

## APPLICATION OF BENCHMARKING METHOD IN THE CONSTRUCTION COMPANIES

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**Abstract.** *The paper presents a benchmarking method dealing with identification of measurable business performance indicators in order to make comparison with the "Best in Class". Fields of application, some classifications in use and benchmarking process phases are outlined. The paper describes systems used in construction companies in different countries (Chile (CDT), USA (CII), Brazil (SISIN) and United Kingdom (KPI)) which indicate the requirements related to the use of performance measures for benchmarking in the construction industry and identify key factors of effective design and implementation of performance measurement system.*

**Key words:** *benchmarking, benchmarking process, performance measurement, systems, construction companies.*

### 1. BENCHMARKING TERM AND FIELDS OF APPLICATION

Benchmarking is a business concept applied to fields of strategic planning, marketing, restructuring, financial management and a practice to "learn from the best". Under conditions of growing competition, the benchmarking became very popular as a tool which supports making and sustaining of a competitive advantage. Data obtained from a benchmarking process contribute to:

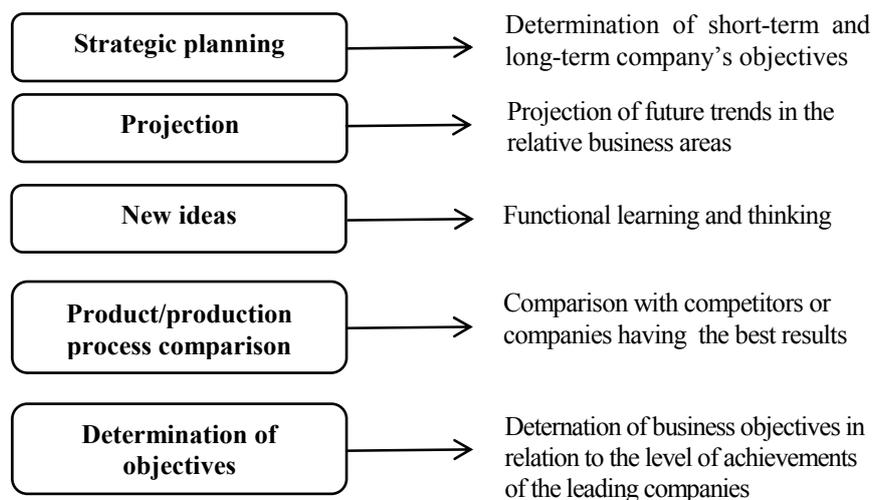
- Identification of company's strengths and weaknesses,
- Identification of the current and potential comparative advantage in relation to other participants in the commercial business operations,
- Evaluation of risks by using the alternative action lines.

Benchmarking relies on determination of factors critical for success of the company. Processes which determine these factors are analyzed. The best attributes of key parameters used for target improvements are defined. Only understanding of internal processes enables recognition and integration of differences, improvements and innovations which exist in companies with the best practice.

Benchmarking is a continuous process of identification, understanding and adjustment of products, services, equipment and processes of the company with the best practice (Figure 1) aiming at improvement of its own business. This process includes:

- Comparison of the company and its sectors with the best ones but not limited to the activity or the country where the activity is performed,
- Comparison of production activities or some other company's activities with the corresponding activities of other companies doing same business in order to define the best ones,
- Comparison of company's products and services with services of the competitors having the best results,
- Comparison of company's technical solutions in order to choose the best special-purpose equipment,
- Application of the best defined business process,
- Planning future development directions and active adjustment to new trends, satisfying and exceeding the consumer expectations. ([www.benchmarkingnetwork.com](http://www.benchmarkingnetwork.com)).

Benchmarking is a search for the best industry practices that lead to more superior performance. First of all, it is research and observation of the best practice of competitors and/or search for the best industry practice leading to producing the more superior performance (Camp, 1989).



**Fig. 1.** Fields of benchmarking application (Source: Spendolini, 1992)

It is stated in the European studies from 1994 that 88% of companies were involved in the benchmarking activities (Voss et al, 1997). In United Kingdom 85% of companies use benchmarking (CBI, 1997) while in USA 76% of companies use benchmarking as a management tool (Rigby, Bilodeau, 2005). Data obtained from research show that benchmarking is more frequently used for performance comparison (The Benchmarking Exchange, 2001).

## 2. BENCHMARKING TYPES

Various business situations require that operation managers and staff apply different benchmarking skills. In accordance with these applications, three benchmarking types are defined:

- Process benchmarking,
- Performance benchmarking,
- Strategic benchmarking. (Bogan, English, 1995)

Process benchmarking requires identification of the most effective work practices in the companies having similar operating functions. If one organization improves the basic process, it has an influence on performance improvement (increased productivity, lower costs or improved sale). Effects of application of benchmarking process are shown in the improvement of financial results in very short time period.

Performance benchmarking enables managers to assess their competitive position by comparison of products or services. Performance benchmarking is usually focused to price elements, technical quality or characteristics of service (rate, reliability, etc.). Numerous industries apply performance benchmarking as a standard method in relations with competitors.

Strategic benchmarking researches long-term successfulness pattern and tries to identify the winning strategies that have enabled success of companies in their markets. The organizations that look for short-term benefits apply process benchmarking which produces the results much faster.

In addition to this, there are numerous classifications but the most often used is classification which differentiates two benchmarking types:

- Internal benchmarking – implies comparison of some sectors and divisions within the organization. This benchmarking type is generally used in big, multinational companies where each company's department performs specific activity or operation. In these companies a starting point for the benchmarking project is an intensive internal research in order to get an insight into business operations, department's strengths and weaknesses and operating method of each department,
- External benchmarking which is divided into external competitive benchmarking, external industrial or functional benchmarking and external generic benchmarking. External competitive benchmarking is comparison of company's activity with direct competitors. The objective of external competitive benchmarking is obtaining specific and important data on the competitor's business and it facilitates positioning of products and company's business services on the market in relation to competitors. External industrial or functional benchmarking compares company's functions with functions of other companies. It is used when company wants to make improvements by comparing the elements of its business with the elements of other companies from the same industry but which are not the direct competitors. External generic benchmarking broadens fields of application of benchmarking process beyond the limits of specific company and industry it belongs to. In this benchmarking type, different industries having similarities in many business processes are compared and benchmarking applied to these operation elements enables important insight into information originated from the industries which are not interconnected.

Table 1. Comparison of different benchmarking types (Source: Harington, 1996)

Benchmarking type	Decision making time	Benchmarking Partners	Results
Internal benchmarking	3-4 months	Within the company	Significant improvements
External competitive benchmarking	6-12 months	Competitors	Better than competitors
External industrial benchmarking	10-14 months	Same industry	Creative breakthrough
External generic benchmarking	12-24 months	All industries worldwide	Change of rules
Combined internal and external benchmarking	12-24 months	All industries worldwide	The best of kind

### 3. BENCHMARKING PROCESS

There are numerous different models of benchmarking process (they differ in number and name of phases) but all models have the same essence. According to some authors, if benchmarking is globally considered, we can talk about:

- Pre-benchmarking phase – it includes making decision on what will be measured, how the measurement will be performed and which partners or criteria will be used in that process,
- Benchmarking phase – process of collecting data, measuring results and assessing gap is formulated in the course of this phase,
- Post-benchmarking phase – the results are obtained, action plan formulated, strategy created and initiated,
- Reinstitution of the process – providing feedback as a base for future decisions is very important in this phase. Review of the strategy, reset of goals and continuous planning of improvements in this phase lead back to the first step i.e. pre-benchmarking phase. ([www.innovnet.com](http://www.innovnet.com))

### 4. POTENTIAL ROLE OF BENCHMARKING IN THE CONSTRUCTION INDUSTRY

The main interest of the construction companies regarding the benchmarking is to compare their performance to other construction companies. However, the main problem of many construction companies is impossibility to become involved and carry out performance measurement and benchmarking on a permanent basis. The lack of resources is particularly critical in small sized construction companies. Based on the experience of benchmarking initiatives in United Kingdom, Chile, Brazil and USA, it is important to emphasize some key issues for the design and implementation of performance measurement systems aimed at application of benchmarking in the construction companies.

The set of measures shall be chosen in the way to enable company to have good survey of the situation and to include both leading and lagging indicators.

The procedures for data collecting must be simple in order to facilitate the creation of the database and to enable simple evaluation of project performance in relation to other projects in real-time. Therefore it is useful to design an interactive on-line tool allowing data access and providing feedback. On-line tools can be used during whole project life cycle aiming to offer to the companies the opportunity to analyze the results and to promote improvements.

The applied system must be fully understood by the involved people using that system. It is also important to promote training courses for the companies involved, including the communication of results, evaluation of indicators and the exchange of experiences between participants.

## 5. PERFORMANCE MEASUREMENT SYSTEMS FOR BENCHMARKING IN THE CONSTRUCTION INDUSTRY

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 companies. However, the lack of performance measurement is a problem that affects the construction industry in general. This is related to the attitude and lack of training of managers to a great extent. 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.

In the last few years, specific systems were established. Their primary goal is to indicate requirements related to use of performance measures for benchmarking in the construction industry and to identify key factors of effective design and application of performance measurement system. The text below presents some of these systems, such as:

- National Benchmarking System for the Chilean Construction Industry (CDT),
- Construction Industry Institute Benchmarking and Metric (CII),
- Performance Measurement System for The Brazilian Construction Industry, (SISIND )
- Key Performance Indicators in the United Kingdom (KPI).

### 5.1. 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 Pontificia Universidad Catolica de Chile. This project started in 2001. By comparing key performance indicators, the CDT hopes to identify best practices and generate short-term improvement opportunities for participating companies.

The selection of performance indicators was based on previous studies that included an extensive literature review and empirical research (Alarcon, Serpell, 1996; Grillo, 1997). Initially, there were over 30 performance indicators that were analysed in several meetings with 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 objectives of this set of indicators were to promote continuous improvement and benchmarking between companies.

This is the current set of indicators used:

- Deviation of cost by project,
- Deviation of construction due date,
- Change in amount contracted,
- Accident rate,
- Risk rate,
- Efficiency of direct labour,
- Productivity performance,
- Rate of subcontracting,
- Client cost complaints,
- Urgent orders,
- Planning effectiveness.

In the first phase of the project, the construction companies adopted a set of indicators that were fairly easy to measure, using existing control systems in the organisations. For the implementation of these indicators, the companies involved received a support guide-book and had access to an information system; which had specific tools that enable comparisons to be performed. The National Benchmarking System uses quantitative and qualitative tools for data analysis, such as: mean, ranking curves, radar graph, tables displaying companies result.

Also, a correlation analysis is carried out on the data using Pearson's correlation, factor analysis and multivariate linear regressions etc.

The set of indicators is concerned with five sub-sectors of the Construction Industry: high-rise building, low-rise building, civil works, heavy industrial construction, 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. These companies are members of the Chilean Chamber of Construction. The main difficulties in the implementation of the system were:

- The indicators were not easy to measure for all of the companies involved ( not all of the companies had quality management systems ),
- The essence in the approach is to create a measurement culture within the organisation that will facilitate future implementation. Most of companies had difficulties in introducing performance measurement and in involving their work force in this initiative,
- There was poor standardisation of measures, lack of continuity of measurement and inexistence of a regular and committed project team in many companies.

## **5.2. Construction industry institute benchmarking and metrics (CII)**

The CII Benchmarking and Metrics Programme started in 1993, it aims to provide performance norms to the industry, quantify the use and value of best practices. A committee of industry representatives working with the CII staff has defined critical performance measures that can be used in practice. In 2000 CII established this set of indicators:

1. Cost indicators (Table 2)
2. Schedule indicators (Table 3)
3. Safety indicators (Table 4)
4. Changes indicators (Table 5)
5. Rework indicators (Table 6)

**Table 2.** Performance Metric Category: COST (www.cii-benchmarking.org)

<i>Project Cost Growth</i>	Formula:	$\frac{\text{Actual Total Project Cost} - \text{Initial Predicted Project Cost}}{\text{Initial Predicted Project Cost}}$
<i>Delta Cost Growth</i>	Formula:	$  \text{Cost Growth}  $
<i>Project Budget Factor</i>	Formula:	$\frac{\text{Actual Total Project Cost}}{\text{Initial Predicted Project Cost} + \text{Approved Changes}}$
<i>Delta Budget Factor</i>	Formula:	$  1 - \text{Budget Factor}  $
<i>Phase Cost Factor</i>	Formula:	$\frac{\text{Actual Phase Cost} - \text{Initial Predicted Phase Cost}}{\text{Initial Predicted Phase Cost}}$
<i>Phase Cost Growth</i>	Formula:	$\frac{\text{Actual Phase Cost} - \text{Initial Predicted Phase Cost}}{\text{Initial Predicted Phase Cost}}$

**Table 3.** Performance Metric Category: SCHEDULE (www.cii-benchmarking.org)

<i>Project Schedule Growth</i>	Formula:	$\frac{\text{Actual Total Proj. Duration} - \text{Initial Predicted Proj. Duration}}{\text{Initial Predicted Proj. Duration}}$
<i>Delta Schedule Growth</i>	Formula:	$  \text{Schedule Growth}  $
<i>Project Schedule Factor</i>	Formula:	$\frac{\text{Actual Total Project Duration}}{\text{Initial Predicted Project Duration} + \text{Approved Changes}}$
<i>Delta Schedule Factor</i>	Formula:	$  1 - \text{Schedule Factor}  $
<i>Phase Duration Factor</i>	Formula:	$\frac{\text{Actual Phase Duration}}{\text{Actual Overall Project Duration}}$
<i>Total Project Duration</i>		Actual Total Project Duration (weeks)

**Table 4.** Performance Metric Category: SAFETY (www. cii-benchmarking.org)

<i>Total Recordable Incident Rate</i>	Formula:	$\frac{\text{Total Number of Recordable Cases} \times 200,000}{\text{Total Site Work-Hours}}$
<i>DartRate(days away, restricted activity, or transfer)</i>	Formula:	$\frac{\text{Total Number of DART Cases} \times 200,000}{\text{Total Site Work-Hours}}$

**Table 5.** Performance Metric Category: CHANGES (www. cii-benchmarking.org)

<i>Change Cost Factor</i>	Formula:	$\frac{\text{Total Cost of Changes}}{\text{Actual Total Project Cost}}$
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**Table 6.** Performance Metric Category: REWORK (www. cii-benchmarking.org)

<i>Total Field Rework Factor</i>	Formula:	$\frac{\text{Total Direct Cost of Field Rework}}{\text{Actual Construction Phase Cost}}$
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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. Participants receive real-time evaluation on their projects' performance using the web- based Progress Key Report. In this software, the projects can be immediately compared to the database and the reports show metrics score, performance quartiles, and graphic comparisons of individual project performance to the database etc.

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 main difficulties identified in the CII Benchmarking & Metrics is getting corporate commitment to benchmark at the company level.

### 5.3. Performance measurement system for the Brazilian construction industry (SISIND)

The SISIND Project 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 project 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.

Since then, several initiatives have been established involving academic institutions, research funding agencies, industrial bodies and the Federal Government. The most recent initiative is the SISIND-NET project, which involves the conception and implementation

of a performance measurement system for benchmarking for the Brazilian Construction Industry. The aim of this project was:

- The development of a web-site for disseminating and collecting data,
- The development a web based tutorial that can be used for training,
- The promotion of workshops and training courses in different places in Brazil, aiming to disseminate and implement the set of measures.

The SISIND project initially devised a set of 35 performance indicators for the residential and commercial building segment of the industry, which can be used as a starting point for establishing sets of measures for specific companies. Later for the benchmarking initiative, ten indicators have been jointly chosen by the research team and industry representatives:

- Cost deviation,
- Time deviation,
- Non-conformity index for critical processes,
- PPC (percentage of plan completed),
- Supplier performance,
- Degree of user satisfaction (product),
- Sales time,
- Ratio between the number of accidents and total man-hour input,
- Construction site best practice index,
- Degree of internal client (workers) satisfaction..

The following activities were carried out in the SISIND project:

- Production of a publication describing the set of indicators,
- Production of five reports based on the data collected by partner companies,
- Development of research studies related to the definition and use of new measures for a number of key processes.

Since the launching of SISIND, several construction firms have joined the project and participated in training courses aimed at enabling managers to implement the proposed measures in their organisations.

A database including data of approximately 80 companies and 200 projects has been created (Lantelme and Formoso, 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 on a continuous basis. According Formoso and Lantelme (2000), the main problems identified in the SISIND Project were:

- The lack of human resource argued by company managers is related to the fact that performance measurement is not properly integrated in process control at the operational levels,
- Companies tend to collect some indicators that are not related to critical processes only because those are easy to collect,
- The measures that demand the investigation of root causes, such as "number of complaints from users in relation to the total number of units delivered", are relatively complex to implement, since they require both quantitative and qualitative data to be processed, and the effort of several people working as a team,
- The lack of training was also identified as an important barrier for the implementation of performance measurement system.

A more recent study (Costa, 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) ineffective communication and dissemination of results.

#### **5.4. Key performance indicators (KPI) in the United Kingdom**

The KPI Programme was launched by the UK Best Practice Programme in 1998, the purpose of the KPI programme is to enable measurement of project and organisational performance throughout a large number of projects and hence provide indications about performance of the construction industry. The main ways that Construction Consultants KPIs are used in the construction industry are:

- To benchmark the performance of a specific project or company,
- To provide a measurement framework for partnering and framework agreements,
- To provide evidence of value for money in procurement,
- To provide measures other than price to support procurement decisions,
- As a marketing tool,
- To meet the requirements of ISO 9001 quality management systems,
- To provide a health check as part of a continuous improvement programme.

##### *5.4.1 The KPI data, the KPI groups, the level of KPIs*

Each year, on behalf of the BIS (Department for Business Innovation and Skills) and the project partners, the KPI Consortium carries out data collection surveys of clients and consultants across the United Kingdom. Data are collected by questionnaires and processed and the results are presented in the reports and graphs showing performance level for critical questions. Then the results are entered in the corresponding databases. Access to databases is enabled by appropriate on-line software supporting the corresponding project performance analyses related to the corresponding benchmarks.

Clients of the construction industry want their projects delivered: on time, on budget, free from defects, efficiently, right first time, safely, by profitable companies. The KPI framework consists of seven main groups:

- Time,
- Cost,
- Quality,
- Client Satisfaction,
- Client Changes,
- Business Performance,
- Health and Safety.

The indicators presented in this report (table 7) are designed to be applied at a project or a company level, depending on the indicator in question. In some cases the company indicator is the average value of that company's project indicators.

- **Headline Indicators** provide a measure of the overall, rude state of health of a firm.
- **Operational Indicators** bear on specific aspects of a firm's activities and should enable management to identify and focus on specific areas for improvement.

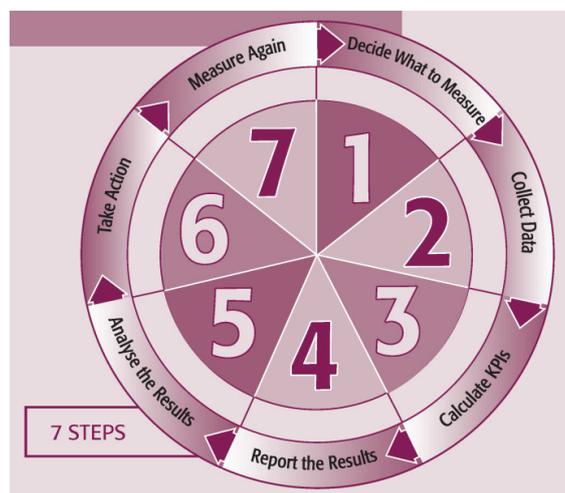
- Diagnostic Indicators provide information on why certain changes may have occurred in the headline or operational indicators and are useful in analysing areas for improvement in more detail.

**Table 7.** The KPI groups and their associated indicators (KPI Report, 2000)

Group	Indicators	Level
Time	1. Time for Construction	Headline
	2. Time Predictability - Design	Headline
	3. Time Predictability - Construction	Headline
	4. Time Predictability - Design & Construction	Operational
	5. Time Predictability - Construction (Client Change Orders)	Diagnostic
	6. Time Predictability - Construction (Project Leader Change Orders)	Diagnostic
	7. Time to Rectify Defects	Operational
Cost	1. Cost for Construction	Headline
	2. Cost Predictability - Design	Headline
	3. Cost Predictability - Construction	Headline
	4. Cost Predictability - Design and Construction	Operational
	5. Cost Predictability - Construction (Client Change Orders)	Diagnostic
	6. Cost Predictability - Construction (Project Leader Change Orders)	Diagnostic
	7. Cost of Rectifying Defects	Operational
	8. Cost In Use	Operational
Quality	1. Defects	Headline
	2. Quality Issues at Available for Use	Operational
	3. Quality Issues at End of Defect Rectification Period	Operational
Client Satisfaction	1. Client Satisfaction Product - Standard Criteria	Headline
	2. Client Satisfaction Service - Standard Criteria	Headline
	3. Client Satisfaction - Client-Specified Criteria	Operational
Change Orders	1. Change Orders - Client	Diagnostic
	2. Change Orders - Project Manager	Diagnostic
Business Performance	1. Profitability (company)	Headline
	2. Productivity (company)	Headline
	3. Return on Capital employed (company)	Operational
	4. Return on Value Added (company)	Operational
	5. Interest Cover (company)	Operational
	6. Return on Investment (client)	Operational
	7. Profit Predictability (project)	Operational
	8. Ratio of Value Added (company)	Operational
	9. Repeat Business (company)	Operational
	10. Outstanding Money (project)	Operational
	11. Time taken to reach Final Account (project)	Operational
Health and Safety	1. Reportable Accidents (inc fatalities)	Headline
	2. Reportable Accidents (non-fatal)	Operational
	3. Lost Time Accidents	Operational
	4. Fatalities	Operational

#### 5.4.2 Procedure to Implementing KPIs and Main Problems Identified KPIs

There are seven basic steps to the successful use of KPIs (see Figure 2).



**Fig. 2.** Seven basic steps to the successful use of KPIs  
(Source: UK Construction Consultants, Handbook, 2009)

The set of KPIs is annually updated by the Construction Best Practice Programme. A few hundred companies have been participating in this programme. Despite the initiatives of the KPI Programme in promoting the comparison between companies, a fairly limited number of companies are really involved to the benchmarking programme. Some main problems identified in KPI:

- 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 view-point, since this is a way of identifying potential mechanisms for improvements.
- The KPIs are specific to projects and offer very little indication as to the performance of the organisations themselves from a business point of view, apart perhaps from the customer perspective.
- Another area that is generally poorly covered in the construction industry is the performance of the suppliers in projects.
- In general, the main difficulties in the whole process of the KPI programme are concerned with the availability of data and their validity.

## 6. CONCLUSION

Benchmarking is an efficient tool for collecting data and information related to competitors' business, financial situations and possibilities for business in the specific market sectors. Benchmarking identifies production-related and other operations in the company that should be improved and goes much beyond the traditional analysis of the competitors. It implies deeper analysis of the best competitors, detailed examination of their

achievements and how they did them as well as analysis of operation capabilities and characteristics of competitors' products aimed at taking actions to improve their own performance and business.

Benchmarking benefits are well recognized and nowadays companies all over the world increasingly implement benchmarking to improve continuously business functions and products and to strengthen their positions into the global market. Performance measurement and information about performance are very rare in the construction companies. In the last few years, specific performance measurement systems for benchmarking in different countries - Brazil (SISIND), Chile (CDT), United Kingdom (KPI) and USA (CII) were established. Based on their experiences, rules supporting design and implementation of benchmarking system in the construction companies were formulated. These rules are related to choice of indicators, procedures for data collection and availability of the system to all participants in the project.

Benchmarking introduction in the companies is a complex project requiring considerable effort and investment. Limiting factor for many companies to make comparative analyses, especially external ones, is relatively high project operationalization costs. Continuity of involvement, lack of resources – especially in the small-sized companies – insufficient training level of managers and absence of performance measurement system which provides key information for decision making are additional difficulties for introduction and implementation of benchmarking.

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## PRIMENA BENČMARKING METODE U GRAĐEVINSKIM PREDUZEĆIMA

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*U radu je prikazana metoda benčmarkinga koja se bavi identifikacijom merljivih pokazatelja performansi poslovanja u cilju poređenja s najboljim iz branše "Best in Class". Navedena su područja primene, neke od klasifikacija koje se koriste, kao i faze benčmarking procesa. Prikazani su sistemi koji se koriste u građevinskim kompanijama u različitim zemljama (Čile (CDT), SAD (CII), Brazil (SISIND) i Velika Britanija (KPI)), a koji ukazuju na zahteve povezane sa korišćenjem merenja performansi kod primene benčmarkinga u građevinskoj industriji i identifikuju ključne faktore efektivnog projektovanja i primene sistema za merenje performansi.*

Ključne reči: *benčmarking, benčmarking proces, merenje performansi, sistemi, građevinske kompanije.*