Abstract
Target costing is a cost management technique that has been developed to be used mostly during early stages of product development, with the aim of reducing the final cost of the product, in order to obtain the expected profitability. In brief, it consists of a structured way of establishing the cost that must be achieved by the production of a product regarding its selling price and the expected profitability level. However, although these techniques have been widely used to support the product development process in the manufacturing industry, including organizations that claim to adopt a lean production approach, very little has been published of the use of target costing in the construction industry.
This paper present a case study carried out in a Brazilian construction firm that has been successfully using target costing to reduce the estimated cost of industrial and commercial projects. Results show the feasibility of target costing as a cost-planning tool during the early phases of construction projects.

Keywords
Cost management, cost information, production control, target costing, value analysis.

INTRODUCTION
According to Johnson and Kaplan (1987), traditional cost management systems fail to support decisions that affect the overall production result, because the available information from these systems is of little help to managers in their effort to improve production performance. Particularly in the construction industry, the gap between the information made available by traditional cost management systems and the goals set by the business is pointed as being one of the main problems that contribute for the poor performance of those systems (Barnes, 1977; Fine, 1982; Ostrenga et al., 1992). According to Barnes (1977) and Fine (1982), the inadequacy of cost management accounting systems has resulted in the dissociation between cost management and production management. Traditionally, construction cost control consists basically of monitoring actual performance against cost estimates and identifying variances. As a result, traditional cost control systems have been much more useful to manage contracts than production (Howell and Ballard,
Horngren et al. (1999) argue that cost management must not be isolated from other managerial functions, and should play a key role in the implementation of company strategies. Cost management systems should involve a set of processes required to ensure that a construction project is completed within the approved budget, including cost estimating, cost control and cost projection (Kim, 2002).

Uncertainty, variability, interdependence and complexity play a key role in the construction environment, and a major challenge for production management systems is to eliminate or to reduce the impact of those characteristics (Koskela, 2000). Moreover, the uncertainty related to the financial environment must also be considered, regarding the significant amount of capital required by construction projects (Barbosa and Pimentel, 2001). Cost management systems in construction must be dynamic, proactive and able to support different decision-making processes, in order to protect the business from the harmful effects of uncertainty, with the main objective of generating information to support decision-making, mainly concerned with cost reduction, value improvement and financial management. Therefore, an adequate cost management system is an essential step for any company to be competitive (Granja, Picchi and Robert, 2005).

This paper discusses the practice of target costing in the construction industry and presents the results of a case study carried out in a Brazilian construction firm that has been successfully using target costing to reduce costs and improve value in industrial and commercial building projects.

TARGET COSTING

Target costing has been widely used by some leading industrial companies with the main objective of reducing the final cost of the product in order to obtain the expected profitability while ensuring satisfactory quality levels (Maskell and Baggaley, 2003). It can be described as a systematic and structured way of establishing the cost and quality that must be achieved in the development of a product in order to reach the desired profitability (Cooper, 1995; Cooper and Slagmulder, 1997). Basically, it requires two main steps that are illustrated in Figure 1.

![Figure 1: Target costing main implementation steps (based on Cooper, 1995)](image)

As illustrated in Figure 1, the first step to implement target costing consists of establishing the target cost by subtracting the product’s desired profit margin from its expected selling price. Secondly, the target cost of the product is distributed to its components, materials or systems, depending on the segmentation criteria adopted.
From this perspective, cost is seen as an input and not as an outcome of the design process. According to Cooper and Slagmulder, 1997, the target cost becomes the focus of all designers and main suppliers, due to the fact that it establishes quantitative objectives. As a result, it creates a clear and powerful pressure for cost reduction in the company, involving the development of products that satisfy customers and are able to be manufactured under the established cost. Granja, Picchi and Robert (2005) state that the target selling price establishes an acceptable and reasonable price for the client, while the target profit defines the company needs. Besides that, target costing has also been pointed out as a powerful mechanism for interacting with key suppliers (Granja, Picchi and Robert, 2005).

According to an exploratory study undertaken by Dekker and Smidt (2003), several manufacturing companies around the world make widely use of costing techniques that are similar to target costing. Such techniques are known by a diversity of names, being adopted especially in assembling firms, under circumstances of intense competition and high environmental uncertainty. However, Maskell & Baggaley (2003) argue that most existing cost reduction systems do not provide consistent mechanisms that enable them to understand and reduce costs. This is due to either the lack of tangible definition of the sum that must be reduced, or the lack of analysis of the requirements that add value to the customers.

**Target costing in the construction industry**

Based on Ballard and Reiser (2004), target costing has been used to some extent in the construction industry, although details of that practice have not been well documented. The same authors suggest that there is an opportunity to expand and improve the use of this practice in construction by increasing the understanding of this technique in the industry.

Ballard and Reiser (2004) pointed out that the relationship between the manufacturer and its main suppliers is a major difference between construction and other industries, in terms of using target costing. According to the same authors, long-term relationships with even first tier supplier are rare in the construction environment. The influence of the first tier specialty contractors with their own suppliers tends to be greater with service providers than with product suppliers, who are often much larger than the specialty contractors, and is usually larger than the general contractor themselves (Ballard and Reiser, 2004). However, one of the most significant paradigm shifts of modern business management is that individual businesses no longer compete as solely autonomous entities, but rather as supply chain (Lambert and Cooper, 2000). For instance, Toyota has long-term relationship with its suppliers, including first, second and even third tier (Ballard and Reiser, 2004).

From a transaction-cost-economics perspective of the construction supply chain, Vrijhoef, Koskela, and Voordijk (2003) argue that there are three basic characteristics that must be regarded: asset specificity, uncertainty and frequency. According to them, during the pre-contract phase of construction projects, the asset specificity is low. However, it is high during the post-contract negotiations over variations and claims. As a consequence, during the pre-contract phase there is a narrow opportunistic behavior because the client can choose from many suppliers, contractors and architects. Therefore, as contracts are signed with a small number of parties, and due to the one-off nature of the work, these parties do not have to worry over their reputation. According to Granja, Picchi and Robert (2005), the rule of surviving in the rather competitive situation is that clients on one hand and main contract on the other, try to maximize their own benefits what?? resulting in a speculative culture in the construction sector.
Contracting uncertainty is related to the cost uncertainty, as well as the relatively high share of a project in the total turnover of the company (Vrijhoef, Koskela, and Voordijk, 2003). This may include projects conditions changes that cause cost fluctuations (low productivity, design changes, etc) (Granja, Picchi and Robert, 2005). Finally, due to ever-changing project coalitions and the use of market-based bidding procedures, the frequency of transactions between parties in the construction industry can be regarded as low. Thus, an opportunistic behavior, in order to obtain as much benefit as possible before the end of project can be stimulated by the temporary character of relations.

Besides the difficult relationship within the supply chain, Ballard and Reiser (2004) also point out challenges related to the use target costing in the design process. First, they question how the relevant specialists can be involved in the design process, in order to carry out an effective collaborative process. Secondly, they argue that making trade-off decisions between project characteristics is a difficult task. Thirdly, it is wondered how design decisions must be driven to achieve the target.

**CASE STUDY**

This case study was part of a research project that had as one of its main objectives the improvement of cost management systems in construction, resulting in a model for cost planning and control for construction projects. (Kern and Formoso, 2004; Kern, 2005). This case study consisted of the implementation of target costing as a cost planning tool for complex and dynamic construction projects during the design phase, in order to reduce the total cost and be able to produce competitive proposals for different industrial and commercial building clients.

The construction building company involved in this study has as its main market the construction and refurbishment of industrial buildings and hospitals. It is a firm that is strongly committed to the development and implementation of lean production principles and practices. In this context, it has successfully developed a production and safety planning and control systems, as well as has introduced some important innovations in the product development process. Since 2002, the company has been seeking to improve its cost management system because the directors had realized that some projects had not been successful due to inappropriately bidding prices. The cost estimating process used to be strongly based on traditional bills of quantities, produced by the cost estimating department with insufficient participation of production and contract managers. The case study was carried out during the development of the design for an industrial building refurbishment project carried out for a steel mill company. The complexity of this project was much related to the fact that this building was part of an industrial site that remained in full operation. Moreover, the project duration, including design development and building, was relatively short (six months). The client commissioned the architectural and structural designs, which were developed to the sketch design level. The building consisted basically of a reinforced concrete structure, roof steel structure and tiles, and brick walls.

The Construction Company took part in a competitive bidding, in which several other construction firms had participated. The construction firm decided to use target costing since the bidding stage. Figure 2 presents schematically the steps that have been adopted by the company to introduce target costing.
The target cost was initially based on a previous similar project and also on the available design. Based on this information the final price of the project was established, and the target cost resulted from the subtraction of the profit margin expected by the firm directors. After establishing the project target cost, directors and the contract manager (who had experience in similar projects) established the target-costs for the main subsystems involved and estimated the overhead costs with the support from the cost-estimating department.

Figure 2. The use of target-costing by the construction company

For the negotiation with subsystem suppliers, costs was estimated adopting unit prices, initially established for each of them, based in past information, e.g. foundation (m^3), reinforced concrete pre-cast structure (m^3), steel roof structure (m^2).

Once the project started and the main suppliers were contracted, the Construction Company started to make collaborative meetings in order to develop detailed design, involving both the client and suppliers. Those meetings were conducted once a week, during the first two months, managed by the constructor contract manager. They jointly develop design solutions and production methods, aiming to meet requirements from both the client and the production system.

RESULTS

The most important changes introduced in the project consisted of a new conception of the foundations, reinforced concrete structure and roof steel structure, resulting in a reduction of 9.85% of the total estimated costs, as shown in Table 1. The cost figures have been changed due to the confidentiality of this information, although the proportions between cost items have been kept.

The new conception of the roof structure resulted in a reduction of 37% of the steel weight: in the first design provided by the client, 160,00T of steel were needed, while in the new design this amount was reduced to 100,00T. The subsystem supplier, who was hired by the construction firm, played a key role in developing this new solution.
Also, some major changes were made in the concrete structure. The pre-cast concrete supplier proposed a different column modularization, increasing the beam span from 5 to 10 meters. This was possible because the total load was relieved by replacing external walls for structural tiles and using gypsum plasterboard for the internal walls, instead of ceramic bricks. Moreover, due to those changes, the foundation structure was also reduced.

Table 1. Total cost reduction from new engineering solution

<table>
<thead>
<tr>
<th>Description</th>
<th>Client design</th>
<th>New design</th>
<th>Cost reduction</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead costs</td>
<td>$ 61,11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preliminary</td>
<td>$ 53,54</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>services</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foundation</td>
<td>$ 56,98</td>
<td>$ 48,00</td>
<td>18,71%</td>
<td>Beams elimination</td>
</tr>
<tr>
<td>Concrete structure</td>
<td>$ 205,96</td>
<td>$ 174,49</td>
<td>17,96%</td>
<td>New modularizations: pillars elimination</td>
</tr>
<tr>
<td>Walls</td>
<td>$ 87,74</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete floor</td>
<td>$ 67,37</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windows/doors</td>
<td>$ 58,42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof</td>
<td>$ 475,32</td>
<td>$ 417,20</td>
<td>13,92%</td>
<td>New structure conception</td>
</tr>
<tr>
<td>Painting</td>
<td>$ 22,27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanitary installation</td>
<td>$ 9,85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>$ 1,098,47</td>
<td>$ 1,000,00</td>
<td>9,85%</td>
<td></td>
</tr>
</tbody>
</table>

From this case study, the construction firm decided to implement and use target costing during the early planning phase (before tendering) of future projects in a structured way, following the flowchart presented in Figure 3, that also describes tasks and responsibles.

Figure 3. Target cost flowchart to be followed by the construction firm
<table>
<thead>
<tr>
<th>Task</th>
<th>Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify requirements of different clients, including everyone involved</td>
<td>Managing directors, commercial manager, cost estimating manager</td>
</tr>
<tr>
<td>Establish the project target cost</td>
<td>Managing directors, commercial manager, cost estimating manager</td>
</tr>
<tr>
<td>Identify the resources that are needed and estimate direct cost</td>
<td>Cost estimating sector with support form production managers</td>
</tr>
<tr>
<td>Analise the estimated cost comparing it with the established target cost</td>
<td>Managing directors, commercial manager, cost estimating manager</td>
</tr>
<tr>
<td>Estimate the overhead costs and produce a technical proposal</td>
<td>Production manager and managing directors</td>
</tr>
<tr>
<td>Define the suppliers and negotiate with them</td>
<td>Managing directors, commercial manager</td>
</tr>
</tbody>
</table>

According to the Figure 3, managing directors, commercial manager and cost estimating manager must identify different requirements from the perspective of the client, the firm and the subsystems suppliers. The second task consists of establishing the target cost of the project, involving the same people. Afterwards, the cost estimating sector has to identify all the resources (or subsystems) needed to estimate the direct cost of the project. This task must be carried with help of production managers in order to take into account the demands of the production system, such as construction methods, capacity, durations, etc.

Once the direct costs are estimated, managing directors, the commercial manager and the cost estimating manager assess the estimated cost in relation to the established target cost. Then the directors and production managers estimate the overhead costs and produce a technical proposal, and invite the main suppliers.

An executive committee (formed by directors, the contract manager and the production manager) start negotiating with the suppliers in order to produce the final bid.

**CONCLUSION**
Differently from other target costing implementations presented by bibliography, both in in the construction industry and elsewhere, in this case study the introduction of this cost management technique started before the construction firm had chosen its main suppliers. In fact, the main suppliers were chosen after the contract was signed with the client. As a consequence, the first design analysis and the efforts to develop new solution were carried out by the firm solely. After the contracts were signed, the main suppliers and people from the construction firm worked together in order to improve the product development process, resulting in a total cost estimative reduction of 9.85%.

In this case, value analysis was not properly applied. The new solution developed were focused in cost reduction, not so much in value improvement. Those solutions were concerned with mostly changes in the concrete structure and cladding. Further investigation on the joint implementation of target-costing and value analyses in construction projects is necessary.

According to the contract manager of the construction company, the main difficulties of using target costing and value analysis during the early stages are: (a) reliable cost estimates are hard to obtain due to the very short time available and the lack of historical data; (b) integrating some suppliers at the early stages of the project is hard; (c) there is not enough time to capture customer requirements during the cost estimating process. Also, he also pointed out the difficulty of keeping the target cost after the contract is established since the client tends to increase their demands in terms of requirements to be fulfilled but there is a limit budget.

Moreover, cost reduction efforts may also be undertaken after the design phase (Kern and Formoso, 2004; Granja, Picchi and Robert, 2005). In this context, the combined use of target and kaizen costing should be properly investigated through case studies, regarding cost management as a process that involve different phases of a construction project.

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