

GUIDELINES FOR CONCEPTION, IMPLEMENTATION AND USE OF PERFORMANCE MEASUREMENT SYSTEMS IN CONSTRUCTION COMPANIES

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ABSTRACT

Despite recent efforts carried out by academics and the growing interest from construction sector associations to disseminate performance measurement concepts and practices, the use of performance indicators is not systematic in most construction companies. The lack of adequate measures has been pointed out as a major difficulty for establishing performance measurement systems in those companies.

This article describes some results of a research project that aims to propose some guidelines to the conception, implementation and use of performance measurement systems. Such guidelines emphasise the need to establish a link between performance measurement and firms' competitive strategies, as well as the effective insertion of measures into the management of critical processes. This research project is based on five case studies carried out in medium and small sized companies from the Metropolitan Region of Porto Alegre, State of Rio Grande do Sul, Brazil.

This paper focuses on the framework that was proposed to establish performance measures aligned with the firm's competitive strategy. It identifies a number of best practices and improvement opportunities related to the conception and implementation of such systems.

KEY WORDS

Performance measurement, strategies, process management, best practices

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INTRODUCTION

Performance measurement is an essential element in the management of construction companies. It provides the necessary information for process control, and makes it possible to establish challenging and feasible goals. It is also necessary to support the implementation of business strategies.

Despite the importance of performance measurement, it has not been widely implemented in the construction industry. Many managers still make decisions based mostly on their intuition and common sense, and on a few broad financial measures, which are inadequate in today's competitive environment. This problem has also been observed in other sectors (Berliner and Brimson, 1988; Kaplan and Norton, 1992). Due to this problem, several frameworks have been proposed to support the development of performance measurement systems, focussing mostly on establishing a balanced set of measures. For example, Keegan et al. (1989) proposed a balance between internal and external measures and between financial and non-financial measures. Lynch and Cross (1995) devised a pyramid of measures that integrates performance measurement throughout the hierarchy of the organisation. Kaplan and Norton (1992) proposed a performance measurement framework associated to four strategic perspectives, named Balanced Scorecard, which has become known throughout the world.

These frameworks are usually multi-dimensional, in the sense that they focus on a broad set of both financial and non-financial measures and are concerned with different managerial levels. They provide mechanisms for facilitating the alignment of performance indicators to both the company strategic objectives as well as for linking them to key managerial processes. However, very little has been published on the effectiveness of such frameworks. Besides, none of them consider the needs of project-based industries, such as the construction industry.

In Brazil, there is growing concern with performance measurement in the construction industry for several reasons: (a) many companies have been involved in the development of quality management systems based on quality award criteria or on the ISO9001 standard, due to demands of public and private clients; (b) traditional measures used in production management, such as productivity rates, do not support decision making in the current business environment; and (c) companies need measures that can be used by the sector as a whole so that they can do benchmarking.

This article proposes some guidelines to the conception, implementation and use of performance measurement systems. Such guidelines emphasise the need to establish a link between performance measurement and the firm's strategy, as well as the effective insertion of measures into the management of critical processes. This study was based on five case studies carried out in medium and small sized companies from the Metropolitan Region of Porto Alegre, State of Rio Grande do Sul, Brazil. It identifies some best practices in the conception and implementation and the potential improvement opportunities for construction companies. This project is the continuation of a long term research and development program, carried out at the Building Innovation Research Unit (NORIE) at the Federal University of Rio Grande do Sul, named SISIND (System of Quality and Productivity

Indicators for the Construction Industry), which was previously discussed at IGLC (Lantelme and Formoso, 2000), and elsewhere (Formoso and Lantelme, 2000).

RESEARCH METHOD

The case studies were carried out in five construction companies (Table 1) from the metropolitan region of Porto Alegre, State of Rio Grande do Sul. The selection of these companies was based on three requirements: (a) there was a fairly good performance measurement system; (b) favourable conditions for making the company competitive strategy explicit, and (c) interest in participating in this research study. Each case study was divided into two main phases: (a) the evaluation of the company existing performance measurement system, and (b) the proposal of improvements in the measurement system. The evaluation of the performance measurement system involved the discussion and formalisation of the company strategy, the identification of the performance measures used by the company and the critical analysis of the performance measurement system.

Table 1: Description of the companies involved in the case studies

Company	Main Activity	Main Characteristic	People involved in the study
A	Development and construction of low income house building projects, construction of commercial and industrial for private clients	Medium company. All labour subcontracted. ISO 9002 certification. Performance measurement system started in 1997, related to the employee reward program and critical processes. There was a previously formalised strategic plan	Three top managers and a corporate strategy consultant
B	Development and construction of residential buildings for higher middle class in Porto Alegre	Small family company. All labour subcontracted. Participated in Quality Awards since 1996. Competitive strategy was previously formalised. Performance measures were linked to strategies	The quality director
C	Development of residential building projects for higher middle class in Porto Alegre	Development of residential buildings for two years. No formal strategic plan. Performance measurement system had only financial and production control measures	The company top manager
D	Development and construction of residential buildings for higher middle class in Porto Alegre	Small family company. Most labour subcontracted. ISO 9002 certification. Performance measurement system started in 2000, due to employee reward program.	Two top managers and the quality co-ordinator
E	Development and construction of commercial and industrial buildings for private clients	Medium sized company. All labour subcontracted. ISO 9002 certification. Performance measurement system started in 2000, strongly related to the production planning and control system. There was a formalised strategic plan.	The finance director, the quality co-ordinator, and a project manager

FORMALISATION OF THE COMPANY STRATEGIES

The discussion and formalisation of the company strategy was carried out by the top managers of each company at a number of meetings, which were facilitated by the research team. The formalised strategy was a combination of the strategy that the company had been implementing (realised strategy) and what the top managers would like the company to be (intended strategy).

A fairly simple tool named **strategy mapping** (Figure 1) was used at the meetings. On this map, the company strategies were grouped into five functional strategies: financial,

human resources, manufacturing, product development and marketing. A functional strategy specifies how that function will support the desired competitive advantage and how it will complement the other functional strategies (Wheelwright, 1984).

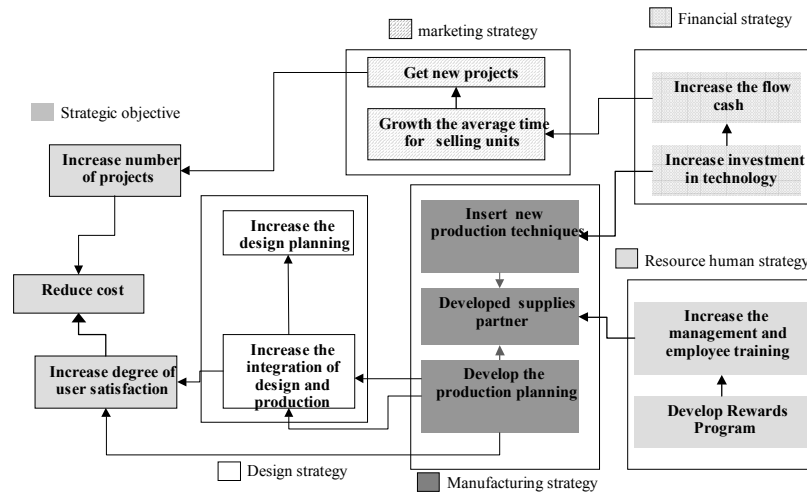


Figure 1 – Example of strategy map

The marketing strategy is concerned with the needs of the customer and the company's ability to satisfy them. This strategy allows the strategists to identify market opportunities and to use the potential of the company to achieve the competitive advantage. A marketing strategy is composed of several interrelated elements: market selection, product planning, distribution system, communications and pricing (Kotler and Armstrong, 1998; Corey, 1992).

The human resources strategy is related to the contribution of the human resources strategies in the achievement of the main organisation objective, and simultaneously to provide and stimulate the individual objectives of the employees (Chiavenato, 1998). It is focussed on the typical human resource management activities, such as employee admission and dismissal, training, rewards and performance evaluation.

The financial strategy is related to the way the strategic accounting plan can be achieved and how it contributes to the firm's competitive strategy. It is focussed on investments, working capital, debt, and finance sources (Gitman, 1997).

The manufacturing strategy is related to the behaviour profile of the organisation in the production process, such as facilities, capacity, technology, vertical integration, workforce, quality, production plan, organisation. This determines the capability of a production system. The manufacturing strategy specifies how the production system will operate to meet a set of production objectives that are consistent with overall strategic objectives (Platts et al., 1996).

Finally, the product development strategy was associated to the following pattern of decisions: technology management, design tools, and supply chain management.

By using strategy mapping, the relations and the logical sequence between the functional strategies and the corporate strategy, including its strategic objectives, were made explicit. Then, the performance measures were linked to both the functional and the organisational strategies.

FRAMEWORK TO CLASSIFY THE MEASURES

A framework was proposed to classify the existing measures into categories aiming to link them to the company's strategy and to the critical processes. It also makes it easier to understand the importance of each measure for the company and to identify gaps in the performance measurement system. The proposed categories are presented below:

Operational and strategic indicators: strategic indicators are those that enable the strategic goals to be established and monitored. The operational indicators are those that support decision making at the operational level. They should be consistent with the objectives and strategies of the company (Oliveira et al., 1995) (figure 2).

FUNCTIONAL STRATEGY	STRATEGIC INDICATORS	OPERATIONAL INDICATORS
Production <ul style="list-style-type: none"> Develop the production planning Developed supplies partner 	Number of accidents Performance evaluate of supplier	Attendant to NR 18 Check list 18 Percentage of Plan Completed
Design process <ul style="list-style-type: none"> Increase the design planning 	Lead time - design	Percentage of Plan Completed - design
Marketing <ul style="list-style-type: none"> Growth the average time for selling units 	Average time for selling units Degree of user satisfaction	Number of complaints
Resource Human <ul style="list-style-type: none"> Increase the management and employee training 	Degree of employee satisfaction	Number of hour of training
Accounting <ul style="list-style-type: none"> Increase the flow cash 	Return on investment Cost for administration	

Figure 2: Example of framework indicating strategic and operational indicators

Critical and supporting indicators: these two categories were introduced to identify the indicators that were related to critical processes. Critical processes are the ones that have a significant impact in the company success. Critical indicators support strategic decision-making. Supporting indicators are used to monitor processes that have a supporting role. These are necessary but should not exist in a large number (figure 3).

Collection's Responsible	CRITICAL MANAGERIAL PROCESS							
	Accounting	Marketing	Design Planning	Production Planning	Work safety	Suppliers	Client	People
Accounting manager	Return on investement							
Marketing manager		Average time					Degree of users satisfaction	
Design manager			Percentage of Plan Completed - Design					
Production manager				Percentage completed Plan construction	Attendant to the NR 18 check list	Supplier performance evaluation		
Human resource manager								Degree of employee satisfaction

Critical indicators Supporting indicators

Figure 3: Example of framework indicating critical and supporting indicators

Product and process indicators: each process must have measures related to the process itself and to the product that is delivered to the client. Both the product and the process indicators must consider whether the client requirements are being fulfilled (Hronec, 1993). Process measures are usually related to proactive measures while product measures are concerned with final results.

CONSTRUCTS FOR CRITICAL ANALYSIS

Four constructs were established to undertake the critical analysis of the performance measuring system of each company. These are (a) measure definition; (b) alignment of measures to strategies; (c) insertion of measures into the company routine; and (d) learning achievement through measurement. Each construct was depicted into a number of variables, and for each of them the sources of evidence were identified.

BEST PRACTICES AND IMPROVEMENT OPPORTUNITIES

Table 2 presents a summary of the best practices and improvement opportunities that were identified in the five companies involved in the case studies.

Table 2: Summary of the critical analysis in the five studied companies

Constructs	Best practices	Improvement opportunities
Measure definition	<ul style="list-style-type: none"> • Most indicators are easy to understand. • Most indicators have been formalised (either due to the certification of ISO 9001 Quality Systems or the need for an employee reward program). 	<ul style="list-style-type: none"> • The team responsible for the data collection and analysis has not been well defined. • Lack of consistency between the objective of the indicator and the information provided. • Too many measures in relation to the organisation structure. • Key performance indicators have not been properly defined.
Alignment of measures to strategies	<ul style="list-style-type: none"> ▪ Some measures are linked to the critical processes. ▪ Employee reward programs have encouraged the selection of the measures and the targets that should be achieved. 	<ul style="list-style-type: none"> ▪ Most measures are not clearly linked to strategies. ▪ Targets for the measures are difficult to establish. ▪ Measures are seldom used in strategic decision-making. ▪ Few indicators have been used for benchmarking
Insertion of measures into company routine	<ul style="list-style-type: none"> ▪ In general, data collection has been systematic for production control and accounting measures. ▪ Some production and accounting measures have been supporting decision making. ▪ Most systems are decentralised. 	<ul style="list-style-type: none"> ▪ Measures are seldom used in decision-making at middle and low managerial levels. ▪ Some indicators have not provided the information that are demanded by users. ▪ Data collection has not been automated. ▪ Information Technology is not used to build an integrated database. ▪ Data are not easily available to the users.
Learning achievement through measures	<ul style="list-style-type: none"> ▪ Insertion of new indicators or proposal to change them. ▪ Process improvement through the use and control of measures 	<ul style="list-style-type: none"> ▪ Improve the use of information to support decision-making ▪ Provide fast feedback to process management.

Some companies had too many measures, most of them related to supporting processes. For example, company B had several human resource management and social accountability measures, mainly due to the demands of its Quality Programs rather than because those

measures were related to their critical process. Some human resource management measures, such as labour turnover and accident rate are much simpler to collect than, for instance, design and production measures. For that reason they tend to be popular among construction companies (Formoso and Lantelme, 2000). However, **if the number of measures is too high, it may be difficult for the company staff to understand what should be the priority**. This also wastes company resources in data collection and processing. According to Lingle and Schiemann (1999), the number of metrics is less important than the process used to produce them and the focus must be on linking measures to strategic capabilities, market place needs and customer expectation.

In both Company A and Company D, the **development of an employee rewards program had a positive effect on the performance measurement system**. This type of program requires the measures that are the basis for rewards to be linked to strategies and key processes. It also tends to favour the decentralisation of data collection and processing, since the company staffs become more interested in monitoring and improving performance.

In general, **the development of quality management systems has also encouraged companies to develop performance measurement systems** - this is a major requirement in the ISO9001:2000 standard and also in several quality awards. Companies should not only have their performance measures but also be able to compare them to other companies' measures.

Regarding the alignment of measures to strategies, three of the companies investigated had a formalised strategic plan. Both Company A and Company B had systematically evaluated whether their strategies had worked by comparing measures to the established targets. By contrast, Company E had formalised its strategy, but the measures were not clearly aligned to the strategies. For that reason, the existing measures did not support strategic decision-making. This problem was observed in Company C and Company D, which had only an implicit strategy. **The lack of alignment of measures to strategies is bound to happen in most companies in the construction sector**, since most of them have difficulties in clearly stating their strategic objectives. According to Barros Neto (1999), a major cause for this problem is the fact that construction managers are not properly trained for strategic thinking.

With regards to the insertion of measures into the company's routine, the existing performance measurement systems presented several drawbacks. There were several measures that did not provide the necessary information for decision-making about the critical processes. Another problem was that information was not available when needed. Therefore, the inadequate design of the measures is one of the main problems identified in the study. Another problem was the **very modest use of information technology in data collection and processing**. Only Company D used information technology to automate most of the work involved in data collection and processing. However, there were several independent information systems - for instance, production control, financial control, and customer servicing - that were not integrated.

Despite the lack of alignment of measures to strategies and the limited use of such measures to support decision-making, **all companies have recently attempted to assess whether the measures meet the needs of their users**. Furthermore, they have changed or incorporated new indicators to improve the quality of the information provided. In fact, it is

necessary to increase the effort related to data analysis and dissemination, in order to support managers' decision making.

Table 3 presents a general analysis of the performance measurement systems in companies A, B, C and E. This analysis was not carried out in company D, because its performance measurement system was not sufficiently structured for it.

Table 3: Analysis of companies' performance measurement system

Constructs	Variable	High Satisfaction	Regular	Low satisfaction
Measure definition	Adequate procedure for data collection, processing and analysis.	A, B, C, E		
	Consistency between the objective of the indicator and the information provided.	C, E	A, B	
	Easy data collection and understanding.	A, B, C	E	
	Definition of the team responsible for data collection, processing and analysis.	B, C		A, E
Alignment of measures to strategies	Use of measures to monitor and control the critical process.	A, C, E	B	
	Use of measures in strategic decision-making.	C	A	E
	Establishment of targets for measures.	B	A, C, E	
	Use of measures for benchmarking.	B		A, C, E
Insertion of measures into company routine	Decentralisation of collection, processing and data analysis.	C	A, E	B
	Use of measures for middle and low managerial level decision-making.		A, B, C, E	
	Measure cost-effectiveness	C	B, E	A
	Effective communication and dissemination of results.	C	A, B	E
Learning achievement through measures	Improvement in the process through the use of indicators.	A, E, B	C	
	Regular improvement of the measurement system.	A, B, C, E		
	Reflection about results.	A	B, C, E	

Some of the difficulties in the implementation of performance measurement were related to the fact that construction is a project-oriented industry. Although there may be several repetitive processes from one project to another, each project is unique in terms of design, site conditions, organisational structure, and supply chain. For that reason, some additional problems exist:

- Establishing a project's performance measurement system and incorporating the measures into the company's routine require a fairly intense effort. If the company is involved in a wide range of different project types, it is likely that a different performance measurement system will have to be designed at the beginning of each project;
- The responsibilities for data collection, processing and analysis must also be well defined at the beginning of the project;

- Each project usually has a different managerial team and the use of measures will depend on the capacity and involvement of each manager;
- Due to the large number of stakeholders and components, some of them with a diverse level of quality, it is difficult to establish measures, especially the ones related to quality.

PROPOSALS FOR IMPROVING PERFORMANCE MEASUREMENT SYSTEMS

Three kinds of improvements were made:

- The company had a relevant indicator in its system, but there was no systematically data collection and control. Therefore, it was necessary to **improve the implementation**;
- The improvement in the measurement system depended on the **insertion of the indicator in the managerial process** which was part of the company's routine;
- The improvement in the measurement system depended on the **introduction of changes in the managerial process** – for instance, the implementation of a new production control system.

Table 4 presents suggestions of some indicators for each company, indicating how the measure could be inserted in each system.

Table 4: Proposals for improving the performance measurement systems

COMPANY	Improve the implementation	Incorporation in the managerial process	Changing in the process
A	<ul style="list-style-type: none"> • Relation between the number of accidents and total man-hours input 	<ul style="list-style-type: none"> • Forecast of project delay • Activity rate deviation • Attendant to the NR 18 check list • Effectiveness of training provided by company 	
B	<ul style="list-style-type: none"> • Attendant to the NR 18 check list 	<ul style="list-style-type: none"> • Forecast of project delay • Effectiveness of training provided by company 	<ul style="list-style-type: none"> • Non conformance in critical activities index
C	<ul style="list-style-type: none"> • Attendant to the NR 18 check list 	<ul style="list-style-type: none"> • Forecast of project delay • Degree of stakeholders satisfaction • Effectiveness of training provided by company 	<ul style="list-style-type: none"> • Percentage of plan completed
D	<ul style="list-style-type: none"> • Percentage of plan completed 	<ul style="list-style-type: none"> • Degree of users satisfaction • Supplier evaluation 	<ul style="list-style-type: none"> • Number of complains from users in relation to total number of units delivered
E	<ul style="list-style-type: none"> • Attendant to the NR 18 check list • Percentage of plan completed for design 	<ul style="list-style-type: none"> • Relation of hours of training provided by company and the number of employees 	<ul style="list-style-type: none"> • Non conformance in critical activities index • Effectiveness of training provided by company • Percentage of irregular delivery of material

GUIDELINES FOR THE CONCEPTION, IMPLEMENTATION AND USE OF PERFORMANCE MEASUREMENT SYSTEMS

Based on the literature review and on the case studies' results, a set of guidelines to conceive, implement and use performance measurement systems was proposed.

CONCEPTION OF PERFORMANCE MEASUREMENT SYSTEMS

The first step to devise a performance measurement system is to understand the company's competitive strategy, since the organisation needs to define the business objective and goals to be pursued. Besides, it is necessary to establish when the results have to be achieved. These are the guidelines related to the competitive strategy:

- Definition of strategic objectives and goals, functional strategies related to the company and projects;
- Establishment of a logical relation between the functional strategies. This explains how each function will support the desired competitive advantage and how it will complement the other functional strategies;
- Use of tools to allow the strategic objectives and goals to be visualised and communicated to the company's directors and staff. It is important to provide transparency for the links between the measures and critical process, aiming to improve the efficacy of the strategic control.

The identification of the critical processes is another important stage, since there must be a priority in performance measurement based on those processes that are essential for the success of the company. These are the guidelines concerned with process management:

- Definition of key and supporting processes for the company and projects;
- Use of tools to allow the visualisation and communication of those processes for the company staff;
- Identification of the role of the people involved in the measuring process.

The definition of measures plays a crucial role in the conception of the company's performance measurement system. It is necessary to clearly define the necessary measures and their objectives. These are the guidelines related to the definition of measures:

- Selection of strategic and operational measures linked to the strategies which can assess whether the goals are being achieved;
- Selection of product and process measures to both process control and customer satisfaction evaluation;
- Definition of measures in terms of data needs, data sources, data collection and processing procedures, and data storage and retrieval (Sink and Tuttle, 1993);
- Selection of measures that are objective, simple, easy to understand, pro-active, and provide relevant and timely information and accurate feedback (Neely et al, 1997);

- Establishing a mechanism for internal and external comparison of the company's performance in key business activities. This makes it easier to learn lessons from other companies and to establish improvement targets (KPI, 2000; CDT, 2002).

IMPLEMENTATION OF PERFORMANCE MEASUREMENT SYSTEMS

It is important to devise a framework to evaluate and control the implementation of the performance measuring system. These are the guidelines related to the implementation:

- The company strategy and measures should be clearly communicated to all company managerial levels, aiming to increase the efficacy of goal achievement;
- A suitable environment and culture for measurement must be developed. This involves changes in leadership, an information sharing policy and the development of self-evaluation practices (Schiemann and Lingle, 1999);
- Formal moments defined at specific work times should be established in order to properly evaluate the results and develop plans (Lantelme and Formoso 2000);
- Individual and team education and training related to the meaning of the information and how it should be used (Manoochehri, 1999);
- Managers' participation, involvement and motivation to perform systematic data collection and analysis, seeking to understand what is going on in the project and what can be done to improve its performance;

USE AND UPDATING OF PERFORMANCE MEASUREMENT SYSTEMS

In order to use measures effectively it is necessary for the people involved to develop a critical sense about the information provided for the measures. These are guidelines for using and updating the measurement system:

- Identification of the information flow needed for decision making in order to improve the information access and sharing;
- Development and implementation of information systems that integrate data from different departments and projects, building a unique data base of measures;
- Development of mechanisms to review and update strategies measures and goals.

FINAL COMMENTS

This article presents a contribution about the conception, implementation and use of a performance measurement system in construction companies, emphasising the alignment of measures to the company's competitive and functional strategies and the insertion of measurement into the management of the critical process. The current stage of performance measurement observed in the case studies indicate that, despite the existence of measurement systems and the interest of their managers, they are largely ineffective. First of all, the top managers did not have a clear understanding of the real meaning and the objective of establishing a set of strategies. This contributed to the selection of inappropriate measures, most of them not linked to the existing strategies.

Another typical problem is related to the fact that data is often collected but these are not properly analysed and, consequently, are not used to support managers in decision making . In fact, the importance of data analysis is not clear to the companies. One of the main difficulties for managers is to define clearly the information flow for performance measurement, including the responsibilities for data collection, processing and analysis, and users' needs. From an academic point of view, it is necessary to investigate ways to improve the implementation and use of the performance measurement systems in construction companies. Based on the literature and on recent experiences in Brazil and other countries, it seems that the main barriers for the success of performance measurement are fairly similar. In this respect, it would be useful to create mechanisms for systematically exchanging experiences among research groups involved in this theme. For this reason, the authors have developed a web site to discuss and disseminate ideas about the theme. Those interested in participating in this initiative, please contact the first author of this paper by email.

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REFERENCES

- Barros Neto, J. P. (1999) "Proposal of a model to formulate manufacturing strategy for small construction companies". Ph.D, Administration Pos Graduation Course, Federal University of Rio Grande do Sul, Porto Alegre, Brazil. (in Portuguese)
- Chiavenato, I. (1999). "Management human resource". Rio de Janeiro, Brazil: Campus. (in Portuguese)
- Corey, R. (1992) "Marketing strategy: an overview". *Havard Business School*. N. 17, nov, p. 1-19.
- Corporacion de Dearrollo Tecnologico (2002). "National benchmarking system for construction industry". Report. 1 ed. Santiago, Chile: CDT. (in Spanish)
- Formoso, C. T.; Lantelme, E.M.V. (2000) "A performance measurement system for construction companies in Brazil". *International Project Management Journal*, v. 6, n. 3, p. 54-60.
- Gitaman, L. J. (1997) *Principles of managerial Finance*. 10 ed., Hardcover.
- Hronec, S. M. (1993). *Vital Signs: using quality, time and cost performance measurement to chart your company's future*. Hardcover.
- Kaplan, R. S.; Norton, D. P. (1992) "The balanced scorecard-measures that drive performance", *Harvard Business Review*, January-February, p. 71-79, 1992.
- Kotler, P.; Amostrong, G. (1998). *Principles of marketing*. 9 ed. Hardcover.
- Lantelme, E. M. V., Formoso, C. T. (2000) "Improving performance though measurement: the application of lean production and organisatonal learning principles". In: *Eight Annual conference of the International Group For Lean Construction*, 2000, Brighton. Proceedings. University of Sussex.
- Lynch, R.L; Cross, K. F. (1995). *Measure up: yardsticks for continuos improvement*. 2.ed. Cambridge: Blackwell business.

- Manoochehri, G. (1999). "Overcoming obstacles to developing effective performance measures". *Work Study*. V. 48, n. 6, p. 223-229.
- Neely, A. et al. "Performance measurement system design: should process based approaches be adopted?" *International Journal Production Economics*. N. 46-47, p. 423-431, 1997.
- Oliveira, M.; Lantelme, E. and Formoso, C.T. (1995) "System of quality and productivity indicator for the construction industry: user manual". Porto Alegre, Brazil, SEBRAE/RS.(in Portuguese)
- Platts, K.W et al. (1996). "Evaluating manufacturing strategy formulation process". *International Journal of Production Economics*. N. 46-47, p. 233-240.
- Schiemann, W. A.; Lingle, J.H. (1999) *Bullseye! – hitting your strategic targets through high-impact measurement*. New York: The Free Press.
- Sink, D.S. and Tuttle, T.C. (1993) *Planning and measuring for performance*. Rio de Janeiro, Quality Mark. (in Portuguese)
- The KPI Working Group. (2000) *KPI Report for The Minister for Construction*, Londres: Department of the Environment, Transport and the Regions.
- Wheelwright, S. C. (1984). "Manufacturing strategy: defining the missing link". *Strategic Management Journal*, v. 5, p. 77-91.