as important as whether they made a profit on this or any other individual project. Consequently, they might be prepared to incur a loss on a specific project if it protected or advanced their reputation within the network.

This temporal embeddedness and the broader institutional structure provided the basis for the institutional trust which allowed the project to start before the contracts setting out the details of the risk sharing arrangements had been finalised. However, a preliminary business case had been prepared by FEI and this provided the initial economic structure for the project. As the Phenom project leader explained, this business case “*set a target [cost] for the product, added a profit mark up, and determined the sales price*”. This price was initially assessed in relation to the optical microscopes with which the Phenom was seeking to compete. However, as the product was developed and research was done into what customers might want, additional features were added and this extended the specifications and the ultimate price. According to the project leader “*the struggle between the functionalities and the price of the product was not settled at the outset*”. He went on to add that “*a business case is never fixed. In particular, in the case of the Phenom, the market is not well known*”. In addition to the target price for the product, a budget for development costs was included in the initial business case, but as additional functionalities were added this had to be increased – as we will see below.

Furthermore, the technical specification of the Phenom was not tightly defined at the outset. The basic technology was known, but how it should be integrated to produce a marketable product still needed to be defined. As a result the technical specification set out what was to be achieved, rather than how it should be done. Nevertheless, the technical specification set out the major milestones for the project.²¹ As a result the technical structure of the Phenom project had to (and was allowed to) evolve along with the social structure as the product was developed. Furthermore, the risk-reward model was also subject to re-negotiation, both during the product development process and later when difficulties were encountered in selling the Phenom. Nevertheless, an economic structure and a technical structure were put in place when the project was initiated, but they allowed considerable flexibility, which was made possible due to the nature of the institutional structure (and especially the temporal embeddedness of the project). Thus, there was a minimal structure in place at the initiation of the project. This comprised the institutional structure, which provided the context for the flexible economic and technical structures, and these economic and technical structures themselves. In Section 4.3

we will describe how the social structure evolved as the project began to be executed, and how the other structures changed as the project progressed.

4.3. The execution

As indicated above, a number of organisations contributed to the Phenom project and various individuals from these organisations worked together to co-develop the Phenom. As we will argue below, these individuals formed the project team which could be considered a temporary (project-based) organisation. In this section we will discuss how a social structure emerged and interacted with the institutional, economic and technical structures to form a minimal structure for the Phenom project – i.e., a structure which combined firmness and flexibility. This flexibility provided the space which was needed for creativity to take place.

As individuals with various types of expertise were drawn from the different parties, their work on the Phenom project had to be integrated, and this was achieved through the emerging social structure. The bulk of the development work was divided among three operational teams: mechatronics, electronics and software. In the early stages the FEI system architects played a prominent role in advising these teams, as they possessed the domain specific knowledge (i.e., knowledge about electron microscopes). However, over time the FEI architects became less and less involved as they transferred their relevant knowledge to the engineers employed by the co-developers. As explained by the contract manager of Sioux:

Our knowledge is that good that we don't need FEI for most of the development activities; we can now do it ourselves.

Nevertheless, in the early stages of the project FEI had concerns about the technical competence of the NTS engineers. This was partly because the engineers in FEI, an American company, were usually academically trained to PhD level, whereas the engineers in NTS, a Dutch company, had professional training following a master's degree from a technical university or a bachelor's degree from a polytechnic institute. The FEI engineers questioned whether the NTS engineers had the necessary academic training to solve the technical problems which would inevitably arise in the Phenom project. These concerns were overcome quite quickly in practice as the NTS engineers were able to solve problems as they arose, sometimes with simple, but practical solutions, while the American engineers would probably have adopted far more complex and consequently more costly solutions. By working together competence trust increased as the social structure evolved.

However, in one instance the NTS project leader realised that he had not allocated the appropriate engineer to a specific task, because the person allocated lacked certain technical skills and, more particularly, the requisite social skills to work within the team of people who now comprised the Phenom project. Building a team of people who were able to work together on the project was a crucial element of the social structure. This was facilitated by everyone working together in the project room located in the NTS building. Some people from the various

²¹ These major milestones, which set out the dates by which the key activities had to be completed, were later incorporated into the stage-gate model for the project, as will be explained below.

parties worked full time in the project room, while most of the others worked there at least 2–3 days each week, seeing and interacting with the other members of the project team. The Phenom project leader (from NTS) emphasised the importance of enabling people to work together while allowing them sufficient autonomy, as technically competent professionals, to work as a team; interacting, supporting and even challenging each other. He wanted to avoid, what he called, *micro-managing* the project, i.e., telling each person what to do. Instead, he wanted to create an environment in which everyone could contribute as fully as possible. As he explained:

Choosing the right (i.e., technically competent) people is very important . . . I stimulated the people to communicate. I tried to get an organisation in which the people are at the same level, and are not afraid to say what they think without looking at hierarchical lines.

Consequently, it was essential to be able to trust both the technical competences of the other members of the project team, and their motivation/commitment to the project. Although the institutional context, comprising the network of organisations and the temporal embeddedness of the project, created institutional trust at an organisation level, it was still necessary to build trust at the individual level – what [Bachmann and Inkpen \(2011\)](#) refer to as interaction-based trust (see also [van der Meer-Kooistra and Vosselman, 2000](#); [Nooteboom, 2002](#); [Sako, 1992](#)). This trust had to develop quite quickly so that the project could be completed in the planned time scale. Normally, building trust can be a slow process, but in a project such as this it had to develop quickly (cf. swift trust – [Meyerson et al., 1996](#)). This was facilitated, in part at least, through the integrated team-based structure and the regular meetings which enabled everyone to communicate with each other.

The project team comprised three working groups (each with a group leader, a systems architect and various engineers). The members of the working groups worked together on a day-to-day basis, but also held weekly meetings to discuss progress. The system architects from the three working groups met weekly, together with the FEI systems architects, to co-ordinate the various aspects of the work. In addition, there was a weekly project meeting, chaired by the project leader, which brought together the leaders of the working groups, the FEI system architects and managers from FEI, NTS, Sioux, Benchmark, and Van Berlo. This meeting discussed the progress of the working groups, problems which had been encountered, and any sales and marketing issues. However, the project leader (and also the systems architect in the early stages) worked very closely on a day-to-day basis with the working groups and was thoroughly informed about the issues and problems they were facing, and where necessary brainstorming sessions were used to find solutions. Consequently, the weekly project meetings were to allow the managers from the co-developers to monitor progress, rather than to actively manage the project. In describing these meetings Benchmarks' Director of Development Engineering Resources commented:

In these meetings the senior managers of the companies were informed about the progress of the project, they did not tell the people involved in the project what to do.

Thus, the meetings were used to communicate and inform, rather than to actively direct and manage the engineers and other people working on the project. As the working groups had considerable autonomy, communication was essential to integrate their work. The project leader emphasised that the meetings were essential to “*create good communication*”, and he went on to say:

There were a lot of complete group [the entire project team] sessions where we said we want to go through the designs so everybody knows where we are and what the planning is. And then we go and have dinner and a drink. It creates a good feeling and everything needed to make communication as easy as possible during the work.

However, communication alone is not sufficient. As the above quote indicates, there were designs (technical specifications) which guided the project. In addition, there were budgets and time frames for the individual activities. The times allowed for the individual activities were set out using the NTS ‘stage-gate’ model,²² which identified all the steps in the product development process, as well as the achievements and authorisations (gates) which are necessary to move from one stage to the next (see for example, [Hertenstein and Platt, 2000](#); [Cooper, 1990](#)).

Consequently, the autonomy given to the working groups was within the boundaries set by the technical specifications, financial resources and time scales of the project (we will return to these boundaries below). Furthermore, communication does not necessarily lead to consensus – differences of opinion on both technical and financial matters can, and did, frequently arise. However, if such differences could not be resolved at the project team level they were ‘escalated’, i.e., passed upwards for resolution/decision at a higher level.

In the Phenom project, when an issue/problem had to be escalated, it was dealt with by an escalation committee formed of senior (business level) managers from each of the co-developers. As these managers were the representatives of the risk sharing parties, they had a strong interest in resolving conflicts and finding jointly acceptable solutions to such issues/problems. The CEO of Sioux described how an issue relating to the choice of software architecture was escalated and then resolved by the escalation committee. Whereas Sioux (and NTS) wanted to use a specific type of software architecture, which they thought would be the best for the Phenom, the FEI system architects preferred another type of software architecture. As the CEO of Sioux explained:

We had a real issue, because who is going to decide. We, NTS and Sioux, believed that this architecture is the best software, but the customer [i.e., the FEI system architects] said no, no. And so we escalated it. We argued we are

²² The NTS stage-gate model was used as the project leader was from NTS, and it was very similar to the stage-gate models used by the other parties in their own and other projects.

*responsible for delivering the product (within a certain budget, a certain period of time, with certain functionalities, for a certain cost price), and for that we take responsibility, so **we do it our way**. . . . OK they said, but **you'd better be right!** [emphasis in the form of speech].*

The escalation committee in this instance comprised the VP for New Business of FEI, the CEOs of Sioux and NTS, and the FEI system architects. Thus, here, the decision was taken outside the project team, by a higher level committee. However, wherever possible all decisions were taken within the project team. In a sense, it was an admission of failure on the part of the project team and its leadership to have to escalate an issue. The Sioux project manager explained that when there are differences of opinion the decision should be taken on the basis of good arguments instead of escalating it to a higher level. And he said:

That is what we do. People sit together for many days weighing the pros and cons. At the end there is a good solution.

He went on to argue that the good relationships between the senior managers of the companies contributing to the project²³ can help to develop trust between the individuals working on the project. These senior managers did not solve problems themselves, but created the conditions in which the project team members could solve problems:

It's getting the mind-set, or creating the playing field, so that the teams can do it themselves . . . to do that you need a certain playing field and managers should create it – should create the conditions so that people can do it.

The CEO of Sioux made a very similar point:

I am responsible for where we go, but not for how we do it. I leave that to the employees.

Furthermore, the Phenom project leader (from NTS) was making a similar point when he said he wanted to avoid *micro-managing* the project (see above). In view of the autonomy given to the project team, as we discussed above, the project leader emphasised the importance of communication. He also emphasised that it is important for all members of the project team to have the same interests in the successful outcome of the project. In the Phenom case the risk-reward parties (especially NTS and Sioux) wanted the project to be developed as quickly as possible so that they could start recovering their investments. However, Benchmark did not have a similar incentive and there were some tensions at the organisational level. However, the Benchmark engineers were fully committed to the project. As Benchmark's Programme Manager acknowledged in relation to their projects more generally:

Our engineers are more committed to their project than to their own company. Much of the work is co-developing and this implies that they work together with the customer and not with the rest of the department.

This commitment was due to their shared interest in the successful development of the Phenom, and to their social relationships with the other members of the project team. The former CEO of the NTS Group recognised this in the following comment:

The social aspects are so important, you have to respect your colleague coming from another party and you need to share what you are doing and you need to be open to other knowledge and other ideas. Everybody is responsible for the end goal: the product with specific features, and not for a specific part. If there is a problem, it is everybody's problem. The people from all the parties, not only from the risk-reward parties, had to work in this way.

The strength of the commitment to the project was further emphasised by FEI's VP for New Business, when he commented:

Within 12–18 months we developed a kind of machine [an electron microscope]. Normally, these machines are developed over many years. This project was very fast, by far the fastest project of FEI. People were so excited just doing it. It was just fun. People worked day and night to meet the schedule. There was an enormous speed in the project. NTS and Benchmark appointed new project leaders. These young people were very eager to make the project a success – the project was a step in their career.

With this commitment to the Phenom everyone in the project team was focused on developing the product. As Sydow et al. (2004) pointed out: "Being focused means that you care less or not at all about things outside the project" (p. 1481). As the members of the project team became totally immersed in developing the Phenom, the project's temporal embeddedness at the outset gave way to a form of a-temporality (see Janowicz-Panjaitan et al., 2009b). In other words, the individuals working on the project came to identify themselves more with the project and its immediate objectives (i.e., developing the Phenom), than with their own (employing) organisation and the project's temporal embeddedness. As such, when problems, issues and differences of opinion arose at the project level, there was a strong motivation for the project team members to search for solutions which would lead to the successful completion of the project – i.e., to develop a product which meets the technical specifications and target price set at the outset. However, focusing on the project in this way can pose potential problems for the organisations contributing to the project as their employees may 'forget' about the interests of the organisation which ultimately employs them. For instance, by focusing entirely on the successful completion of the project in terms of the desired technical specifications and target price, they can ignore cost and other issues which might have implications for the profitability of the project to their employing organisations.

To overcome such problems, and to ensure that their employees continue to identify with their own employing organisations, informal activities are regularly organised to maintain social relationships between the employees working on different projects for various customers. For instance, each week Sioux organises what they call "pizza evenings" at which their employees working on different

²³ This was discussed earlier in relation to the temporal embeddedness of the project and the institutional trust between the parties.

projects come together to exchange knowledge and share ideas, and NTS regularly organises various types of social activities for its employees. This creates a parallel social structure through which individuals working on different projects for different customers can maintain social relationships within their (employing) organisation.

Within the project, the a-temporality emerged as the social structure came to define the relationships between, and the interests of, the individuals who now identified themselves with the project. In this sense the project had become a temporary organisation (i.e., a project-based organisation) with an identity separate from the companies contributing to it. The social structure was needed to translate the institutional-based trust between the organisations (which arose out of the temporal embeddedness and institutional structures) into interpersonal trust between the individuals involved on a day-to-day basis, which was necessary during the execution phase. Interpersonal trust, both in the competence of the other members of the project team and their commitment to the project, was essential as the project team had substantial autonomy in the development of the Phenom. The representatives of the contributing organisations created the “*playing field*”, monitored the progress of the project, and took decisions when issues were escalated to them. This left considerable space for flexibility in the product development process. While the project's social structure integrated the work of the different parties, it nevertheless encouraged them to be creative. This social structure, combined with the institutional, economic and technical structures (described earlier), provided a minimal structure for the project – i.e., a structure which combined both firmness and flexibility.

As this was an innovative project, both in terms of the risk-reward model and the technological development, there was the need for considerable flexibility in the product development process. Although there were both economic and technical structures, they were not unduly constraining, rather they provided the boundaries within which the product could be developed. Nevertheless, it was important to monitor the costs of the project; both the development costs and the expected cost of the product. The project leader, together with the system architects, closely monitored these costs, as he explained:

I am responsible for the total cost of the product. You start by making a specification, then you make a global design and then you start to make a first cost estimation. You try to estimate what each module will cost based on the functions of the module. For this cost estimation, we use cost engineers, people who are experienced in estimating the cost of the modules to be developed. Then you design more detailed concepts, and make a concept choice. To make this choice you have to know how the function of the concept is designed, what is the expected price, and other pros and cons. You make this decision together with the architects. We had various sessions to decide what concepts we will use for a certain module. Then you slowly specify the requirements for designing the module. Based on the detailed drawings you can set the exact price and go to the supplier and tell him what target price he has to meet.

There was also a budget for the development costs and this was updated each month by the project leader. Where changes were made and/or additional functionalities were added to the product the budget for the development costs had to be increased. Both the updated budget for the development costs and changes to the expected cost of the product were closely monitored during the weekly project meeting (which, as mentioned above, was attended by managers from the various contributing parties). In addition, the business case for the project was updated approximately every three months and agreed by the risk sharing parties. In this way the economic structure evolved as the project was executed, but at the same time it provided the boundaries within which the product development could take place. It is interesting to note that although cost information was used in this process, accountants were not directly involved. The information was produced by cost engineers and used by the project manager and the project committee.

In addition, the technical structure had to develop during the execution phase. As explained earlier, although the general nature of the Phenom had been agreed in technical terms during the initiation phase, many of the technical details and specifications of the product had to be worked out during the product development process. This meant that as the Phenom was being developed many technical decisions had to be taken. However, some of the interviewees questioned whether some of the specifications had become fixed too early and whether it might have been better to have been less specific in the early stages of the project so that other possible solutions could have been considered. As Benchmark's Programme Manager commented:

FEI needed working prototypes as soon as possible. Within about three months we had to complete working types of the electronics and also an image that could be displayed. But it is always dangerous if you show that it is already working, as they think the project is already done. But what we did not do is stop and look at the concepts and make corrections where needed. We kept on running. We had to force our engineers to stop being creative, but to make something that works. How things were solved on the circuit board was chosen really early in the project and could not be changed any more. When we showed the prototype, FEI said: well, now industrialise it. There was no time to evaluate the prototype and rearrange and change concepts. The time pressure was extremely high. I would not do it again. It went well, but it also could have been a disaster.

This illustrates that as a project is executed decisions will be taken about various technical aspects of the product and this will reduce the subsequent room for manoeuvre. As such, the flexibility which may be available within the technical structure in the early stages of a project will inevitably reduce over time as the selection of specific technical options will rule out other options. Thus, in a creative process, if decisions about technical solutions to specific problems are taken too early, they can limit creativity later in the process. Hence, it may be necessary to try to avoid the technical structure becoming too firm too early, so as to allow the flexibility which is needed to be creative in the

later stages of the project. However, this may not be possible. In many projects it may be necessary to take technical decisions early in the process, but this can remove much of the flexibility from the technical structure, although there may still be flexibility in the economic and social structures.

The economic and technical structures, which were set up in the initiation phase of the Phenom project, set boundaries for the product development process. In this case, however, the boundaries were initially quite wide and flexible, although changes in both the economic and technical structures as the project was executed tightened the boundaries and removed much of the flexibility. The initial flexibility was facilitated in part by the institutional structure – i.e., the institutional trust between the organisations and the temporal embeddedness of the project. Nevertheless, a social structure was needed to develop (interaction-based) trust between the individuals who had to work together on the project. By integrating the individuals from different organisations into a project team, a temporary (project-based) organisation was created and the social structure led to a form of a-temporality, as the individuals concerned identified more with the project than with their employing organisations. As a result, these organisations used other informal mechanisms to set up a parallel social structure to (re-)integrate them into their employing organisations. By monitoring the boundaries set by the economic and technical structures, the various contributing parties could avoid micro-managing the project and they could allow their own staff to focus on the project, while at the same time ensuring that their organisations' interests were served in the longer term and within the wider institutional network.

4.4. The completion

As a product development project the Phenom was very successful – technically it is a very good product and it is easy to use. Furthermore, as mentioned above, it was developed very quickly. However, initial sales were disappointing, partly due to the economic climate at the time, but also because FEI had not adequately developed a sales network for the product. As FEI normally sells large and much more expensive electron microscopes to, for example, research institutes, they did not have and did not develop a network of sales agents for marketing the Phenom, which essentially competes with optical microscopes rather than larger electron microscopes. FEI's failure to sell the planned volumes of the Phenom was a major problem, particularly for the other two risk-sharing co-developers (NTS and Sioux), as they would only recover their development costs as the product was sold. This led to some significant tensions between the risk-sharing parties, but after substantial discussion and negotiation it was decided to set up a new and quite separate marketing company (owned jointly by FEI, NTS and Sioux) to market the Phenom worldwide – hence its name: Phenom World. This is now selling the Phenom much more successfully.

When FEI formally accepted the completed product in May 2007, the product development team (i.e., the temporary organisation) was disbanded and the various parties assigned their employees to other projects. In addition, the

role of the parties in the risk-reward model changed from being co-developers to being producers of the various parts for the product, which NTS now integrates. Successfully taking the product to the market was crucial for the co-developers; for NTS and Sioux as the risk-reward partners, and also for Benchmark which had invested in production capacity to produce the electronics for the Phenom. So setting up Phenom World was in the interests of all these parties. As a result, NTS, Sioux and FEI continued their collaboration, but now focused on selling the Phenom. Furthermore, based on feedback from the customers, NTS and Sioux continued to work on updates and new releases; for example, new off-line software applications have been added. Although, as the suppliers of parts for the Phenom, the risk-reward partners are still working together, there are new supply contracts and the parts are produced by the manufacturing departments within these suppliers.

In the completion phase temporal embeddedness re-emerged as the individuals involved in developing the Phenom were assigned to other projects. For most of the individuals, and also for their companies, working in a team of co-developers with responsibility for the development of a complete product was a new experience. Hence, their experiences in working on the Phenom project are likely to influence how they work on other projects in the future. Furthermore, as the risk-reward model was used for the first time in the Phenom project, and as it was recognised as an innovative form of project organisation in the southern part of the Netherlands, it is likely to influence future product development projects in this region. However, NTS indicated that it would be unlikely to undertake risk-reward projects *of this scale* in the future as, if they were not successful, they could have serious financial implications for the company. Nevertheless, as NTS and Sioux have shown that they are able to act as system suppliers, this is likely to influence their involvement in future projects. Finally, at the organisational level collaboration between the parties will continue, albeit in the role of suppliers or in the case of NTS, Sioux and FEI as the joint owners of Phenom World. Furthermore, the parties can be expected to collaborate in the future on other product development projects, both with each other and with others in their wider network.

Thus, the temporal embeddedness, which was important during the initiation phase of the project, once again shaped the relationships between the various organisations which were involved in the Phenom project. As we saw earlier, the temporal embeddedness of the project and the good relationships between the various parties were important in the early stages of the project. It was part of the broader institutional structure which enabled the project to start before the contracts had been signed and the technical specifications of the product finalised. This meant that there was considerable flexibility in both the economic and technical structures. The temporal embeddedness of the project and the good relationships between the senior managers of the collaborating organisations provided the basis for institutional trust. However, as the project got under way it was necessary to build inter-personal trust between the individuals involved in the project on a day-to-day basis. This was achieved through the emerging social

structure which integrated the activities of the various parties, but avoided micro-managing them. Consequently, sufficient space was left for creativity, although this space was reduced as the project progressed. Furthermore, the social structure encouraged a form of a-temporality as the members of the project team identified rather more with the project than with their employing organisations. During the project the social structure combined with the economic and technical structures in governing the product development activities and the relationships between the collaborating parties.

As such, the economic, institutional, social and technical structures provided both firmness and flexibility and, accordingly, they could be described as providing a minimal structure for the project. We will discuss this in more detail in the next section. However it is important to recognise that we are not claiming that the elements of these four structures will be the same in other co-development projects, as in the Phenom project. The Phenom project was particularly complex both in terms of the technology being developed and in terms of the risk sharing agreements between some of the parties. The specific nature and context of each new product co-development project will influence the nature of the minimal structure which governs the relationships between the collaborating parties. Nevertheless, we would argue that the minimal structures framework we have adopted in analysing the Phenom project in this paper has the potential to help in understanding the governance of other co-development projects.

5. Discussion

Our concern in this paper is the governance of the relationships between the various parties involved in co-product development projects. For this reason we have drawn on the minimal structures framework which we developed in [van der Meer-Kooistra and Scapens \(2008\)](#). In this framework a minimal structure provides both the firmness necessary to structure the relationships and the flexibility which is needed to encourage creativity. However, it is important to recognise that minimal structures are not necessarily loose structures. Some of the elements of minimal structures could be very tight, whereas others could be relatively loose.

At the start of the Phenom project there was considerable flexibility in both the technical and the economic structures. This was facilitated by the network of relationships between the organisations contributing to the project (part of the institutional structure). However, as the project got underway a social structure developed and this was very important in the day-to-day governance of the project (i.e., the project-based organisation). Although it could be said that the social structure became quite tight, it might be better to use the term 'cohesive', rather than tight. The social structure moulded the participants into a tight, or cohesive, team in which all the participants worked well together – after resolving some initial problems.

As a co-development project, the Phenom project brought together several different organisations and their lateral relationships were very important, especially (but not only) for the risk sharing parties. As these parties

were drawn from a (local) network of organisations which regularly collaborate with each other, the temporal embeddedness of the project was due to the experience which the parties had of working together in the past and their expectations that they would work together in the future. The good relationships which existed between the senior managers of the collaborating organisations were particularly important as they provided the basis for the institutional trust which was necessary for the project to begin before the (risk sharing) contracts had been agreed and signed.

As we noted earlier, temporal embeddedness ([Bakker and Janowicz-Panjaitan, 2009](#); see also [Engwall, 2003](#); [Lundin and Söderholm, 1995](#)) goes beyond the notion of path dependency which is discussed in the institutional theory literature (e.g. see [David, 1985](#); [Nelson and Winter, 1982](#)). Whereas path dependency is concerned with the past, temporal embeddedness involves both the past and the future. For example, in the Phenom project, as the parties had worked together in the past, their shared experiences and good relationships influenced the way in which they approached the opportunity to become involved in this co-development project (cf. path dependency). However, in addition, as they anticipated that they would work together in the future their expectations regarding the likely impact of the successful completion of the Phenom project on their reputation within the network also shaped their relationships with the other parties. Nevertheless, the individuals working day-to-day on the project were more concerned with the specific objectives of the project – i.e., developing the new product – rather than its temporal embeddedness.

As the social structure integrated these individuals into a project team, a temporary (or project-based) organisation was formed and a-temporality (see [Janowicz-Panjaitan et al., 2009c](#)) emerged and suspended (at least for them) the temporal embeddedness of the project. This occurred as the individuals who were working day-to-day on the project increasingly focused on the problems of producing the new product, rather than worrying about the past or future relationships of their employing organisations. For them, the project had become a (temporary) organisation with its own objectives, interests and members (see [Janowicz-Panjaitan et al., 2009b](#) and Section 2.4). However, this was perceived as a potential problem for some of the managers of the employing organisations, as they were concerned that their employees could become more committed to the project than to their own organisation (cf. [Sydow et al., 2004](#)). To address this problem, and also to encourage knowledge sharing between their own employees, some of these managers arranged regular social activities for their own employees to bring together individuals working on different projects. As well as helping to maintain social relationships between their own employees, these social activities made it possible to share the knowledge created in different projects and also to allow colleagues to help each other to solve difficult problems. As such, there were overlapping social structures. The Phenom project team leader coordinated the execution of the project, while at the same time the managers from the contributing organisations ensured, not only that the project was executed efficiently, but also that the individuals they had allocated

to the project remained in contact with others in their employing organisation and shared knowledge with them.

As we observed, there were interconnections between the various structures (economic, institutional, social and technical), and these interconnections changed over time. However, first it is important to note that the economic and technical structures were put in place during the initiation phase, and whereas the institutional structure already existed, the social structure had to be built during the execution phase. As a number of different organisations were involved in the Phenom project, some form of economic structure was necessary, and this makes it somewhat different to the typical product development projects which take place within an organisation. The institutional structure, together with this economic structure, was particularly important in the initiation of the project. These structures governed the relationships between the parties as they came together to set up the project.

As indicated earlier, [Kamoche and Cunha \(2001\)](#) proposed a minimal structures framework which contained only a technical and a social structure. It was when [van der Meer-Kooistra and Scapens \(2008\)](#) extended the Kamoche and Cunha framework to study lateral relationships that we added the institutional and economic structures. As the literature on the management control of product development projects usually studies projects undertaken within a specific organisation, they generally focus on formal project controls (see [Davila et al., 2009a,b](#)) and these can be considered elements of the economic or the technical structure. Nevertheless, some writers have recognised the importance of studying social aspects of such projects (see [Chenhall et al., 2011](#)) – i.e., the social structure. During the execution phase of the Phenom project the technical and social structures were particularly important, as they governed the product development activities within the project-based (temporary) organisation. As such, there are similarities in the way the Phenom project was managed within the temporary organisation and the way in which intra-organisational product development projects are managed within a single (non-temporary) organisation. Hence, it is not surprising that during this execution phase the technical and social structures were important, as proposed by [Kamoche and Cunha \(2001\)](#). Nevertheless, we must not forget the governance of the relationships between the collaborating organisations, and between those organisations and their staff working on the project. The economic and institutional structures remained in place for the governance of the relationships between the parties. Thus, whereas the social and technical structures governed the day-to-day activities of the project in the temporary organisation, the economic and institutional structures provided the context for the project (i.e., the temporary organisation) and governed the relationships between the collaborating parties.

In the Phenom project the network of (institutional) relationships between the various parties helped to shape the technical and especially the economic structure. The good relationships which existed between the senior managers of the collaborating organisations provided the basis for the institutional trust which enabled the project to begin before the contracts had been signed and the final

technical details agreed. Hence, the institutional structure facilitated flexibility in the technical and economic structures. However, a social structure had to be built in order to create the interpersonal trust which was required for the various parties to be able to work together. Although there were good relationships between the organisations contributing to the project at the level of the senior managers, most of the individuals working on the project had not worked together before. Consequently, in order to combine their capabilities and knowledge, flexibility was needed in the technical structure to provide space for creativity and innovation. Nevertheless, the technical structure contained various types of project controls which were used to manage the project and also to monitor the individuals working on the project.

Superficially there was little evidence of the involvement of management accountants in the project. Nevertheless, accounting and financial information was important. The initial business plan set the financial framework for the project, providing both the budget for the development work and a bill of materials setting out the expected/desired cost of producing the new product. The development budget comprised largely the cost of the time of the engineers who were to contribute to the project. In managing the project on a day-to-day basis it was the hours of these engineers which were important, rather than financial numbers, although the project manager regularly monitored the development budget. In general terms, the financial information set the boundaries for the project – it defined the (time) resources available to the project and the target for the costs of producing the new product. If it was necessary to go beyond these boundaries permission from the managers of the contributing organisations would be needed. For example, if new functionalities were to be added to the product and this would increase the development costs and/or the expected cost of producing the product, the approval of the appropriate supervising committee would be needed. Hence, there could be flexibility to go beyond the boundaries set by the financial numbers provided appropriate approval was received.

In a case study of intra-organisational new product development, i.e. within a (non-temporary) organisation, [Jørgensen and Messner \(2009, 2010\)](#) noted that accounting information was used to assess progress of the product development at the individual gates (within the stage-gate model²⁴) at which specific activities should be completed and the project evaluated before passing to the next stage. In the Phenom project, although the financial numbers were monitored by the project leader and the supervising committee (comprising the collaborating parties), the assessment of the product development at the 'gates' focused rather more on the technical progress, rather than the financial numbers. As the product development projects studied by [Jørgensen and Messner \(2009, 2010\)](#) were undertaken within a non-temporary organisation the product development process was part of a much broader flow of time and activities. Jørgensen and Messner describe how the product development process was linked to the

²⁴ See, for example, [Hertenstein and Platt \(2000\)](#) and [Cooper \(1990\)](#).

Broad	Flexible	Loose
Narrow	Tight	Flexible
	Impermeable	Permeable

Fig. 2. Types of boundaries.

emerging strategy, and they discussed the links between accounting and strategizing (see especially, Jorgenson and Messner, 2010). As such, the new product development projects were part of the much wider processes taking place within the organisation. In contrast, in a temporary organisation (as in the Phenom project) the primary focus is on the development of the product. Although it would be possible to terminate such a project before its completion, this would be a very complex process in view of the contracts (both legal and implicit) between the collaborating organisations and their temporal embeddedness. Furthermore, terminating a project could have a negative effect on the reputations of the collaborating organisations within the wider network. Consequently, the focus was on the technical development of the Phenom within the financial budget set out in the business case.

In this sense, the financial numbers set the boundaries for the project, although they could be revised or crossed in pre-defined circumstances and with the agreement of the collaborating parties. Consequently, to understand the nature of the boundaries set by financial numbers in the governance of such product development projects we need to look more closely at what we mean by tight and loose boundaries. In this discussion we will consider boundaries generally – not just financial boundaries. In product development projects there are likely to be technical as well as financial boundaries, and these boundaries could be: (1) broad or narrow and (2) permeable or impermeable. By 'broad or narrow' we mean the extent to which they limit the available options, and by 'permeable or impermeable' the extent to which it is possible to transcend them. Although these are not dichotomies it may be helpful to look at the taxonomy in Fig. 2. If the boundaries are 'narrow and impermeable' they could be described as very tight. Such boundaries may be suitable for routine manufacturing activities in a predictable environment, but they could severely limit innovation and creativity in the product development process. In contrast, boundaries which are broad and permeable could be described as loose. While such boundaries could provide considerable space for innovation and creativity, they could also encourage over-engineering of products which might not be commercially viable. The other two possibilities in Fig. 2 could both be regarded as flexible boundaries. On the one hand, they could be broad and impermeable, while on the other hand they could be narrow but permeable. The boundaries set for the Phenom project were relatively broad, but largely impermeable. The technical and economic structures were allowed to evolve with the project, but it would have been difficult to go beyond the agreed general technical specifications of the product, and it would have been very

difficult to obtain additional funding to go beyond the originally agreed development budget.

Thus, we can conclude that, although management accounting was not particularly visible in the Phenom project, it did play a role in the governance of the inter-organisational relationships. Financial information was included in the contracts (an element of the economic structure), and also in the technical specifications (an element of the technical structure). The project was monitored on a day-to-day basis by the project manager and other senior members of the project team, and various committees monitored progress on a periodic (weekly/monthly/quarterly basis), but without any direct involvement of (management) accountants. Furthermore, cost estimates for the bills of materials and the project budgets were produced by cost engineers, rather than cost (or management) accountants. Nevertheless, management accounting was an element of the minimal structure. Specifically, management accounting information formed the basis of the initial business case, the development budget and the target bill of materials, and as such was an element of the economic structure. In addition, the technical structure included various project management controls.

Using the terms mentioned above, the boundaries set by the economic and technical structures could be quite narrow, but sufficiently permeable to provide the flexibility needed for creativity in the day-to-day product development process, especially where additional resources could be available for the project if this was considered desirable by the appropriate authorising body. In such cases, the project controls typically seen in intra-organisation product development projects (see Davila et al., 2009a: p. 333 for a list of project controls) are likely to be used. However, as the Phenom project involved co-development, another form of flexibility was needed as the various parties brought different capabilities and knowledge to the project team, and consequently space was needed to facilitate creativity and innovation through their collaboration. Thus, although the accounting information, which defined the financial boundaries of the project, together with project controls, could create a quite firm structure for the product development process, the governance of the project required both firmness and flexibility – i.e., a minimal structure.

As such, the minimal structures framework has enabled us to understand where project controls and management accounting fits into the governance process. Governing inter-organisational product development projects is not simply a matter of designing a set of technical project controls to manage the execution of the project. It is necessary to understand the different structures which are needed – some of which may be designed during the initiation phase (the economic and technical structures), while others may already be in place (the institutional structure) or need to evolve during the execution phase (the social structure). In some product development projects tight project controls may be necessary, but they may still be part of a minimal structure which facilitates both firmness and flexibility – i.e., setting the boundaries for the project while at the same time providing flexibility where it is needed. In other

projects, project controls may be less important as the necessary firmness may be provided by the boundaries which the institutional and/or economic and technical structures set for the project. In some cases narrow boundaries may be set (through, say, the technical and economic structures), but elements in the institutional and social structures may allow them to become permeable in specific situations. In contrast, in other situations rather broad boundaries may be set, but these may be impermeable.

Thus, to understand the role of management accounting and project controls in the governance of product development projects, it is important to locate them within the broader context of the economic, institutional, social and technical structures, and to assess how they provide both firmness and flexibility. Furthermore, it is also important to recognise that the relative influence of the structures shifts as projects progress. For example, budgets may provide quite broad boundaries in the early stages of a project, but as technical decisions are taken fewer options may be available and consequently there may be less flexibility in the accounting/project controls.

6. Conclusions

The primary aim of this paper has been to study how minimal structures can govern product co-development projects, i.e., where the parties are drawn from multiple independent organisations. The Phenom project was both technically and organisationally complex – its notion of risk sharing being relatively new in the context of product development projects, at least for the organisations involved. Nevertheless, by exploring the economic, institutional, social and technical structures we were able to understand how a minimal structure governed the relationships between the collaborating parties.

It should be emphasised that economic, institutional, social and technical structures are conceptual categories which provide a sensitising framework to assist our understanding of minimal structures, but in practice it may be difficult to classify individual mechanisms into one of these four structures. For example, contracts may specify the technical nature of the product to be developed, while at the same time setting out the costs to be incurred and the rewards to be obtained. As such, contracts could be considered to be part of both the technical and economic structures. In addition, while relationships between organisations in a network can be classified as part of the institutional structure, relationships between the individuals from those organisations who are working together on a specific product development project could be classified as part of the social structure.

The conceptual categories of economic, institutional, social and technical structures focus our attention on the way in which minimal structures can provide both the firmness and flexibility which are needed in product development projects and in lateral relationships more generally. Furthermore, as the Phenom project demonstrates, in setting up a product development project it is not a matter of simply designing these structures. Some elements, especially of the economic and technical structures, may be designed when a project is set up, but the

context and temporal embeddedness of the project may mean that an institutional structure is already in place, while the social structure may have to emerge as the project is executed. As such, some elements of a minimal structure can exist prior to the project while other elements evolve during the project.

Although we are primarily interested in inter-organisational relationships in the context of the co-development of new products, we have seen in this paper how a product development project can become a temporary (project-based) organisation, with a beginning and an end, in which various parties collaborate to achieve its objectives – i.e., the development of a marketable product. So in one sense, the inter-organisational relationships could be said to transform into relationships between the various members of the temporary organisation. However, to focus only on control within the temporary organisation would be to forget the concerns and interests of the collaborating organisations. While the social and technical structures govern the day-to-day activities within the temporary organisation, the economic and institutional structures provide the context for the temporary organisation and also govern the relationships between the collaborating organisations.

As we saw in the Phenom project the temporal embeddedness of the relationships between those organisations can be very important in the initiation of a product development project. However as the project moves into the execution phase, a-temporality may emerge as the members of the project-based (temporary) organisation focus on the product, rather than the interests of their employing organisations. In the Phenom case, we saw examples of how organisations try to maintain social structures through which their own employees interact with colleagues (from their employing organisation) in regular, but informal ways, separately from the social structure which is built up within the project.

Although management accountants were not directly involved in the Phenom project, we saw how accounting information, along with technical specifications, were important in setting the boundaries for the project. However, we also suggested that these boundaries might be broad/narrow and permeable/impermeable. Consequently, it is important for accountants and controllers in organisations contributing to collaborative product development projects to understand the nature of minimal structures, and the role of the economic, institutional, social and technical structures. Each has a role in the governance of the relationships between the parties, as well as the product development process, and it is important not to focus only on the technical aspects of control – whether they are accounting controls or project controls. Although there were few explicit accounting controls in the Phenom project, project controls were used. Furthermore accounting information was important in defining the boundaries for the project – i.e., setting the developmental budget and the target price/cost for the product being developed.²⁵ As

²⁵ It is interesting to note that in terms of [Simons \(1995\)](#) levers of control (which are widely used in studying performance management systems in

such, there can be a role for management accounting in the governance of inter-organisational product development projects, despite the apparent absence of management accountants.

In the Phenom project it was the cost engineers who provided the financial information needed to estimate the bill of materials and it was the project leaders who monitored and managed the project's performance. However, performance was managed in terms of time rather than financial numbers. The financial resources available to the project were translated into resources of time – i.e., the available time of the various categories of engineers. Using these time-based resources the project leader had to ensure that specific activities were completed on time. In so doing, he undertook activities which are normally associated with management accounting: planning, monitoring, variance analysis, taking control decisions and performance reporting. However, the basis of accountability was expressed in terms of time, rather than financial numbers, although financial resources underpinned the time resources.

One might question whether this process could be described as management accounting. However, putting aside the semantic question, it is clear that, despite flexibility in the minimal structure, the project leader closely controlled the project on a day-to-day basis. In technical terms, the way in which he controlled the project within this temporary organisation is probably similar to the way in which product development projects are controlled within a non-temporary organisation. Nevertheless, in order to fully understand the governance of the lateral relationships involved in such projects we must look beyond technical and financial (project) controls to the way in which minimal structures provide both firmness and flexibility. Furthermore, we must recognise that management accounting, and management controls more generally, can both constrain and encourage creativity/innovation at the same time. To appreciate how it does this, we need to locate management accounting within the minimal structure which is used to govern the relationships between the parties contributing to the product development project.

The practical implications of our study are that practitioners should look beyond the technical and accounting controls which are normally considered the way to control product development projects. It is important to build a strong social structure (i.e., cohesive team of people who bring the necessary skills and experience to the project and are mutually committed to its successful completion), and to provide a 'playing field' on which the team members can work together to *jointly* solve problems. This will be helped by well-developed institutional relationships between collaborating organisations with experience of working well together in the past and expectations of working together again in the future. Such relationships can be particularly important when initiating a project, and may even mean that the project can start before the contract between the parties has been signed and the technical

specifications of the project fully agreed. Nevertheless, management accounting information will be important in setting the boundaries for the project, and technical controls will be needed for planning and monitoring the progress of the project. However, the technical (and accounting) controls must leave sufficient space for creativity and innovation. This can be facilitated by the availability of a strong social structure, but this needs developing within the context of the institutional and economic structures which govern the relationships between the collaborating organisations.

It must be emphasised that in this paper we have been studying the co-development of new products; in other words, where several independent organisations collaborate in the development of a new product. In our case study the product development took place in a temporary (project-based) organisation. Although the day-to-day management of the project within the temporary organisation was somewhat similar to in-house product development in non-temporary organisations, we wanted to study the broader governance of the relationships between the collaborating parties. As such, we have studied a particular form of inter-organisational relationships, where the activities are undertaken within a temporary organisation. Despite some similarities with intra-organisational product development projects, we have taken a wider view of governance, going beyond the technical and financial controls which have typically been discussed in the literature on management control in product development (as reviewed by Davila et al., 2009b). In this paper we have focused on the governance of the lateral relationships between the parties, rather than the day-to-day control of the product development process, although we have also explored the way in which the co-development project was executed.

Thus, we have studied a particular form of new product development, one which involves inter-organisational collaboration. As such, it is somewhat different to the studies of new product development in the existing management accounting literature (for example, Mouritsen et al., 2001; Dekker, 2004; Cooper and Slagmulder, 2004; Agndal and Nilsson, 2009). Furthermore, although we have studied inter-organisational relationships, as these relationships came together in a project-based (temporary) organisation they had a rather different form to that previously studied in the management accounting literature on inter-organisational control. Consequently, it might be argued that we have been studying a very specific form of new product development but, as we pointed out in Section 1, there is increasing evidence of this kind of collaboration in modern, high-tech industries (for example, see Chesbrough, 2003; Faems et al., 2005; Hagedoorn, 2002). In this context we have shown how a minimal structure can provide both the firmness and flexibility needed in the co-development of new products. Furthermore, we have shown that in order to understand the role of management accounting, and management controls more generally, in this context it is important to examine the governance of the inter-organisational relationships. As we pointed out earlier, existing studies of management accounting and control of new product development in the accounting

the management accounting literature) in our case management accounting was not prominent in either the interactive or diagnostic controls, but it was an important part of the boundary system.

literature have tended to focus on the use of particular management and accounting techniques (see Section 2.1). However, our study has illustrated, albeit in the specific context of co-development, the importance of studying the governance of the inter-organisational relationships. We believe that studying the governance of the relationship between the parties will enable us to better understand the role of management accounting in other forms of inter-organisational new product development as well.

The Phenom project had some very specific complexities (including risk sharing parties) which may not be present in all such inter-organisational product development projects. Consequently, we are not claiming that the economic, institutional, social and technical structures are likely to be similar in other projects; instead we are arguing that by exploring these structures in other projects, we will better understand how management accounting and formal management and operational controls fit within the minimal structures which govern the relationship between the collaborating parties. Although the primary aim of this paper was to study how minimal structures can govern product co-development projects, we were able to explore the role of management accounting in the Phenom project. Further studies are needed to focus more specifically on the role of management accounting both within project-based (temporary) organisations, and in managing the relationships between the collaborating parties. In other industries and in other (especially larger) projects, management accounting may have a more important role than we observed in the Phenom project. In this paper we have taken a first step towards understanding how management accounting fits within the minimal structures used in the governance of co-product development projects.

Appendix I. The Phenom project: interviews

Role	Organisation	Date
Project leader Phenom project	NTS Mechatronics	27 November 2009
CEO	Sioux Group	8 March 2010
CEO (former)	NTS Group	8 March 2010
Project leader	Van Berlo Studios	8 March 2010
CEO	Van Berlo Studios	8 March 2010
Project leader Phenom project	NTS Mechatronics	9 March 2010
Managing director/project manager	Sioux Embedded Systems	9 March 2010
Director of Development Engineering Resources, and Programme Manager (2 people)	Benchmark Electronics	3 May 2010
Vice President (VP) New Business	FEI	4 May 2010

Appendix II. Issues covered in interviews

Position of the interviewee

What is your position in your company?

What is your position in the project (your relationship with the other members of the project team)?

Why are you involved in this project?

How was the decision made about your involvement?

Have you been involved since the start (the go-decision) of the project or even before the go-decision?

Do/did you collaborate with the same parties in other projects?

What is the percentage of time you are spending on this project? How does your company evaluate your performance?

What is the importance of the project for your organisation?

Contractual arrangements: (Can we see the contract?)

What are the most important contractual arrangements (boundaries, time frame, facilitating flexibility and knowledge exchange, definition of project phases, project management, each party's involvement in the project over time, project evaluation)?

What are the uncertainties in the project?

Have you concluded additional arrangements or changed existing arrangements over time?

What was the role of the contractual arrangements in the project?

How much flexibility is needed in the development of the project and in its execution?

Could the project be terminated prematurely?

Governing the relationships between the parties

How do you exchange knowledge with the other parties in the project?

Have you created new knowledge over time? Who is the owner of this knowledge?

How have the parties protected this new knowledge?

If the project faces problems, e.g. financial, technical, co-operation or compliance problems, how do you solve these problems? Could you give an example of such a problem and elaborate on how you did solve this problem?

When another party faces problems that influence the project, do you try to help this party to solve its problems? Could you give an example of such a problem and tell us how you did help your partner?

Which problems do you always discuss within your own company?

Have you developed performance measures and set performance targets for your own contribution and for the project as a whole? If you do not meet these targets, what will be the possible consequences within your own company and for the project?

Have you developed norms about how to co-operate with each other (at the start of the project or over time)?

How do you perceive the co-operation with your partners and how do you perceive the co-operative attitude of your partners? What is crucial for a good co-operation?

How do you perceive the relationship with the representatives of the partners in the project?

How do you know that your partners recognise that you make a good contribution to the project?

How do you evaluate your partners' contributions to the project?

What have you learned from the project over time (learning about the technology, about and from the partner, about the collaboration)?

How and how often do you inform your own company (higher management levels) about the progress of the project? What type of information do you report to or discuss with your own company?

What are the governmental and/or business regulations (quality standards) you have to comply with?

Working with the other parties

What are the key issues that make the collaboration easier or more difficult?

What are the interfaces between your work and the work of your partners (interdependencies between the partners)?

How often do the members of the project team meet each other (formal and informal meetings)?

How does the project team react to changing circumstances (e.g. the current economic downturn)?

Do you assess and discuss the collaboration with your partners (how and how often)?

Do you feel yourself liable for all the project activities, even those executed by your partners?

How do you plan the daily project activities?

How do you evaluate the progress and the success of the project (perception of the interviewee)? Has the project team made any mistakes (innovative activities need room for making mistakes)?

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