

EXTENDING COST MANAGEMENT IN THE PRODUCT DEVELOPMENT PROCESS IN THREE DIFFERENT PERSPECTIVES

Jorge Oliveira,^{1*} Manuel Nunes¹ and Paulo Afonso¹

¹ Department of Production and Systems, University of Minho, Portugal

* Corresponding author: jmoliveira@dps.uminho.pt, University of Minho, 4800-058 Guimarães, Portugal.

KEYWORDS

Cost management, Product development process, Delphi study.

ABSTRACT

This study focuses on the extension of cost management practices in product development. An exploratory Delphi study was conducted among 37 experts (company collaborators, academics and consultants). The results indicate that cost management is an important domain. Contradictorily or paradoxically, the results suggest, firstly, that cost management tools may be easier implemented in small firms than in large or multinational firms but, secondly, the awareness of the need to apply cost management methods and techniques in small enterprises is in general very low. Also, Cost Management in NPD is presented here with three important extensions: [1] a vertical internal extension (within the company and across multiple departments); [2] a product life-cycle extension (from Target Costing to Kaizen Costing or vice versa); [3] extension of TC or KC to the downstream and upstream of the company (external cost management, which occurs mainly with suppliers but also with clients). The results of the Delphi study allow to conclude that the external extension has a more important role in cost management in NPD than the internal ones (vertical and life-cycle).

INTRODUCTION

Cost management in new product development (NPD) aims to apply a set of engineering and cost management tools in NPD processes to make these processes more effective and efficient. The effectiveness of the process is related to the decrease of the time-to-market and the increase of the potential of success of the product in the market (Afonso et al., 2008). On the other hand, NPD processes will be more efficient by reducing the costs of new products and the product development process itself. Therefore, cost management in NPD can play a fundamental role in the success of companies. Indeed, according to some authors, cost management strategies are among the most important managerial tools and techniques employed by companies (e.g. Zengin and Ada, 2010).

Cost management systems have been used by Japanese companies as decision making tools, oriented toward profit management and competitiveness. Target Costing (TC) and Kaizen Costing (KC) are two of their main pillars (Monden, 1995). TC is applied to products in the development phase and Kaizen costing is applied to products that are already in the production phase.

Target Costing can be also extended towards suppliers. For instance, the supplier's detailed product cost breakdown can be called or included into the concept of open-book accounting (Wouters et al., 2016). In fact, TC is closely associated with interorganizational cost management (IOCM). IOCM is a structured approach to cost management in supply chains (Kajüter, 2002) and consists in coordinated efforts between buyers and suppliers to reduce costs (Agndal and Nilsson, 2009).

Three IOCM tools are identified by Cooper and Slagmulder (2004a), namely: functionality–price–quality (FPQ) tradeoffs, interorganizational cost investigations and concurrent cost management. The level of interaction and involvement between buyer and supplier is the main difference in these three approaches. While the FPQ tradeoffs can be developed with a low level of interaction, the other two techniques require a higher level of interaction between the parties (Cooper and Slagmulder, 2004a).

Cao and Zhang (2010) mention four generic advantages of collaborative supply chain, which are: (i) collaborative advantages are achieved by supply chain partnerships activities (e.g., information sharing, decision synchronization, sharing of complementary resources and the alignment of the incentives with the costs and risks of the partners); ii) there are greater benefits than if companies acted independently; iii) there are some leverage effects or synergistic results; iv) it involves the creation of joint knowledge and joint innovation.

According to Cooper and Yoshikawa (1994), Fayard et al. (2012) and Barbosa et al. (2013) IOCM practices help suppliers and buyers to find ways to reduce costs through collaboration during the NPD process. This type of collaborative partnerships between companies can provide competitive advantages for the company as well as for supply chain partners. Companies share cost information about production, use of materials and technologies, and research and development (Cooper

and Yoshikawa, 1994), in order to reduce costs in the value chain and improve the strategic position of companies involved in the collaborative process (Fayard et al., 2012).

This paper intends to extend the domain on cost management in the product development process in three different perspectives through a two-round Delphi study.

The remainder of this paper is organized as follows. A literature review is briefly presented in which emphasis is given on internal and inter-organizational cost management. In the next section, the research methodology is explained. Next, the main research results are presented. Three dimensions are highlighted: importance and applicability of cost management in the product development process to companies; extending this domain in three different perspectives; addressing several paths or strategies regarding such extended perspectives. The conclusions and further research are presented at the end.

LITERATURE REVIEW

Cost management in NPD is not a process that concerns only management accountants because involves active and continuing participation of individuals from different departments, being treated as multi-functional team work which brings together customers, engineers, designers, accountants and sales people (Zengin and Ada, 2010).

Traditionally, companies have focused on costs that they can control from within, which is known as internal cost management (ICM) (Fayard et al., 2014). There are a number of ICM techniques used in different phases of the product life cycle (Cooper and Slagmulder, 2004b). For example, target costing (TC), quality function deployment (QFD), value engineering (VE), design for manufacture, assembly (DFMA) and kaizen costing.

TC is a highly important tool in cost management in NPD, at the design and development stage, to reduce costs and increase competitiveness (Kato, 1993; Ewert and Ernst, 1999; Ellram, 2002; Dekker and Smidt, 2003; Filomena et al., 2009; Kee, 2010). TC goes beyond a simple cost management technique, i.e. it is a strategic management tool that involves other important management tools such as QFD and VE (Zengin and Ada, 2010). Ibusuki and Kaminski (2007) argue that VE and TC are complementary processes, since the VE allows to identify where cost savings can be achieved and the TC shows the target to be achieved by ensuring long-term profitability for the company.

Kaizen Costing allows cost reduction through continuous improvement during the production phase of the product life cycle, i.e., is used later than TC (Lee and Monden, 1996 and Weil and Maher, 2005). The functionality of a product can not be changed at this stage (Cooper and Slagmulder, 1997) thus, Kaizen Costing contributes to improve the existing product manufacturing process increasing the efficiency of the

production process and reducing costs for a specific product, without changing its functionality (Cooper and Slagmulder, 1997). Successful kaizen programs, in addition to cost reduction, can increase product quality and production process safety (Weil and Maher, 2005). Kaizen costing is the application of continuous improvement principles to find ways to turn production process more efficient (Weil and Maher, 2005).

Cooper and Slagmulder (2004b) argued that a significant percentage of a product costs are blocked by its design, and companies focus cost reduction in the design stage and cost containment during production. However, Cooper and Slagmulder (2004b) also report that there are significant cost reductions in the production phase. Therefore, cost management in production stage can result in incremental gains. In fact, such incremental gains in the production phase may persist for some time and/or reflect in other products.

Furthermore, TC can also be extended towards suppliers (IOCM). IOCM practices is a set of activities that enable companies to manage the costs that go beyond their boundaries, i.e., is a strategic cost management practice that includes cost management among supply chain partners, going beyond traditional internal costs management (Coad and Cullen, 2006; Cooper and Slagmulder, 2004a and Fayard et al., 2012). Collaborative partnerships between companies can provide competitive advantages for the company and supply chain partners. These companies share cost information on the production and control of the products namely, about the materials and technology used as well as research and development (Cooper and Yoshikawa, 1994), in order to reduce costs in value chain and improve the strategic position of the companies involved in the collaborative process (Fayard et al., 2012). IOCM involves sharing sensitive information about costs, revenues and nonfinancial information (Wouters and Kirchberger, 2015).

IOCM practices represents an active involvement of two or more companies using together the combined resources associated with these activities for their mutual benefit. Fayard et al. (2014) argued that IOCM activities are the inter-organizational extension of internal cost management (ICM) activities, i.e., companies extend to their partnerships what they have been doing internally. Traditionally, TC has been an internal cost management technique but it was extended to involve partner companies. So, companies with a strong IOCM capability may have leveraged a strong ICM focus (Fayard et al., 2014). A strong ICM capability may be a necessary precondition to IOCM, because "companies that use ICM techniques extensively are able to leverage their expertise to use more IOCM techniques" and thus "a first step is to focus on sound, fundamental ICM practices, which then can naturally evolve across company boundaries into IOCM practices" (Fayard et al., 2014, p. 8).

Clients can benefit from involving suppliers early in the development process, rather than working

independently when it comes to optimize the time-to-market of new products, product quality, development cost, and product cost. So, supplier involvement in NPD can help the client to gain new competencies, share risks, move faster into new markets and conserve resources (Wagner and Hoegl, 2006). The cooperation among supply chain members implies the early involvement of major suppliers in product development forcing an IOCM.

Cooper and Slagmulder (2004a) identifies three IOCM techniques: functionality–price–quality (FPQ) tradeoffs, inter-organizational cost investigations and concurrent cost management. The first resolves relatively minor cost overrun problems and involves only modest specification changes. The second is applied when FPQ trade-offs were unable to produce the desired level of cost reductions and involve more intense interactions and more significant changes both to the design of the outsourced item and to the specifications of the end product. The third is addressed to cost problems that demand the most significant cost reduction. In this case, there are intense interactions between the buyer's company and the supplier that leads to significant changes in both the buyer's product and the outsourced components.

The sophistication level of cost accounting and budgeting systems tends to increase with a firm's size (Haldma and Lääts, 2002). Management accounting sophistication is positively associated with firm's size (measured by the number of employees) (Merchant, 1981).

RESEARCH METHODOLOGY

To collect empirical data, an expert panel was constituted. The expert panel was compounded by 37 elements (academics, consultants and company collaborators). The worldwide group of experts has significant knowledge and experience in cost management and/or NPD.

It was developed a questionnaire in which the experts could give their opinion on NPD process, cost management in NPD, people, departments, and business partners involved in NPD process management and practices, as well as the tools and approaches used in this process.

In addition, 65 items were evaluated on a 7-point Likert scale. All items that did not reach consensus (IQR less than or equal to 1) were selected for the second round. The second questionnaire contained previous answers of each expert, as well as the Median and the IQR. Thus, in round 2, experts had to compare their previous answers with the median and the IQR of all responses obtained in round 1. In round 2 respondents were asked to confirm or to reconsider and change their previous answers. If their final response was outside the IQR, they were asked to justify their decision using the comments box of the corresponding group of questions.

RESULTS

This paper addresses and explores three key ideas on cost management in the product development process. First, it focuses on the importance and applicability of this domain to companies. Second, it extends this domain in three different perspectives. And third, it addresses various paths or strategies adopted by companies regarding such extended perspectives.

In fact, cost management in NPD is an important domain for companies to become more competitive and profitable.

"Cost Management will be in the future the unique way to assure that is possible to release new products because of the competition in the markets" (System Test Engineer and Testing Project Manager)

Furthermore, top management seems to play an important role in the adoption of cost management methodologies.

"Cost management is increasingly important given global competition. The trend will have to be to produce fast, with high quality and at lower cost. This depends on the coordination of a great working team and in our country, it depends on the "open minds" of the people involved in the top management of organizations" (Mechanical Engineer and Responsible of Production and Planning)

The results seem to indicate that "cost management in NPD" is more likely to occur from cost management to NPD than NPD to cost management. Cost Management Responsibilities see more interest in integrating these domains and therefore they have a stronger role in this process, leading to the integration of cost management tools in NPD. NPD Responsibilities have a weaker relationship in the role of cost management in NPD, i.e., they bring less cost management tools to NPD.

Moreover, some experts believe that few people are involved in cost management in NPD and seem to be desirable that:

... "cost management personnel should be embedded within product development teams to directly support the product development team to achieve the allocated cost target." (Professor and Consultant of new product development, design for manufacturability, design-to-cost, process reengineering, manufacturing management and cost management)

In addition, some experts indicate that cost management in NPD is developed in a very specific way in each company based on personal opinions of the participants involved.

"This kind of tools are not standard for any kind of industry, including the resistance of the people to use it." (R&D Process Integration Engineer)

Despite the cost management concept to be all the same in any industry or company, its application can be different in terms of practices, tools and approaches. Furthermore, the application in NPD is usually limited to large and multinational companies. However, some experts suggest that cost management is generally not a priority in firms that do not face a strong competition and have high profits.

"Cost Management is generally not a priority in organisations that have a sort of monopoly as long as they are earning a high profit" (Cost Accountant and Consultant)

Some expert consider that the tools could be easier implemented in small firms than in large or multinational firms, because large firms have already their own cost management standards in NPD and the acceptance of new models could put in cause their models developed along the years of their existence.

"I can't see how it will become easier given increasing globalization, increasing market uncertainty and competitive turbulence. I would expect it to get far harder" (Professor of Entrepreneurial Management, Entrepreneurship and Innovation)

"The awareness of the need for cost management and the methods and techniques in small enterprises in India is low. Hence, the application of these to NPD is limited to large companies and multinational corporations" (Cost and Management Accounting Professional)

Therefore, there are differences between small and large companies in the application of cost management practices. On the one hand, large firms have blocking forces to new types of management often due to already optimized costing systems and, therefore, they are more rigid to implement new cost management practices. On the other hand, small companies are more agile to implement these methodologies but lack knowledge that lead them to not know how to apply.

Given the relevance, recognition and applicability of cost management in the product development process, extended perspectives can be studied.

In this context, findings from the empirical data analysed suggest that cost management in NPD presents may be presented through three important extensions: (1) within the company; (2) over time; (3) within the supply chain. Within the company means across multiple departments (e.g. Top Management, Accounting and Finance, Innovation and R&D, Engineering and Technology, Product Design). Over time focuses on the extension of Target Costing (applied during the product design stage) to Kaizen Costing (used to reduce costs during the manufacturing stage). Within the supply chain focuses on cost management of

external activities, which occurs mainly with suppliers but also with clients.

The results indicate that cost management in NPD is more interconnected to the technical dimension (product design, engineering and technology) than to the management dimension (Table 1). In this context, domains related to product development such as design, engineering and technology seem to play a more interventive role in NPD than top management.

Table 1: Domains interconnected with cost management in NPD

	IQR	Median
Management and Finance	5-7	6
Marketing and Innovation	5-7	6
Product design	6-7	6
Engineering and Technology	6-7	6

In addition, the results indicate that IOCM can play a more important role in cost management than ICM (Table 2).

Table 2: Cost management approaches in NPD

	IQR	Median
Value engineering	5-6	6
Target Costing, DFMA&L, kaizen costing, Modular design and use of common components and processes	5-7	6
Inter-organizational relations and Functionality-Price-Quality (FPQ) trade-offs	6-7	6

The results of the Delphi study allow to conclude that cost management approaches in NPD are important, with emphasis on inter-organizational relations and Functionality-Price-Quality (FPQ) trade-offs (which characterize an IOCM) as it presents consensus among experts with an IQR between 6 and 7.

In addition, Cost Management in NPD seems to grow from inside to outside of the company (Fayard et al., 2014), but not necessarily from upstream to downstream of the NPD process. In fact, a company can only be mass-production, in which it adopts kaizen costing tools and later start developing products by adopting Target Costing tools. Fayard et al. (2012) and Fayard et al. (2014) argue that companies with a strong ability to manage internal costs may leverage their knowledge and experience to manage inter-organizational costs.

Therefore, the path of cost management in NPD can be from upstream to downstream or from downstream to upstream in the development process. The application and experience of internal cost management (ICM) tools can make companies to adopt more IOCM tools, i.e., solidified ICM can evolve beyond the boundaries of the company to IOCM practices (Fayard et al., 2012; Fayard et al., 2014). IOCM practices sometimes are described as "an inter-organizational extension of ICM activities, with the same planning and control

capabilities fundamental to ICM being applied to IOCM" (Fayard et al., 2014, p. 2).

Therefore, companies can follow several strategies, that is, there is no order or a defined path in which companies must follow. They can start by being TC intensive as KC or IOCM. As companies grow and develop their businesses, cost management can be extended in different ways. There is no rule or order that must be rigorously fulfilled and therefore each approach must be studied or adapted to each context in order to enhance the benefits for the company.

In fact, Rezayat (2000) refers that 60% to 80% of all components from Original Equipment Manufacturers (OEMs) are produced by suppliers. Indeed, nowadays, in global supply chains, most of the knowledge on the process belongs to suppliers and not to OEMs. So, when a new design is being conceptualized, the "manufacturing knowledge cannot be reused easily to address issues such as manufacturability and cost" (Rezayat, 2000, p. 299). This shows that OEMs are driven mainly by the philosophy of inter-organizational cost management. Therefore, there are intensive companies in Target Costing, others in Kaizen Costing and finally others in IOCM. Thus, cost management in NPD can be disseminated in a way that can have multiple directions.

CONCLUSIONS AND FURTHER RESEARCH

This paper focuses on the relevance, recognition and applicability of cost management in the product development process. It presents an extended perspective of this domain in three different dimensions and highlights various paths or strategies adopted by companies regarding such extended perspectives.

The awareness of the need of cost management in NPD in small companies is low in opposed to multinational and large companies. However, the implementation of cost management in NPD could be easier in small companies, once the others have already their own cost management, possibly developed over several years and therefore in multinational and large companies there is a smaller opening to accept new approaches and the implementation of new practices and tools.

In addition, cost management in NPD is more interconnected to the technical dimension than to the management dimension. These are two important dimensions within the company, with different levels of importance. In addition, the inter-organizational relations still seem to take on greater importance in relation to these two dimensions.

Furthermore, findings showed that Cost Management in NPD may be extended in three different dimensions. In this context, the following extended perspectives are presented: extension within the company and across multiple departments (vertical internal extension); an extension from Target Costing to Kaizen Costing or vice versa (a product life-cycle extension); external extension, which occurs mainly with suppliers but also

with clients (extension of Target Costing or Kaizen Costing to the downstream and upstream of the company). Moreover, results indicate that the external extension can have a more important role in cost management in NPD than the internal extensions (vertical and temporal) since it can provide significant cost savings for companies.

This research has some limitations which also reveal possible avenues for further research. Namely, a different research methodology can be adopted to collect the empirical data and the sample size could be larger. Also, in future work it will be important to study the level of efficiency and effectiveness of the adoption of different strategies of cost management by companies.

REFERENCES

- Afonso, P., Nunes, M., Paisana, A., & Braga, A. (2008). The influence of time-to-market and target costing in the new product development success. *International Journal of Production Economics*, 115(2), 559-568.
- Agndal, H., & Nilsson, U. (2009). Interorganizational cost management in the exchange process. *Management Accounting Research*, 20(2), 85-101.
- Barbosa, C., Afonso, P., & Nunes, M. (2013). Cost Management Practices in Collaborative Product Development Processes. In *Advances in Production Management Systems. Competitive Manufacturing for Innovative Products and Services* (pp. 494-501). Springer Berlin Heidelberg.
- Cao, M., & Zhang, Q. (2010). Supply chain collaborative advantage: A firm's perspective. *International Journal of Production Economics*, 128(1), 358-367.
- Coad, A. F., & Cullen, J. (2006). Inter-organisational cost management: towards an evolutionary perspective. *Management Accounting Research*, 17(4), 342-369.
- Cooper, R., & Slagmulder, R. (1997). *Target costing and value engineering*. Portland: Productivity Press.
- Cooper, R., & Slagmulder, R. (2004a). Interorganizational cost management and relational context. *Accounting, Organizations and Society*, 29(1), 1-26.
- Cooper, R., & Slagmulder, R., (2004b). Achieving full-cycle cost management. *MIT Sloan Management Review*, 46(1), 45-52.
- Cooper, R., & Yoshikawa, T. (1994). Inter-organizational cost management systems: The case of the Tokyo-Yokohama-Kamakura supplier chain. *International Journal of Production Economics*, 37(1), 51-62.
- Dekker, H., & Smidt, P. (2003). A survey of the adoption and use of target costing in Dutch firms. *International Journal of Production Economics*, 84(3), 293-305.
- Ellram, L. M. (2002). Supply management's involvement in the target costing process. *European Journal of Purchasing & Supply Management*, 8(4), 235-244.
- Ewert, R., & Ernst, C. (1999). Target costing, co-ordination and strategic cost management. *European Accounting Review*, 8(1), 23-49.
- Fayard, D., Lee, L. S., Leitch, R. A., & Kettinger, W. J. (2012). Effect of internal cost management, information systems integration, and absorptive capacity on inter-organizational cost management in supply chains. *Accounting, Organizations and Society*, 37(3), 168-187.

- Fayard, D., Lee, L. S., Leitch, R. A., & Kettinger, W. J. (2014). Interorganizational cost management in supply chains: practices and payoffs. *Management Accounting Quarterly*, 15(3), 1-9.
- Filomena, T. P., Neto, F. J. K., & Duffey, M. R. (2009). Target costing operationalization during product development: Model and application. *International Journal of Production Economics*, 118(2), 398-409.
- Haldma, T., & Lääts, K. (2002). Contingencies influencing the management accounting practices of Estonian manufacturing companies. *Management Accounting Research*, 13(4), 379-400.
- Ibusuki, U., & Kaminski, P. C. (2007). Product development process with focus on value engineering and target-costing: A case study in an automotive company. *International Journal of Production Economics*, 105(2), 459-474.
- Kajüter, P. (2002). Proactive cost management in supply chains. In *Cost Management in Supply Chains* (pp. 31-51). Physica, Heidelberg.
- Kato, Y. (1993). Target costing support systems: lessons from leading Japanese companies. *Management Accounting Research*, 4(1), 33-47.
- Kee, R. (2010). The sufficiency of target costing for evaluating production-related decisions. *International Journal of Production Economics*, 126(2), 204-211.
- Lee, J. Y., & Monden, Y. (1996). An international comparison of manufacturing-friendly cost management systems. *The International Journal of Accounting*, 31(2), 197-212.
- Merchant, K. A. (1981). The design of the corporate budgeting system: influences on managerial behavior and performance. *Accounting Review*, 813-829.
- Monden, Y. (1995). *Cost Reductions Systems: Target Costing and Kaizen Costing*. Productivity Press.
- Rezayat, M. (2000). Knowledge-based product development using XML and KCs. *Computer-aided design*, 32(5), 299-309.
- Wagner, S. M., & Hoegl, M. (2006). Involving suppliers in product development: Insights from R&D directors and project managers. *Industrial marketing management*, 35(8), 936-943.
- Weil, R. L., & Maher, M. W. (2005). *Handbook of cost management*. John Wiley & Sons.
- Wouters, M., & Kirchberger, M. A. (2015). Customer value propositions as interorganizational management accounting to support customer collaboration. *Industrial Marketing Management*, 46, 54-67.
- Wouters, M., Morales, S., Grollmuss, S., & Scheer, M. (2016). Methods for Cost Management during Product Development: A Review and Comparison of Different Literatures. In *Advances in Management Accounting* (pp. 139-274). Emerald Group Publishing Limited.
- Zengin, Y., & Ada, E. (2010). Cost management through product design: target costing approach. *International Journal of production research*, 48(19), 5593-5611.