Design and Implementation of Performance Measurement Systems for Benchmarking in the Construction Industry

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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. The effective implementation of performance measurement systems is not simply a matter of selecting the right measures, but it also implies a much deeper change in decision-making and also in the learning approaches adopted in the organization. In the last few years, there have been some initiatives concerned the establishment of performance measurement systems for benchmarking in different countries. The objective of this paper is to describe the scope of those initiatives and discuss its potential role for benchmarking construction companies, specially those involved in the design and implementation of new operations management ideas. This investigation is focussed on four initiatives, carried out in Brazil, Chile, the UK and the USA. The paper concludes by proposing some further directions on this research topic.

Keywords: Performance measurement, benchmarking, construction industry

1. Introduction

Despite the importance of performance measurement, it has not been widely implemented in construction companies and information on the performance of the construction industry as a whole is also scarce. The lack of performance measurement is still 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 [1]. 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 [2].

Moreover, some companies have too many measures, most of them related to supporting rather than critical processes [3]. 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 [4].

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 [5]. This new focus is concerned with identifying goals and linking them to the critical factors required to achieve them.

However, the effective implementation of performance measurement systems is not simply a matter of selecting the right measures, but it also implies a much deeper change in decision-making and also in the learning approaches adopted in the organization.

An important role of performance measurement is to enable the company to do benchmarking. Benchmarking is a systematic process of investigation and learning of the performance against other similar organisations in key business activities. Then, lessons learned from the best practices should be used to establish improvement targets and to promote changes in the organization [6,7]. Benchmarking must be an integral part of the planning and on-going review process to ensure a focus on the external environment as well as to strengthen the use of factual information in developing plans [8].

The greatest benefits of the benchmarking process is the way that work gets done, rather than results, and the involvement of managers in the process [9]. Besides, it is used to improve performance by understanding the methods and practices required to achieve higher performance levels [8]. The general purpose of benchmarking is to encourage continuous learning for both managers and organisations, being used as an assessment tool [7]. Garvin [9] argues that the benchmarking process can promote a fertile source of ideas, but it only will occur in a receptive environment.

This environment can be created through Benchmarking Clubs, which involves a set of similar companies aiming to compare results and share practices. One of the propositions is that the benchmarking clubs have some similarities to communities of practices, which are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in a specific area by interacting on an ongoing basis [10].

The communities of practice are one mechanism, which involves the process of “Legitimate Peripheral Participation” [11]. This learning approach is broader than simply “learning by doing” or experiential learning, being also known “Situated Learning” [12]. According to Brown et al. [12], what the people pick up is a product of the ambient culture rather than of explicit teaching,
and this is called “process of enculturation”. For these authors, learning and acting are interestingly indistinct, learning being a continuous, life-long process resulting from acting situations.

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 [13], Chile [2], Denmark, the UK [6] and the USA [14]. Such initiatives typically aim to (a) offer some guidance for performance measurement, (b) provide some benchmarks that could be used by individual companies to establish their business goals and objectives, and (c) 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.

2. Initiatives of PMS for Benchmarking in the Construction Industry

Four initiatives were investigated: (a) KPI - Key Performance Indicators from the UK; (b) National Benchmarking System for the Chilean Construction Industry; (c) Construction Industry Institute Benchmarking and Metrics from the United States of America; and (d) Performance Measurement for Benchmarking in the Brazilian Construction Industry. 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.

2.1 Key Performance Indicators (KPI) in the United Kingdom

The KPI Programme was launched by the UK Best Practice Programme in 1998. This programme is supported by the government, through national and regional offices. Recently the Constructing Excellence body was created, which is the amalgamation of Rethinking Construction and the Construction Best Practice Programme (CBPP). The Constructing Excellence aims to achieve a step change in construction productivity by tackling the market failures in the sector and selling the business case for continuous improvement [15].

Four integrated programmes were created aiming to achieve the delivery of Constructing Excellence’ strategic objectives: (a) innovation, which aims to identify and promote tomorrow’s best practices; (b) productivity, which aims to improve the competitiveness of the UK construction industry; (c) best practice knowledge, which aims to create continuous improvement through the exchange of best practice; and (d) engagement, which aims to work with people, businesses and organisations to change the culture of the industry. These programmes are complementary and in each one there is a set of integrated programmes activities [15].
Nowadays the Key Performance Indicator (KPI) makes part of the Productivity Programme. The first set of KPIs was produced in November 2000, and the current set of KPI is based upon projects completed in 2002 [16]. The design of the first set of KPI was the result of an initiative involving extensive reviews by a panel of experts and the publication of a report. The set of KPIs is annually updated by the Construction Best Practice Programme [15].

For the implementation of the KPIs, companies receive a support handbook and guidance for measurement and access to an online software. The companies are responsible for collecting data, introducing them in the database, and for updating the project data. This software supports the analysis of the project performance in relation to the benchmarks. The companies involved can also access reports and wall charts, which contain graphs of performance (ranking curve and radar chart) for 10 key issues for construction such as client satisfaction, cost and time. The wall charts show the benchmark scores and allow an organisation’s score to be benchmarked against a large sample across industry.

A few hundred companies have been participating in Best Practice Knowledge Programme, on a voluntary basis for demonstrations projects. The companies present their projects, which are reviewed by a panel of experts. Two main reasons have encouraged these companies to enter the KPI programme: marketing of the company and the opportunity to improve their performance.

The companies involved can participate in a Benchmarking Club and are given access to information form all main Benchmarking initiatives, clubs and organisations that provide services to the construction industry [15]. Each Benchmarking Club is a forum for individuals to learn about the principles of best practices, while creating a culture and a local support network for supporting continuous improvement. The Clubs are local services, and each new Club is started by the drive and vision of a person or persons in the local construction industry [15].

### 2.2 National Benchmarking System for the Chilean Construction Industry

The National Benchmarking System was developed by the Corporation for Technical Development (CDT) of the Chilean Chamber of Construction, with the support of the Program for Excellence in Production Management of the Pontificia Universidad Católica de Chile (GEPUC). This initiative started in 2001. By comparing key performance indicators, the CDT hopes to identify best practices and generate short-term improvement opportunities for participating companies [2].

The selection of performance indicators was based on previous studies that included an extensive literature review and empirical research [17,18]. Initially, there were over 30 performance indicators that were analysed in several meetings involving company representatives. The indicators were later prioritised by the participants in a seminar with the purpose of reducing the number of indicators, based on the experience and needs of the companies. The aim of this
The initiative was to use this set of indicators to promote continuous improvement and benchmarking between companies [19].

The set of indicators is concerned with five sub-sectors of the Construction Industry: (a) high-rise building; (b) low-rise building; (c) civil works; (d) heavy industrial construction; (e) light industrial construction. For each sub sector, four main indicators were collected and analysed. By 2001, the National Benchmarking System of Chile had in its data base 120 projects provided by 22 Chilean companies. All companies are members of the Chilean Chamber of Construction and they have committed themselves to keep using the performance measurement system until the end of the project [2].

For the implementation of these indicators, the companies involved received a support guidebook and had access to computer software, which enables comparisons to be performed [2]. The National Benchmarking System use both quantitative and qualitative tools for data analysis, such as: (a) mean; (b) ranking curves; (c) radar graph and (d) tables displaying companies result. Also, a correlation analysis is carried out on the data using Pearson’s correlation, factor analysis and multivariate linear regressions [2; 20].

An evaluation system for managerial practices has been recently developed as an additional part of the Benchmarking initiative [20]. This system seeks to incorporate qualitative data to complement quantitative performance indicators. It compares managerial practices, identify relationships between performance data and determine industry trends.

### 2.3 Construction Industry Institute Benchmarking and Metrics

The CII Benchmarking and Metrics Programme started in 1993 [14]. It aims to provide performance norms to the industry, to quantify the use and value of best practices, and to help focussing CII research and implementation efforts. A committee of industry representatives working with the CII staff has developed its policy and is in charge of overseeing the execution of the program. This committee has defined critical performance measures that can be used in practice and developed a strategic approach to CII’s collection, analysis, and dissemination of industry data. The Benchmarking and Metrics Committee meets on a regular basis for continuous development and improvement of the program [21].

The first data collection of CII Benchmarking and Metrics was in 1996 and the current set of indicators was established in the fifth review, in 2000 [14]. The CII Benchmarking and Metrics program collects the project data as an ongoing process through its website. The web site has an easy-to-use interface and is designed to collect data over the life of a project [21]. Participants receive real-time evaluation on their projects’ performance using the web-based Progress Key Report.

Besides the web site and guides to support the implementation of the system, this program provides annual training to the Benchmarking and Metrics Programme company members,
aiming to improve the reliability of the benchmarking process [21]. The system is also used to analyse the impact of CII Best Practices on projects, but there is limited analysis or correlations on the management practices that might lead to improved project performance.

In January 2003, CII's benchmarking database had over 1100 projects from more than 70 CII owner and contractor companies, 11 ECI (European Construction Institute) companies and 4 BMPPs (Benchmarking Participants). This represents $55 billion in total construction cost. The projects are from the heavy industrial, building, light industrial, and infrastructure industry groups, with the majority representing heavy industry [21].

2.4 Performance Measurement System for Benchmarking in the Brazilian Construction Industry (SISIND-NET Project)

The SISIND-NET Project is a fairly recent initiative, initiated in April 2004, that has been developed by the Building Innovation Research Unit of the Federal University of Rio Grande do Sul (NORIE/UFRGS) and the Association of Construction Companies from the State of Rio Grande do Sul (SINDUSCON/RS), with the support of the National Council for Scientific and Technological Development. It involves the design and implementation of a performance measurement system for benchmarking in construction companies from the State of Rio Grande do Sul. Its aims 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.

The first stage of the SISIND-NET Project was the definition of the set of measures for benchmarking, based on the international experiences [14, 6, 2] and past studies in Brazil [22, 23]. Four criteria were considered in the definition of measures: (a) previous use of the measures by companies; (b) possibility of performing external comparison; (c) generic measure enabling the application in different projects context; and (d) mix of leading and lagging indicators. Several meetings involving both representatives of the companies and members of the research team were carried out for defining the set of measures. In each meeting a sub-set of measures was discussed, including their objectives, formulae, and data collection and analysis procedures. The final version of the set of measures was defined in the end of August 2004.

So far, 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, establishing the first Benchmarking Club in Brazil. A training course was provided for the companies’ staff involved in the implementation of performance measurement in the companies. In October 2004, the implementation process was started and the data began to be sent to the database by the companies. Currently, the companies are starting to share results and practices in the Benchmarking Club, through monthly meetings. A web-based online tool for entering and processing data will be available for companies until March 2005.
One important result of this initiative is the participative process that has taken place in the Benchmarking Club. Through the meetings, the companies have participated in decisions concerning the choice and definition of measures, including the negotiation of data collecting criteria. As a consequence, the representatives of the companies involved understand well the set of measures and now they are aware concerning the relevance of each measure for them. This is an improvement in relation to similar initiatives carried out in Brazil.

As a consequence, the preliminary assessment of the involvement of the companies in the SISIND-NET Project indicates that they perceive this as a favourable environment to introduce and internalise the use of performance measurement. This process has motivated the systematic data analysis, due to the companies’ interest of comparing performance and sharing practices with other companies in the same and different sectors.

In the following stages of this project, the research team intends to explore the learning opportunities provided by this initiative. This will be made by understanding the learning processes that is going on in the Benchmarking Club and also by the transfer of knowledge in a small group of construction companies. One of the main propositions of this study is that the process of learning of the Benchmarking Clubs can be motivated by using concepts of communities of practices, since it involves collective or collaborative learning in an informal manner. The potential of the Benchmarking Club for triggering managers’ knowledge as well as for promoting organizational learning will be investigated.

3. Lessons learned from the benchmarking initiatives

Based on the experiences of benchmarking initiatives in UK, Chile, USA, and Brazil some key issues for the design and implementation of benchmarking systems were identified. Firstly, this kind of initiative demands a joint effort from several organisations, such as government, construction clients, individual companies, research institutions, and industry organisations. In the construction industry there are a number of barriers, due to its peculiarities, such as (a) construction is a project-oriented industry, each project is unique in terms of design and site conditions; (b) establishing a project performance measurement system and incorporating the measures into the company routine require a fairly intense effort; (c) the responsibilities for data collection, processing and analysis, in general, are not well defined at the beginning of the project; (d) each project usually has a different managerial team and the use of measures will depend on the capabilities and motivation of each manager [3].

In general, the set of measures for benchmarking should be simple and well designed in order to effectively support improvement initiatives. The set of measures must give a holistic, company-wide view including a mixture of leading and lagging indicators [24]. Table 1 summarizes the main set of performance measures adopted in each of the four initiatives. Although all sets involve a wide range of measures, some of them are common among the programmes, such as cost, time and safety. This suggests that such initiatives could be potentially involved in some kind of international benchmarking scheme.
As it is shown in table 1, 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 the identification of improvement opportunities during the period for which the measure has been taken [24]. By contrast, the design of CII and SISIND-Net benchmarking systems includes a set of performance measures that can be used during the whole life of the project.

No measures related to suppliers’ performance, employee satisfaction, site management, and quality management were found in CII, CDT and KPI initiatives. As these were considered to be of major importance for the Brazilian companies they were included in the SISIND-NET initiative.

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 four initiatives (KPI, CDT; CII and Sisind-Net) offer an interactive online tool for the collection and evaluation of the benchmarking measures. Such a tool allows the user to access an assortment of documents and provides immediate feedback for the Benchmarking Club members. Beatham et al. [24] suggest that the online tool must be used throughout the whole life of a project, in order to create continuous opportunities to analyse the results and to promote improvements. Another key issue of the implementation of the online benchmarking process is data confidentiality and security.

One aspect that has not been sufficiently explored by any of the initiatives is the alignment of the benchmarking measures to the company strategy. Therefore, Benchmarking Club members should be encouraged to design their own performance measurement system according to their strategy and capabilities, making sure that the set of measures is relevant and feasible for them. According to Hudson et al. [25], a strategic performance measurement system for small sized companies must be very resource effective and produce notable short-term results. In addition, it must be dynamic and flexible enough to accommodate strategic changes, which tend to be more frequent in small sized companies, which tend to 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.
Table 1 – Comparison among the Benchmarking Initiatives (UK, Chile and USA)

<table>
<thead>
<tr>
<th>Scope of measures</th>
<th>KPI (United Kingdom)</th>
<th>CDT (Chile)</th>
<th>CII Benchmarking &amp; Metrics (USA)</th>
<th>SISIND-NET (Brazil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagging measures</td>
<td>Client satisfaction*</td>
<td>Deviation of Cost by Project*</td>
<td>Project Cost Growth</td>
<td>Cost Deviation*</td>
</tr>
<tr>
<td></td>
<td>Defects*</td>
<td>Deviation of Construction Due Date*</td>
<td>Project Budget Factor</td>
<td>Time Deviation*</td>
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<td></td>
<td>Predictability cost*</td>
<td>Change in Amount Contracted</td>
<td>Project Schedule Growth</td>
<td>Degree of Client Satisfaction (user)</td>
</tr>
<tr>
<td></td>
<td>Predictability time*</td>
<td>Rate of Subcontract</td>
<td>Project Schedule Factor</td>
<td>Degree of Client Satisfaction (owner)</td>
</tr>
<tr>
<td></td>
<td>Profitability</td>
<td>Cost Client Complaints</td>
<td>Total Project Duration</td>
<td>Average Time for Selling Units</td>
</tr>
<tr>
<td></td>
<td>Safety</td>
<td>Efficiency of Direct Labour</td>
<td>Change Cost Factor</td>
<td>Contracting Index</td>
</tr>
<tr>
<td></td>
<td>Productivity*</td>
<td>Accident Rate*</td>
<td>Recordable Incident Rate (RIR)</td>
<td>Ratio between the number of accidents and total man-hour input</td>
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<tr>
<td></td>
<td></td>
<td>Risk Rate*</td>
<td>Lost workday Case Incident Rate (LW CIR)</td>
<td>Index Non-Conformity Index in the unit delivery</td>
</tr>
<tr>
<td>Leading measures</td>
<td>Effectiveness of Planning</td>
<td>Total Field Rework Factor Phase Cost Factor</td>
<td>PPC (Percentage of Plan Completed)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Urgent Orders</td>
<td>Phase Cost Growth (owner data only)</td>
<td>Construction Site Best Practice</td>
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<tr>
<td></td>
<td>Productivity</td>
<td>Phase Duration Factor</td>
<td>Supplier performance (Sub contracted, material and design)</td>
<td></td>
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<tr>
<td></td>
<td>Performance*</td>
<td>Construction Phase Duration</td>
<td>Number of Non-Conformity in audit</td>
<td></td>
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<tr>
<td>Positive issues</td>
<td>Online software for users</td>
<td>Online software for users</td>
<td>Degree of employee Satisfaction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Benchmarking Club</td>
<td>Outlined system (qualitative analysis)</td>
<td>Training Index</td>
<td></td>
</tr>
<tr>
<td>Implementation</td>
<td></td>
<td>Online software for users</td>
<td>Online software for users</td>
<td></td>
</tr>
<tr>
<td>Difficulties</td>
<td>Availability of data and validity of data</td>
<td>Annual training</td>
<td>Annual questionnaire for companies evaluation</td>
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<tr>
<td></td>
<td>Do not offer opportunities for real time control</td>
<td>Commitment of companies Measures</td>
<td>Commitment of the companies</td>
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<td></td>
<td></td>
<td>Standardisation</td>
<td>Implementation of improvement process based on the findings from the benchmarking program</td>
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<td></td>
<td></td>
<td>Continuous measurement</td>
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<td></td>
<td></td>
<td>Keeping the project team</td>
<td></td>
<td></td>
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</tbody>
</table>

Note: * measures that could be used if measured during the process
In terms of effectiveness, the KPI initiative in the UK is the only one that has been critically analysed in the literature, and 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 [26];
- 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 [26];
- In general, the main difficulties in the whole process of the KPI programme are concerned to the availability of data and their validity [26];
- 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 post-result lagging KPIs. This kind of indicator is used only as a historic review [24].

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. [19] 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, and then focus on critical processes.

The investigation of the four programmes 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 a route to support performance 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’), leading to improvement actions, instead of only being used for data comparison. Therefore, it is also important to promote training for the companies involved, including the communication of results, analysis of the evolution of the set of indicators, and encourage the exchange of practices and the creation of knowledge in Benchmarking Clubs.

### 4. Final Comments

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

However, the social-economics realities and the construction sector environment among the four countries are different. Chile and Brazil have some similarities, which can promote good opportunities for sharing findings and best practices. These countries are characterised by the high number of small construction companies, large demand fluctuation, mainly in the housing-building sector and a very large informal market. In general, the companies in UK and USA tend
to be larger and the construction sector is better organised. Then, the impact of these four initiatives in terms of supporting learning processes must be investigated taking into account differences in the cultural and social context.

This paper has pointed out some of the benefits, problems and limitations of the existing systems. The lessons learned should be used for upgrading the existing initiatives and devising new ones. A joint effort involving several organizations is necessary for the successful design and implementation of performance measurement 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 best practices among the companies. Moreover, the set of measures should be assessed and revised periodically, according to the needs of the companies involved.

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