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icBench – A Benchmarking Tool for Portuguese Construction Industry Companies

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ABSTRACT

The icBench Project (Construction Industry Benchmarks) has developed a web-based flexible platform to quickly evaluate a company's performance through a set of pre-defined indicators. The Information and Communication Technology (ICT) platform is built to support this set of indicators, although its architecture has been defined so that changes or adjustments to other industries can be easily implemented. The platform is also designed to provide two types of functionalities. One is to act as an internal data management system for each user company. The other is to allow for external benchmarking comparisons. The icBench project aims at being a straightforward tool for providing guidance to construction companies, ensuring that businesses are identifying and targeting the right problems and aware of best practices. Starting with a pre-defined selection of 50 contractors, 50 consultants and 50 construction materials companies, the project expects to expand its usage amongst all construction companies after wider dissemination of the project's results planned for later this year.

Key words: Performance Indicators; Supply Chain; Construction; Management.

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Introduction

The lack of performance measurement is a problem that affects the construction industry in general. 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. Many management decisions are made on the basis of "feeling" rather than objective diagnosis. It is widely recognised by all the industry sectors the importance of having accurate measurements to drive performance. A lot of research has been done in different countries concerned with the establishment of performance measurement systems for benchmarking in order to identify innovative ways to provide managers with efficient tools to accomplish this task.

The Construction Industry is one of the largest industries in Portugal representing 10.7% of employment and 6.4% of the GDP [1], in a sector where approximately 98% are SME's [2]. The aggressive threat of international competition, mainly from Spanish companies, is changing the markets; e-trading and e-commerce in construction products are progressing and new partnering models in client's, contractor's and consulting engineer's relationships are emerging. The increment of performance, new impulses in innovation and learning with the best practices are becoming a priority.

The majority Portuguese organisations do not have in place an effective organisational learning mechanism that can be used to stimulate best practice. It is necessary to re-directed efforts for the knowledge economy by a sustainability growth of the quality levels and innovation guided for an improvement of the performance of goods and services. However, managers are changing their attitudes. They clearly notice an increased general awareness of the importance of the new Internet-based economy and enhancing productivity through an intelligent use of ICT will be a competitive factor in the near future and it can represents the solution for several of their problems.

Performance measurement can provide an answer to enable companies to benchmark their operations and achieve its challenges. Benchmarking is a method of improving performance in a systematic way by measuring the internal key activities and comparing performance against the other companies in the same issues. Afterwards, it is useful by using lessons learned from the best to make target improvements. It can be a decisive fact in separating the best from the rest.

This paper presents the major guidelines of the icBench Project (Construction Industry Benchmarks), a benchmarking platform that provides an information

analysis tools by using Internet technologies designed for addressing the most representative professional profiles of construction industry companies. This web platform provides a set of measurements that enable companies to diagnose themselves and identify their position in the market and demonstrate their performance under an independent-run and uniform base of comparison. A large emphasis is given to Satisfaction, for both Client / Owner evaluating the service provided by his suppliers and also for his intervention in the production process, evaluated by the other actors.

This project is being carried out at Faculty of Engineering of the University of Porto (FEUP), in Portugal and supported by both the National Institute for Public and Private Construction Works (IMOPPI) and the National Innovation Agency (Adi). It has a simple but powerful aim: to assist managers concerned with sustainable strategic decisions to achieve further success by using continuously and systematically benchmarking processes.

Objectives

This project intends to provide a decision support system for construction industry managers, based in a performance measurement web platform. The benchmarking process has been designed in order to ensure the confidentiality of the information, reassuring managers about the disclosure of sensible data.

The main objectives and expected achievements of icBench can be summarised as follows:

Evaluate the state-of-the-art benchmarking projects around the world, applying a SWOT analysis;
Disseminate performance measurement concepts and benchmark practices in the construction industry;
Identify and publicize best practices in the sector;
Select a set of meaningful indicators able to reflect the specifics of the construction industry;
The visibility provided by a measurement system supports better and faster budget decisions and control of processes in the organization, meaning the reduction of risk;
Provide timely process efficiency measurements for a quick assessment of internal critical processes allowing strategic changes in real time - "where do I stand against my own expectations and objectives";
Provide a tool that enables faster adjustment of company strategies enabling a thorough understanding of "where do I stand against the best in the industry";
Ensure the widest possible dissemination of the project's results, creating sector-wide awareness of ICT;

Foster the use of benchmarking schemes in other industry sectors.

Methodology

The methodology used for the selection of the benchmark indicators in the icBench project consisted in a review of the state-of-the-art construction performance measurement/benchmarking schemes from around the world. Particularly relevant schemes were the Key Performance Indicators (Constructing Excellence, UK) [3, 4], the CII-Benchmarking & Metrics (Construction Industry Institute, USA) [5], National Benchmarking System (Corporation for Technical Development, Chile) [6], and the System of Quality Indicators for the Construction Industry (Brazil) [7]. From this review, a synthesized list of relevant indicators covering the main categories was defined. In this process it was found that few of the general construction schemes considered innovation indicators, therefore the basic set was complemented with performance indicators specifically targeting innovation (e.g., [8, 9, 10]).

In the second stage, the set of conceptually derived indicators was tested and improved. This was accomplished by organizing workshops with a selected group of experts involving members from professional associations and from companies representing the different players in the construction value chain (contractors, consultants and construction materials companies, which are also the target users of the system). These resulted in changes to existing indicators to better reflect the specificities of the construction industry in Portugal. However, whenever possible, one tried to keep the indicators as general as possible so as to allow for possible future comparisons with benchmarks from industries other than construction and countries other than Portugal. The final set includes 23 performance indicators divided into five main categories:

Customer / Satisfaction;
Economic / Financial;
Productive Processes / Safety;
Human Resources / Learning;
Innovation / Environment.

A summary of the indicators grouped by its major categories is depicted in Table 1. Some of them are collected from customers, while the others are collected internally in each company, analysing a company's specific projects/jobs or an annual performance. For these, it is up to each company to select the projects/jobs that are assessed (e.g., the ones each company identifies as most critical or representative of its activity).

The ICT platform is built to support this set of indicators, although having enough flexibility to accommodate changes. The platform is also designed to provide two types of functionality. One is to act as an internal data management system (through the creation of a company private area, each company has all performance data readily available for historical analysis, potential for feeding other information systems in the company, for cross-comparison of individual projects/jobs, etc.). The other is to allow for external benchmarking comparisons.

In the first stage, the ICT platform will only be accessible to a selected group of around 150 construction industry companies, chosen by its known awareness of IT and more advanced management approaches. This number was split equally amongst contractors, consultants and construction materials companies (manufacturers and traders), for a usability test of the interface and the provision of information.

It is expected that after this initial trial period and a number of targeted dissemination actions, a larger number of companies will join the project. Until the end of this year it is predicted that it will be possible to show the first indicators from the data inserted by the pilot-test companies.

Table 1: Selected performance indicators grouped by categories

	Indicators	Construction Industry			Addressed to		Frequency	
		Cont.	Cons.	Cons M.	Company	Client	Annual	By Operation
Client / Satisfaction								
01	Client satisfaction – product	■	■	■		■		■
02	Client satisfaction – service	■	■	■		■		■
03	Company satisfaction – Client cooperation	■	■		■			■
04	Company satisfaction – availability of payments	■	■	■	■			■
05	Company satisfaction – cooperative work	■	■		■			■
06	Repetition of business	■	■	■	■		■	
Economic / Financial								
07	Productivity	■	■	■	■		■	
08	Profitability	■	■	■	■		■	
09	Sales growth	■	■	■	■		■	
10	Hanging invoicing	■	■	■	■		■	
Productive Processes / Safety								
11	Predictability – cost	■	■			■		■
12	Predictability – time	■	■	■		■		■
13	Impact of defects at delivery	■	■	■		■		■
14	Type of defects	■	■	■		■		■
15	Accident frequency rate	■	■		■		■	
16	Successful bids	■	■	■	■		■	
Human Resources / Learning								
17	Subcontractors	■	■		■		■	
18	Permanent Employees	■	■	■	■		■	
19	Training	■	■	■	■		■	
20	Employee Satisfaction	■	■	■	■		■	
Innovation / Environment								
21	Management of solid residues	■	■	■	■		■	
22	Water consumption	■			■			■
23	Technology Investment	■	■	■	■		■	

Legend

* Construction Industry: Cont = Contractors; Cons = Consultants; Cons. M. = Construction Materials Companies (manufacturers and traders)

Developments

The icBench platform (Fig. 1) was designed in order to provide construction companies with a two-folded perspective tool: an internal perspective, in order to enhance company's performance by carefully monitoring critical internal processes, and an external perspective, allowing organizations to benchmark with the rest of the construction industry the issues identified as crucial.

Fig. 1: Homepage of the icBench Project (http://www.icbench.net)

The pre-defined selection of companies already committed with the project is responsible for collecting and introducing the data in the platform. In this pilot-test stage, companies are encouraged to identify and define new indicators that are specific and relevant to their projects, providing the research team with this input for future upgrading and updating of the platform.

The questionnaires have three types of possible responses:

Selection of a negative or positive answer;
Introduction of a numeric value and automatic calculation of the respective indicator;
Selection of a number between 1 (worst) and 10 (best), in the satisfaction indicators.

After submission of the data provided in the inquiries, the graphics are automatically generated. Two different types of performance graphs are used according to the selected use of the icBench platform:

Internal Perspective: bar diagrams for internal assessment;
External Perspective: ranking curves and radar charts for industry benchmarking.

Using it as a self-diagnosis tool, the companies can either assess indicators that are measured once a year, (e.g economic and financial indicators) or at the end of a complete operation. The concept of operation varies according to the type of company: for instance, a building for a construction company, a design (structural, architectural, etc) for a consultant or a sale for a construction materials company. The bar chart (Fig. 2, left) illustrates an indicator that assesses client satisfaction with the final product in finished operations, permitting the company to identify the ones which got better recognition from the client and the ones which did not. This information can be used to probe its procedures and detect the reasons for higher and lower efficiency in this issue.

The profitability chart (Fig. 2, right) is an example of an indicator calculated once a year. These bar charts are useful to quickly grasp the variability of the indicators as well as their interval limits.

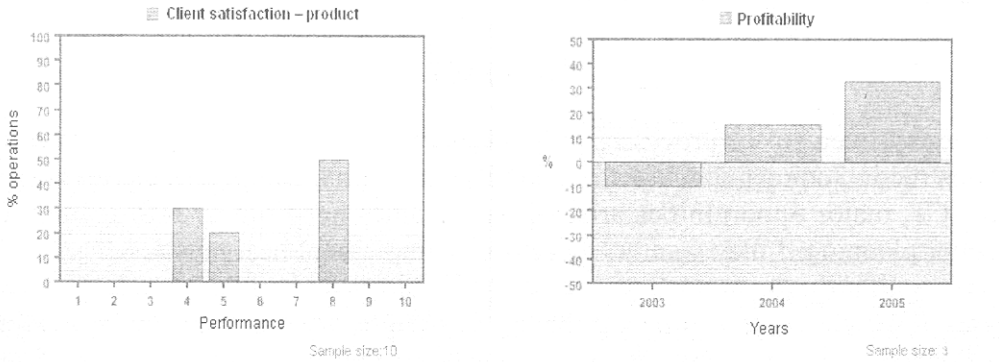

Fig. 2: Example of bar charts of an operation indicator and of an annual indicator

In the ranking curve (Fig. 3, left) it is possible to identify the benchmark score for a company according to a specific indicator. The example represented shows the benchmark ranking curve for profitability. The company performance (a profit of 10%) yields a benchmark score of 82%. This means that 82% of companies have achieved equal or lower profitability and that the remaining 18% have achieved higher profitability than the example company. The radar chart (Fig. 3, right) shows in each appropriate axis the benchmark scores for the selected indicators. In general, the closer the line is to the outer

perimeter of the radar chart, the higher the overall performance. The benchmark score for Profitability of 82%, from the previous example has been plotted on the chart (axis 4). This type of chart provides a quick picture of the organisation's overall relative benchmark performance.

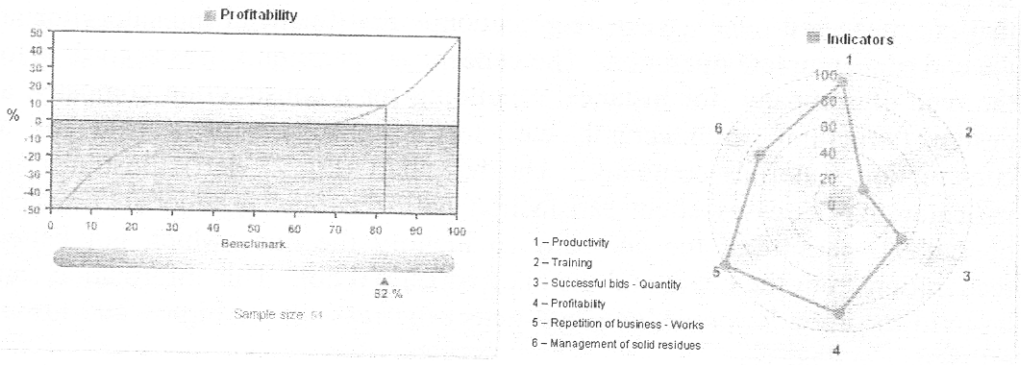

Fig. 3: Example of the calculation of a benchmark score and a radar chart for selected indicators

All the graphs that report the results are usually self-explanatory, but nevertheless, can provide managers with a powerful tool to support informed sustainable strategic decisions.

Conclusions

The improvement of processes and productivity ratios is a major concern for construction companies. In a traditional sector with a comparatively low usage of ICT, major opportunities arise: the companies need timely information for better planning if they want to successfully implement best practice.

The icBench project aims at being a straightforward tool for providing guidance to construction companies, ensuring that businesses are identifying and targeting the right problems and aware of best practices. Starting with a pre-defined selection of companies for a pilot-test stage, the project expects to expand its usage amongst SME's after wider dissemination of its results.

The innovation of this project lies in a careful selection of the more relevant performance indicators after a thorough literature review, extreme care with the usability of the interface, as well as the use of the latest technologies to make interaction as effective and easy as desirable.
This project might be the seed of some implementation of the vision of a Portuguese network enabling construction companies to enhance their future competitiveness in the global marketplace and increase the process leading to more efficient products and services. It can be an integral part of the planning

and on-going review process to ensure a focus on the external and internal situation and to strengthen the use of factual information in developing plans. This is an adequate method to increment a better efficiency in Construction sector and stimulate the best practices.

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