ABSTRACT

Performance measurement is an essential element of business management. 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 construction firms and information on the performance of the construction industry as a whole is scarce. In the last few years, there have been some initiatives concerned with the establishment of performance measurement systems for benchmarking in different countries. This paper discusses three benchmarking initiatives that have been carried out in Chile, USA and UK. Also, two ongoing projects that aim to conceive and implement performance measurement systems for benchmarking in the Brazilian construction industry are briefly described. One of the initiatives will be used by both government and the industry to monitor the performance of construction companies involved in the Brazilian Program for Quality and Productivity in the Habitat (PBQP-H).

Keywords: Benchmarking, construction industry, performance measurement

INTRODUCTION

Since the early eighties, the dissemination of the Total Quality Management (TQM) philosophy in Western countries has encouraged many companies to develop and implement performance measurement systems. In fact, some of the basic principles of TQM are strongly related to the use of measures, such as: provide feedback based on actual data, build continuous improvement into the process, and encourage participation of employees in decision-making. This is why having an effective performance measurement system is a major requirement in the ISO9001: 2000 standard and also in several quality awards.

The application of the Toyota Production System (or lean production) concepts and principles in several industries has also contributed to the widespread use of performance measurements. In the Toyota Production System, measurement systems are strongly related to decentralised control. Measures are intensively used in the learning process at
the operational level, by helping the employees to see how they are performing, rather than simply to provide feedback data for the central control function. According to [Maskell and Baggaley (2004)], lean organizations should use simple and well-designed performance measurements to provide operational and financial control, to motivate people towards lean behaviour, to direct and initiate continuous improvement, and provide focus for decision-making and management direction.

However, the lack of performance measurement is a problem that affects the construction industry in general. This is related to a great extent to the attitude and lack of training of managers [Formoso and Lantelme, (2000)]. In fact, several companies measure and control a wide range of project variables, but only a few have performance measurement systems that provide key information for supporting decision-making [CDT, (2002)].

Moreover, some companies have too many measures; most of them related to supporting rather than critical process [Costa and Formoso, (2003)]. This tends to make it difficult for the company staff to understand what should be the priority and also to define the key indicators that should be used for comparison to other companies [Schiemann and Lingle, (1999)].

Performance measurement must shift from the traditional historical orientation, which looks only at the results and their main causes. Instead, the causes of the desired performance must be identified beforehand and then the measurement and control process that maintain these causes within prescribed limits can be designed [Maskell and Baggaley, (2004)]. This new focus is concerned with identifying goals and linking them to the critical factors required to achieve them.

An important role of performance measurement is to enable the company to do benchmarking. Benchmarking means comparing and measuring the organisation performance against other similar organisations in key business activities, and then using lessons learned from the best to make target improvements [KPI, (2000)]. It is an integral part of the planning and on-going review process to ensure a focus on the external environment and to strengthen the use of factual information in developing plans.

Besides, it is used to improve performance by understanding the methods and practices required to achieve higher performance levels [Camp, (1995)]. The general purpose of benchmarking as an evaluative tool to provide continuous learning for both the project manager and the project organisation are seen as challenges that need to be addressed more widely in the project management discipline [Barber, (2004)]. [Holloway et al. (1997)] point out the main difficulties for performing benchmarking: (a) lack of suitable partners for comparing information; (b) resource constraints, including time, money and expertise; (b) lack of data access transparency; (c) staff resistance; and (e) confidentiality of data.

In recent years, there have been some initiatives concerned with the establishment of performance measurement systems for benchmarking in different countries, such as Australia, Brazil [Formoso and Lantelme, (2000)], Chile [CDT, (2002)], Denmark [Byggeriets Evaluerings Center, (2002)], the UK [KPI, (2001)] and the USA [CII, (2000)]. Such initiatives typically aim to (1) offer some guidance for performance measurement, (2) provide some benchmarks that could be used by individual companies
to establish their business goals and objectives, and (3) identify and disseminate best practices in the industry.

The aim of this paper is to raise some key issues related to the use of performance measures for benchmarking in the construction industry, and identify some key factors on the effective design and implementation of such performance measurement systems. Moreover, this paper briefly describes two ongoing initiatives that aim to conceive and implement performance measurement systems for benchmarking in the Brazilian construction industry.

**PERFORMANCE MEASUREMENT SYSTEMS FOR BENCHMARKING**

Three initiatives carried out in other countries were investigated: (a) KPI - Key Performance Indicators from the UK; (b) National Benchmarking System for the Chilean Construction Industry; and (c) Construction Industry Institute Benchmarking and Metrics from the United States of America. Information about those initiatives was obtained in their web sites, from published papers, and also from interviews carried out with people involved in their implementation. The aim of this investigation was to provide some guidelines for the development of benchmarking initiatives in Brazil.

All three initiatives consist of benchmarking programmes that involve both the industry and the academic community. Their aim is to measure the performance of the sector, and to identify and evaluate best practices, through comparison of key performance indicators [Alarcón et al. (2001), KPI (2001), Construction Industry Institute (2003)].

The process of selecting the performance measures was distinct in each programme. The set of KPIs (United Kingdom) was the result of an initiative involving extensive reviews by a panel of experts and the publication of an initial report [KPI, (2001)]. In the case of the Chilean system, the selection was based on previous studies that included both literature review and empirical research [Alarcón and Serpell (1996), Grillo (1997)]. And, finally in the USA initiative, a committee involving both industry representatives and Construction Industry Institute (CII) staff was established for defining the critical performance measures to be used in practice. That committee also developed a strategic approach to CII's collection, analysis, and dissemination of industry data.

The set of performance measures is wide but some of them are common among the programmes, such as cost, time and safety (see table 1). This indicates that such initiatives could be potentially involved in some kind of international benchmarking scheme.

In the three initiatives a web-based online tool for entering and processing data was developed, and a strong emphasis is given to the confidentiality of data. Moreover, the existing softwares also support the analysis of project performance in relation to the benchmarks results, and provide tools for displaying graphically the comparative performance of the companies involved.
### Table 1 – Comparison among the Benchmarking Initiatives (UK, Chile and USA)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>KPI (United Kingdom)</th>
<th>CDT (Chile)</th>
<th>CHI Benchmarking &amp; Metrics (USA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagging</td>
<td>Client satisfaction*</td>
<td>Deviation of Cost by Project*</td>
<td>Project Cost Growth</td>
</tr>
<tr>
<td>Scope of measures</td>
<td>Defects*</td>
<td>Deviation of Construction Due Date*</td>
<td>Project Budget Factor</td>
</tr>
<tr>
<td></td>
<td>Predictability cost*</td>
<td>Change in Amount Contracted</td>
<td>Project Schedule Growth</td>
</tr>
<tr>
<td></td>
<td>Predictability time*</td>
<td>Rate of Subcontract</td>
<td>Total Project Duration</td>
</tr>
<tr>
<td></td>
<td>Profitability</td>
<td>Cost Client Complaints</td>
<td>Change Cost Factor</td>
</tr>
<tr>
<td></td>
<td>Safety</td>
<td>Efficiency of Direct Labour</td>
<td>Recordable Incident Rate (RIR)</td>
</tr>
<tr>
<td></td>
<td>Productivity*</td>
<td>Accident Rate*</td>
<td>Lost workday Case Incident Rate (LWCIR)</td>
</tr>
<tr>
<td>Leading</td>
<td>Effectiveness of Planning</td>
<td>Total Field Rework</td>
<td></td>
</tr>
<tr>
<td>measures</td>
<td>Urgent Orders</td>
<td>Factor Phase Cost Factor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Productivity Performance*</td>
<td>Phase Cost Growth</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(owner data only)</td>
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<tr>
<td></td>
<td></td>
<td>Phase Duration Factor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Construction Phase Duration</td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>Online software for users</td>
<td>Online software for users</td>
<td>Online software for users</td>
</tr>
<tr>
<td>issues</td>
<td>Benchmarking Club</td>
<td>Online software for users</td>
<td>Annual training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Outlined system (qualitative analysis)</td>
<td>Annual questionnaire for companies evaluation</td>
</tr>
<tr>
<td>Implementation</td>
<td>Availability of data and validity of</td>
<td>Commitment of companies Measures</td>
<td>Commitment of the companies</td>
</tr>
<tr>
<td>Difficulties</td>
<td>data</td>
<td>Standardisation</td>
<td>Implementation of improvement process based on</td>
</tr>
<tr>
<td></td>
<td>Do not offer opportunities for real</td>
<td>Continuous measurement</td>
<td>the findings from the benchmarking program.</td>
</tr>
<tr>
<td></td>
<td>time control</td>
<td>Keeping the project team</td>
<td></td>
</tr>
</tbody>
</table>

Note: * measures that could be used if measured during the process

Table 1 also presents some of the problems that have been identified in the benchmarking programs. Regarding the KPIs in the UK, the following difficulties have been pointed out:

- The KPIs are specific to projects and offer very little indication of the performance of the organisations themselves from a business point of view, apart from the customer perspective [Kagioglou et al., (2001)];
- It is important not only to use the right measures to measure the right things, but also to show the relationships between the different measures from a holistic viewpoint, since this is a way of identifying potential mechanisms for improvement [Kagioglou et al., (2001)];
- In general, the main difficulties in the whole process of the KPI programme are concerned to the availability of data and their validity [Kagioglou et al., (2001)];
- The most significant problem with the KPIs (in their current format) was that they do not offer opportunities for real time control. They are mostly designed to be used as
Performancemeasuring systemsfornumbering

Several companies in the benchmarking initiatives find difficult to start the implementation of measures, partly due to the lack of involvement of workers. Alarcón et al. (2001) suggest that the implementation should start gradually with a small set of performance indicators that are relatively easy to measure. This might facilitate the development of a measurement culture within the organisation, which will facilitate future implementation, then focused on critical processes.

The investigation indicated that some construction companies involved in those initiatives still have a limited view of benchmarking. They are simply interested in comparing their performance to other companies, especially from the same market segment. Such companies should see benchmarking as a source of new ideas, or route to improvement based on observed best practices. The information provided by benchmarking initiatives should enable a better understanding of the workings of business (their own or their competitors’), which could lead to improvement actions, instead of only being used for data comparison.

LESSONS LEARNED FROM THE INTERNATIONAL BENCHMARKING INITIATIVES

Based on the experiences of benchmarking initiatives in UK, Chile and USA, some key issues for the design and implementation of benchmarking systems were identified.

First, the set of measures for benchmarking should be simple and well designed in order to support improvement initiatives. The set of measures must give a holistic, company-wide view including a mixture of leading and lagging indicators [Beatham et al., (2004)]. The KPI and CDT programmes mostly involve lagging measures, based on outcomes. Such measures are important for accessing the success of strategies, but do not support improvement opportunities during the period for which the measure has been taken [Beatham et al., (2004)]. By contrast, the design of CII benchmarking system includes a set of performance measures that can be used during the whole life of the project.

The procedures for data collection should be also simple, aiming to facilitate the creation of the database and to make it simple to evaluate the project performance in relation to other projects in real-time. The three initiatives (KPI, CDT and CII) offer an online tool for the collection and evaluation of the benchmarking measures. For this reason, it is useful to design an interactive online tool, which allows the user to access an assortment of documents and provides feedback. [Beatham et al. (2004)] suggest that the online tool must also be used throughout the life of a project, aiming to offer to the companies the opportunity to analyse the results and to promote improvements. Another key issue of the implementation of the online benchmarking process is data confidentiality and security.

The lack of resources is particularly critical in small sized construction firms. According to [Hudson et al. (2001)], a strategic performance measurement system for small sized companies must be very resource effective and produce notable short-term results. It should also provide long-term benefits to help maintaining the momentum and
enthusiasm of the development team. In addition, it must be dynamic and flexible enough to accommodate strategic changes, which tend to be frequent in companies that have emerging strategies. For those authors, in practical terms, this means that the process should be iterative, in order to maintain the strategic relevance of performance measurement. Due to the problems raised above, construction companies should design their own performance measurement systems according to their strategy and capabilities, making sure that the set of measures are relevant and feasible. Therefore, different sets of measures used for benchmarking should be established for distinct market segment, based on the measures that are important for the companies that operate in each of them.

Finally, the benchmarking system must be fully understood by all people involved. Therefore, it is also important to promote training courses for the companies involved, including the communication of results, analysis of the evolution of the set of indicators, and the exchange of practices between practitioners, such as the ones promoted by the KPI and CII initiatives.

**PERFORMANCE MEASUREMENT SYSTEMS FOR THE BRAZILIAN CONSTRUCTION INDUSTRY**

The SISIND Project (System of Quality and Productivity Indicators for the Construction Industry) was established in 1993, involving the Building Innovation Research Unit (NORIE) of the Federal University of Rio Grande do Sul (UFRGS), the Association of Building Contractors of the State of Rio Grande do Sul (SINDUSCON/RS) and the Agency for the Support of Micro and Small Businesses (SEBRAE/RS). The aim of this initiative was to disseminate performance measurement concepts, principles and practices in the construction industry.

The SISIND Project has been focused on small sized construction firms, since they correspond to a very large percentage of the industry in Brazil both in terms of the number of companies and output. Initially a set of 28 performance indicators was devised for the residential and commercial building segment of the industry. Since the launching, several construction firms have joined the project and participated in training courses aimed at enabling managers to implement the proposed measures in their organisations [Formoso and [Lantelme, (2000)]. In spite of the interest and motivation showed by the construction companies involved in the project, only a relatively small number of them have been able to apply performance measurement in a continuous basis. Two previous studies carried out in Brazil [Formoso and Lantelme (2000), Lantelme and Formoso (2000)] have indicated that there are both organisational and behavioural barriers for the successful implementation of performance measurement systems in the Construction industry:

- Construction managers tend to look for short-time results when collecting data, and do not perceive the benefits of a performance measurement system that takes a relatively long time to be fully developed;
- Due to the lack of resources for data collection and processing, some construction companies tend to choose measures that are easy to collect, rather than the ones that provide the most valuable information. This can potentially result in measures that do
not support decision making properly, since they are not related to the company strategies and to its critical processes;

- Aligning measures and strategic objectives is made difficult by the fact that several companies do not have explicit and well-defined strategies.
- Some managers tend to look for whom or what is to blame for the existing problems, instead of thinking systemically about the process that generated the results and what could have been done to improve them.

A more recent study [Costa and Formoso, (2003)] identified other problems related to the lack of effectiveness of performance measurement systems in construction companies: (a) lack of definition of the team responsible for data collection, processing and analysis; (b) little use of measures in strategic decision making; (c) little use of measures for benchmarking; (d) centralisation of data collection, processing and analysis; (e) lack of cost-effectiveness analysis of measures; and (f) ineffective communication and dissemination of results.

Based on the experience of the SISIND Project, two initiatives have been established involving academic institutions, research funding agencies, industrial bodies and the Federal Government. The first one is the SISIND-NET Project, which involves the design and implementation of a performance measurement system for benchmarking construction companies from the State of Rio Grande do Sul. The main targets are: (a) devise a web-site for collecting and disseminating data, including a web based tutorial that can be used for training; (b) create a learning environment that will enable companies to share both qualitative and quantitative information related to their performance and best practices; and (c) promote workshops and training courses in different places in Brazil, aiming to disseminate and implement the set of measures.

Another initiative is the development of a performance measurement system for assessing the impact of Brazilian Program for Quality and Productivity in the Habitat (PBQP-H). This Programme aims to increase the performance of the construction industry in terms of quality and productivity, focussing on low-cost housing. It involves a wide range of actions, including the certification of quality systems, evaluation of innovative technologies, reduction of non-conformities in the production of building materials and development of new standards. This project will be carried out by a network of research institutions, coordinated by the Federal University of Rio Grande do Sul.

PRELIMINARY RESULTS OF THE SISIND-NET PROJECT

The first stage of the SISIND-NET Project is the definition of the set of measures that will be used for benchmarking. Eighteen construction companies from the State of Rio Grande do Sul have been involved in this initiative, most of them from the residential, commercial and industrial building markets. A schedule of meetings involving both representatives of the companies and members of the research team was established. In each meeting a sub-set of measures is discussed, including their objectives, formulae, and data collection and analysis procedures. Table 2 briefly presents the set of measures.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indicator Name</th>
<th>Formulae</th>
</tr>
</thead>
</table>

Table 2 – Set of measures of the SISIND-NET project
<table>
<thead>
<tr>
<th>Cost Case</th>
<th>Cost Deviation</th>
<th>Time</th>
<th>Time Deviation</th>
<th>Plan</th>
<th>PPC (Percentage of Plan Completed)</th>
<th>Client and product quality</th>
<th>Degree of Client Satisfaction (user)</th>
<th>Client and product quality</th>
<th>Degree of Client Satisfaction (owner)</th>
<th>Sales</th>
<th>Average Time for Selling Units</th>
<th>Sales</th>
<th>Contracting Index</th>
<th>Supply</th>
<th>Supplier performance (Sub contracted, material and design)</th>
<th>Safety</th>
<th>Ratio between the number of accidents and total man-hour input</th>
<th>Safety, health and environment</th>
<th>Construction Site Best Practice Index</th>
<th>Construction product quality</th>
<th>Non-Conformity Index in the unit delivery</th>
<th>Quality Management System</th>
<th>Number of Non-Conformity in audit</th>
<th>People</th>
<th>Degree of employee Satisfaction</th>
<th>Training Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Actual total project cost – Initial predicted project cost/ Initial predicted project cost) x 100</td>
<td>(Actual total project duration – Initial predicted project duration/ Initial predicted project duration) x 100</td>
<td>(Number of assignments 100% completed / Number of planned assignments) x 100</td>
<td>The indicator is obtained through the application of a questionnaire, in which the final customer marks their satisfaction level for each item (strongly dissatisfied, dissatisfied, nor satisfied nor unsatisfied, satisfied, strongly satisfied)</td>
<td>The indicator is obtained through the application of a questionnaire, in which the external client marks its satisfaction level for each item (strongly dissatisfied, dissatisfied, nor satisfied nor unsatisfied, satisfied, strongly satisfied)</td>
<td>(Number of units sold per month/ Number of units for sale) x 100</td>
<td>The indicator is obtained through the application of a questionnaire, in which the company marks its satisfaction level with each supplier (strongly dissatisfied, dissatisfied, nor satisfied nor unsatisfied, satisfied, strongly satisfied)</td>
<td>Number of accidents / Number of working hours x 10^6 (by month)</td>
<td>(Number of items complied in the checklist / Total number of applicable items form the checklist) x 10</td>
<td>(Number of non-conformities / Number of checks) x 100</td>
<td>Number of non-conformities</td>
<td>Number of non-conformities in audit</td>
<td>The indicator is obtained through the application of a questionnaire, in which the internal client marks its satisfaction level for each item (strongly dissatisfied, dissatisfied, nor satisfied nor unsatisfied, satisfied, strongly satisfied)</td>
<td>(Number of hours of training provided by companies / number of employees) x 100</td>
<td></td>
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</tbody>
</table>

The final version of the set of measures will be defined by the end of August 2004. After that a training course will be provided for the companies’ staff who will be involved in the implementation of performance measurement in the companies. In October 2004, the benchmarking process will start: data will be sent to the database by the companies, and meetings for exchanging information will be held every two months.

Form the academic point of view, the aim is to assess the benefits obtained by companies involved in the benchmarking initiatives. Recent experiences in benchmarking clubs around the world have indicated that knowledge sharing helps companies to accelerate the improvement process, as well as support the internal learning process. They have also enabled managers to clearly understand the good practices and changes that take place.
during the process improvement. However, further investigation is necessary to understand the learning process that result from such initiatives.

Simultaneously to the development and implementation of the benchmarking measures in the companies, two other investigations will be developed. The first one is concerning to the development and implementation of performance measurement systems in low-income housing projects. This research aims to (a) define the strategies and competitive priorities for the companies that operate in this market segment; (b) devise some guidelines for implementing performance measurement systems for this type of company; and (c) produce a database of performance measures for low-income housing projects. Two case studies are being developed in two of the companies that are involved in the SISIND-NET benchmarking initiative.

The second investigation is concerned with the development of a theoretical framework for performance management in construction companies. The aim is to improve the understanding of performance management in order to explain the success or failure of existing performance measurement systems, as well as the relationship among measures so that they can be used for organisational learning. The development of a theoretical framework will be achieved through extensive reviews of literature in general management and social disciplines, and the analysis of the implementation of good practices. The study will involve both qualitative studies, aiming to understand the underlying ideas of good practices, and quantitative studies, which will focus on the relationships among measures and the critical success factors that enable an effective performance improvement process. The data provided by the companies involved in the SISIND-NET project.

Both investigations intend to contribute to understand the barriers in the implementation of performance measurement systems for benchmarking, as well as the positive factors, which promote an effective use of the benchmarking measures and practices for the improvement of the companies, and the development of the sector.

**FINAL COMMENTS**

This article has presented a brief description concerning the current stage of performance measurement systems for benchmarking the have been devised in three different countries (Chile, USA and UK). The commonalities among these initiatives indicate that they potentially could be used for international benchmarking.

This investigation has pointed out some of the benefits, problems and limitations of the existing systems. The lessons learned have been used for devising two performance measurement systems for benchmarking in Brazil. A joint effort involving several agents is necessary for the successful development and implementation of PMS benchmarking programs. Such initiatives should not be limited to data collection, but also provide data analysis and training, as well as enable the exchange of good practices among the companies. Moreover, the set of measures should be assessed and revised periodically, according to the needs of the companies involved.

In Brazil, there are two ongoing initiatives in their very early stages of implementation. Both of them have created good opportunities for developing research on performance
measurement. A number of case studies will be carried out in construction companies, focussed on the implementation process. Also, a database of performance measures will be created, which can be used for quantitative analysis.

REFERENCES


