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# APPLICATION OF KEY PERFORMANCE INDICATORS IN SOUTH-EASTERN EUROPEAN CONSTRUCTION

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**Abstract.** The importance of performance based benchmarking has become a necessity in a modern construction company and presents a constant challenge for the construction industry. The aim of this paper is to elaborate significance, role and types of Key Performance Indicators (KPI) in the construction industry and show how different management perspectives perceive the indicators. A literature review was carried out in order to generate a listing of KPIs, used among academe and the industry. Afterwards, using surveys and semi-structured interviews, the data was gathered from more than 30 South-East European construction companies. Results were analyzed, producing a final set of 37 indicators. This study identified a low level of awareness of KPI models and performance management processes among the companies. Furthermore, the analysis showed a substantial difference in perception of KPIs among investors, consultants and contractors, which consequently led to a compiling list of KPIs. The top ten KPI's are: Quality, Cost, Number of investor interferences, Changes in project support, Time increase, Client satisfaction, Employees' satisfaction, Innovation and learning, Time and Identification of client's interest. The paper concludes with final remarks and guidelines for the implementation of KPIs in practice.

**Keywords:** KPI, construction industry, performance, perception, management, perspective.

## 1. Introduction

The importance of identifying organizational performance and promoting it on the world's market is evident throughout its highly appreciated results. The best performing companies will attract both the best employees and future investment and thus maximize their share value. Still, performance management system is only a component of the larger system and should be based on a balanced set of measures representing critical areas of improvement to achieve success of a construction firm (Beatham *et al.* 2005; Kaplan 1984; Neely 1999). In spite of huge amount of research done, the construction industry still suffers from inefficiency and ineffectiveness, and has been proclaimed as the worst among all industries (Alinaitwe *et al.* 2009; Beatham *et al.* 2004) and therefore limps behind others.

Thus nowadays in the construction, only 34% of projects meet their basic project management criteria (cost, time and scope) (<http://www.standishgroup. com>). Furthermore, even though U.K. private companies spend £1.5 billion on tools for performance measurement every year (Edwards and Thomas 2005), the industry still spends circa £1 billion on rework (Nicholson 1999). Therefore the construction ought to replace standard market competition, based on the lowest price bid, with relations based upon transparent measurement of quality and efficiency (Egan 1998) and use a set of performance indicators for benchmarking purposes (Neely 1999).

Performance management has emerged in the last two decades (Sharif 2002) as a logical response to questions such as: *How are we doing business?, How are our projects (firms) performing?,* and *Are we investing in the right project and what benefits is this project bringing along?* Even though the last decades have generated a large number of studies, only a small number of articles explored Key Performance Indicators (KPI) and yet a smaller number focused on construction specifically (e.g. Beatham *et al.* 2005; Cox *et al.* 2003; El-Mashaleh *et al.* 2007; Enshassi *et al.* 2009). KPIs are vehicles used to monitor and control organizational performance, promote its merits, and conduct benchmarking. They are also useful means for communicating with stakeholders about continuing improvement endeavors, since they incorporate other aspects than just financial. Unfortunately traditional accounting based indicators, developed at the beginning of the last century, have still remained in use, despite the criticism of not being able to integrate all aspects of performance (Eccles 1991; Freeman and Beale 1992; Kaplan 1984).

The financial perspective received lot of criticism for not providing a real-time image of field performance (Beatham *et al.* 2004, 2005; Kaplan and Norton 2000). Thus now the focus is now turning into a balanced perspective (i.e. The Balanced Scorecard, (EFQM 2005; Kaplan and Norton 2005), where performance criteria vary regarding organizational specific abilities and position on the market. Nevertheless, a large number of indicators forced managers to weigh the selection of metrics' parameters wrong and vice versa, and thus to form an incorrect image of performance (Cox *et al.* 2003; Neely 1999).


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Consequently, managers spend precious time on extracting and handling valuable information, and can easily come to incorrect decisions (Mao *et al.* 2007). In summary, authors are unanimous on KPIs; In order to set an effective performance management system, managers need a detailed set of KPIs (Beatham *et al.* 2005; Kaplan and Norton 1996; Neely 2000) which trigger actions (increased safety, productivity, quality, decreased cost, etc) that can be then transferred to field activities and revised processes.

## 2. Objectives and limitations

The objectives of this research were to gather and validate data which will help to determine a set of KPIs for construction. KPIs, which were identified in this study, may be used by construction executives and managers to monitor and control the performance and to initiate benchmarking. The study analyzes perceptions of three different management perspectives in the construction, those of: investors, consultants and contractors and identifies:

1. Commonly used construction lagging KPIs (KPO).
2. Commonly used construction leading KPIs (in text will be named as KPI).
3. Commonly used construction perceptive KPIs (measures of perception, known as PerM).
4. Delineation of use of KPIs by:
   - Investors (owners, sponsors…);
   - Consultants (architects, engineers…);
   - Contractors (construction management, subcontractors, self perform…).

## 3. Literature review

The Royal Society of Arts Manufactures and Commerce (<http://www.thersa.org/>) stated a vision of a modern business system: *To achieve sustainable business success, on a demanding World's market, company must… use the relevant set of performance indicators*. KPIs are compilations of measurement information in systems, which are used to assess the performance and to provide the measurement of its efficiency and effectiveness (Edwards and Thomas 2005). The construction excellence working group – U.K., defines KPIs as*: A Key Performance Indicator (KPI) is the measure of performance of an activity that is critical to the success of an organization* (<http://www.constructingexcellence.org.uk//>).

Furthermore, the evidence from the field practice shows that authors still do not recognize the difference among leading, lagging and perceptive measures and the difference between factors and criteria, which Lim and Mohamed (Lim and Zain Mohamed 1999) comprehensively explained. This recognition is of key importance for impacting future performance and aligning strategic priorities for continuous improvement (Xiao and Proverbs 2003). Nevertheless, some performance/quality associations have implemented such classification, e.g. The European Foundation for Quality Management (EFQM), (Beatham *et al.* 2005; EFQM 2005), but still the majority has not. The review yielded with the following conclusions:

- In most cases authors and practitioners use KPOs as leading and lagging indicators and do not recognize them apart. Thus, they do not have the opportunity to change and the indicators are not properly used for making decisions. KPIs are mainly used by performance associations (clubs) in the UK, such as: Respect for people, Satisfaction of services, Construction Project Information, etc. Only two KPIs were common to all: Environmental issues and Safety at work. However we have not considered them as innovative, since they are forced by the legislative. "Respect for People" club has mainly developed leading indicators such as: Absence from the work, Migration, Loss of staff qualifications, Training, etc.
- Every performance indicator must be generated through mission, vision and strategy (Vukomanović *et al.* 2007) and therefore project performance should be integrated with overall performance management system. From the review it was evident that KPIs were neither aligned with the strategy nor were they fulfilling company's mission. Kaplan and Norton (Kaplan and Norton 2004, 2006) came to similar conclusions in their recent studies.
- Even though CBPP had the opening role in introducing such measures throughout different project phases, no model incorporates the importance of different procurement routes in construction projects (Beatham *et al.* 2005; Latham 1994; Ng *et al.* 2002; Ugwu *et al.* 2006). Thus e.g. KPI: Completion of Design Documentation at the beginning of the execution phases, in Design & Build projects is practically irrelevant, since the contractor takes the risk of completing the documentation.
- Many companies have developed their own KPIs, but thus have become unable to conduct benchmarking.

Therefore, KPIs, as performance management tools, are still evolving. In period to come, the focus should be on developing a performance management model which will incorporate both, systematic use of KPI based benchmarking and incorporating those results into internal performance system.

## 4. The use of KPIs in the construction industry

### 4.1. Classification of KPIs

Construction sector (the industry, institutions, academe...) criticizes KPIs for not being able to influence any change and to only summarize the performance completed processes. Mainly they are designed as lagging, offering only information on completed work items. However leading measures (KPI), unlike lagging (Key Performance Outcomes – KPO), have a possibility to affect the final result, and are used to provoke future decisions and to change outcomes. Only a few models made the distinction between these kinds of measures, e.g. EFQM.

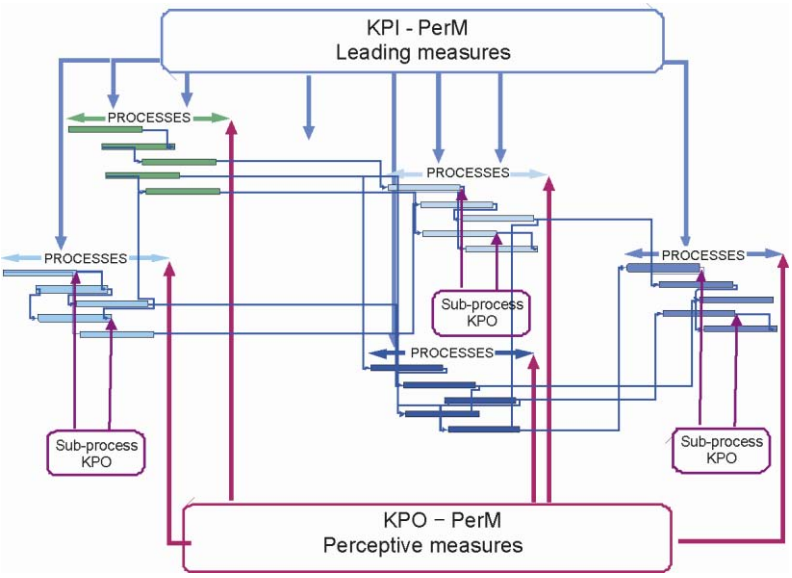


**Fig. 1.** When to use different types of KPIs

Therefore KPIs are indicative of assigned processes and can predict future trends. They are hard to find and often serve as future insights and early indicators of problems and can affect the final outcome during project's early stages. They also provide opportunity for changes.

KPOs, in contrast, are lagging measures and do not enable ability for a change. Managers in construction utilize KPOs as KPIs, even though they are not aware it, e.g.: Profit, Return on Equity, Time, Market share, etc… (Beatham *et al.* 2004, 2005; Kaplan and Norton 2005). KPO can be also assigned to sub-processes (see Fig. 1) to become a leading indicator of its successor (Sub-process KPI).

Perceptive measures (PerM) can be either lagging or leading, regarding the time when they were measured. Often they are measured trough surveys and interviews and are dependent on the managers' focus.

During the review, we have found that construction managers have not yet accepted such a qualitative approach. This is probably a result of an "engineering" approach to managing projects (Vukomanović 2006), e.g.: Construction Best Practice Programme (CBPP) set of KPIs, mostly applied in U.K. construction, uses PerM as lagging indicators. Fig. 2 shows the KPI breakdown structure.

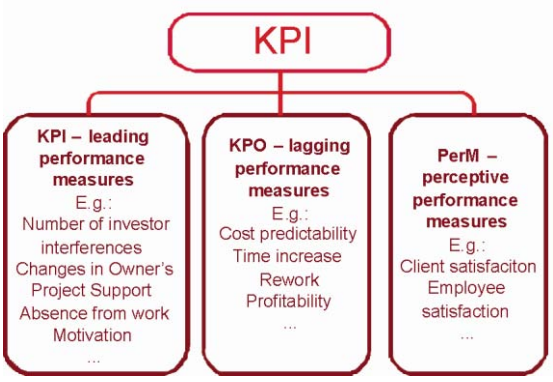


**Fig. 2.** KPI classification

### 4.2. Research hypothesis

The objectives of this research were the following: to define the set of commonly used KPIs in the construction industry; to recognize the level of perception of performance management among construction managers and to observe the perception among different construction management perspectives. Thus, four hypotheses were defined:

**H1.** There is a common listing of KPIs for construction companies regardless of the project management perspective.

**H2.** The construction industry does not recognize performance management and KPIs as the vital part of their overall management process.

**H3.** Construction companies classify key performance indicators on leading (KPI), lagging (KPO) and perceptive (PerM) indicators.

**H4.** KPIs differ within the individual management perspectives.

The data obtained from the literature review, surveys and semi-structured interviews was used to test these hypotheses. Statistics included measures such as: Mean, Student's t-test (to determine whether two samples are likely to have come from the same two underlying populations that have the same mean) and F-statistics (to determine whether two samples have different variances). Relative importance index (RII) (1) was used to rank KPIs within respective groups and to validate results of T-test and F-test statistics. The test was conducted using SAS Insight software.

### 4.3. Research methodology

First, the literature review was undertaken to analyze KPIs across the industry taking into account various performance benchmarking clubs, but also recent KPI models developed by academe (Chua *et al.* 1997; Jin and Ling 2006; Kagioglou *et al.* 2001; Xiao and Proverbs 2003). Having summarized the indicators, a final set which was

then validated through surveys and semi-structured interviews.

**Table 1.** Sample specifics

| | Percent | Count |
|---|---|---|
| Investors (sponsors, owners) | 20.0 | 6 |
| Contractors | 40.0 | 12 |
| Consultants (architects, designers, project management companies…) | 40.0 | 12 |
| 0–49 employees | 0.0 | 0 |
| 50–250 employees | 16.6 | 5 |
| > 250 employees | 83.4 | 25 |
| Croatia | 76.6 | 23 |
| Bosnia and Herzegovina | 16.6 | 5 |
| Slovenia | 6.8 | 2 |

The literature review resulted with a listing of 37 KPIs (see Appendix A) ready to be validated in South East European (SEE) construction industry. The study employed a two-step research. First, the survey was distributed to two professors at the Faculty of Civil Engineering, Zagreb and to selected CEOs of three Croatian construction firms. Based on their suggestions and opinions, the final survey was formed and sent out to the group of selected top companies (Table 1). The companies were selected from Bosnia and Herzegovina, Croatia and Slovenia, but which operate on SEE construction market (Izetbegovic *et al.* 2004).

The demographics are shown in Table 1 in regard to different management perspective, origin and number of employees. In total, 30 out of 120 target construction firms, that we had found active in the region, responded, leading to a 26% rate of response. We accepted this rate since it was in accordance with the common research practice (Fellows and Liu 2003).

Each respondent (CEO or senior manager) was asked to answer questions regarding performance management process and to assign a value for each KPI, using Likert scale [1–6], in respect of their relevance in measuring the overall level of performance. We deliberately used an even number of grades in order to avoid neutral grades. Ugwu *et al.* (2006) and Lam *et al.* (2004) argued that the mean, standard deviation and t-test are not suitable statistical indicators in samples where ordinal scales and a small sample are present and causal relationship analyzed.

Therefore we applied Relative Importance Index (RII) (1) as the ranking method. The method provides a score calculated upon the weight given to each KPI (w), maximal weight given to a specific KPI (A) and total number of respondents (N). RII refers to a value within [0–1] interval. With higher RII the KPI becomes more important. The KPI relative important index is defined as follows:

$$\text{RII} = \frac{\text{S}w}{AxN}. \quad (1)$$

The method was propagated by many authors in similar cases (Chan 2004; Lam *et al.* 2004; Ugwu *et al.* 2006). Still, both T-test and the F-test were applied in order to verify the above arguments. Appendix A provides a listing of the 37 KPIs with RII, T-test and F-test values assigned for each KPI. The KPIs are presented in descending order, according to their respective RII. It can be seen how the criticism of t-test and f-test was right, since all values were higher than 0.05 and thus no difference could be identified. Therefore, judgment was made base only upon RII score.

## 5. The evidence from practice and academe – testing the hypotheses

### 5.1. Common listing of KPIs – H1

The respondents were given opportunity to add or remove KPIs from the initial list (see Appendix A), but none of them did so and so the final list remained the same. Project quality was presented as the most important indicator throughout all three perspectives and got a RII of 0.804. The explanation lies in the fact that every construction product is ultimately assessed through its quality, especially within end-users and so the requirement was high. The second most appreciated KPI was cost with its respective RII of 0.782. Since the construction is mainly market oriented, financial measures represent a vital role for an investor (owner), a client/user or a contractor in assessing the performance. Number of owner interferences (RII = 0.775) and Changes in Owner's Project Support (RII = 0.756) took the third and the fourth places, respectively. This illustrated the importance of scope management in construction projects where these two indicators implicitly showed the level of definition of projects in early phases. Time (Schedule) increase (RII = 0.753) and Time (Schedule) (RII = 0.739) were ranked high, probably because of symbiotic time-cost relationship. Employees' satisfaction (RII = 0.75) and Innovation and learning (RII = 0.743) represented psychosocial dimension and were adequately ranked. Identification of clients' interests (RII = 0.736) and Client satisfaction (RII = 0.75) showed high awareness of client/end-user as the most important stakeholder.

Table 2 shows how the Iron triangle KPIs (cost, time and quality/technical specifications) still remains dominant within top ten KPIs even though the KPIs are not the same across different management perspectives. Therefore, **H1 was tested and accepted**.

### 5.2. The perception of performance management – H2

H2 focused on the perception of performance management systems in construction companies.

Responses from questions, generated from H2, showed the following:

- Construction firms recognize a relatively high (4.50) level of KPI influence on the overall business success.
- 71% of the respondents to the survey stated that they had used some kind of performance indicators. Although KPIs were not methodologically and scientifically based, they served as a good foundation for further improvement initiatives.

− 63% of the companies used some kind of 1st level benchmarking which can be explained as a tendency towards constant improvement.

**Table 2.** The top ten KPIs regarding different project participants

| N | Investors | Contractors | Consultants |
|---|---|---|---|
| 1 | Client satisfaction | Quality | Changes in Owner's Project Support |
| 2 | Cost | Cost | Number of investor interferences |
| 3 | Communication (organizational) | Identification of client's interest | Cost |
| 4 | Time/schedule increase | Time/schedule | Employees' satisfaction |
| 5 | Time/schedule predictability | Cooperation with subcontractors | Profitability |
| 6 | Defects | Motivation | Satisfaction of project team |
| 7 | Avoidance of unprofitable processes | Productivity | Cost predictability |
| 8 | Quality | Innovation and learning | Changes in project objectives |
| 9 | Rework | Time/schedule increase | Motivation |
| 10 | Legal problems with Land | Client satisfaction | Cost increase |

− 43% of the respondents stated high interest for performance management systems, even though they had not understood its importance.

− Only 33% of the respondents used either performance or quality management systems or both. This showed that even though managers used KPIs, they were not aware of its dependence on the performance management system.

Therefore, construction firms did not recognize systematically and scientifically founded set of KPIs. Therefore the **hypothesis** – **H2 was accepted.**

### 5.3. The KPI classification – H3

The responses to the questions, generated from H3 showed that the majority (72%) still did not understand the distinction among leading (KPI), lagging (KPO) and perceptive indicators (PerM). This was very interesting finding, since, during H1 test, we had found leading indicators (KPI) – Innovation and learning and Changes in Owner's Project Support – lagging (KPO) and perceptive (PerM) within top ten indicators (Table 2). Such a low level of understanding among practitioners (28%), **rejected the hypothesis** – **H3**.

### 5.4. Differentiation among management perspectives – Hypothesis H4

Hypothesis H4 was of the greatest importance since it tested perception of KPIs among the different management perspectives. Appendix B shows all the 37 KPIs ranked in regard to a different management perspective and Table 2 the top ten indicators. Thus, while Investors were looking for Client satisfaction, Cost, Communication (organizational), Time/schedule increase etc, Contractors were looking for Quality, Cost, Identification of clients' interests, Time/schedule etc and Consultants were looking for Project support, Number of investor interferences, Cost, Employees' satisfaction etc. This clearly identifies different interests among key stakeholders in construction project in SSE. Therefore, investors, contractors and consultants observed performance from different angles which **accepted the hypothesis** – **H4**.

## 6. Discussion

Investors ranked Client satisfaction the highest, which is a logical subjective perception of their own position in projects. Cost as a traditional indicator took the second place. Time/schedule and Quality followed, acquiring the legacy of the traditional – Iron triangle perspective. Surprisingly, Time/schedule was not of such importance as was Time/schedule increase, probably because investors were not paying so much attention to an agreed deadline, as they were sensitive to its breach. The opposite happened with Cost. Investors were more interested in agreed cost than in its final increase. Legal problems with Land also ranked high probably because of investors' usual participation in land related projects. Just the opposite, Employees' satisfaction (contractor), Number of investor interferences, Project support and Contract issues were

**Table 3.** Final set of KPIs for different types of construction firms

| | | | |
|---|---|---|---|
| 1 | Quality[2] | 21 | Ready to build[2] |
| 2 | Cost[2] | 22 | Defects[2] |
| 3 | Number of owner interferences[1] | 23 | Time/schedule predictability[2] |
| 4 | Changes in Owner's Project Support[1] | 24 | Units[2] |
| 5 | Time/schedule increase[2] | 25 | Improvement in organizational capabilities[2] |
| 6 | Client satisfaction[3] | 26 | Cost increase[2] |
| 7 | Employees' satisfaction[3] | 27 | Communication (organizational)[1] |
| 8 | Innovation and learning[1] | 28 | Productivity[2] |
| 9 | Time/schedule[2] | 29 | Cost of work[2] |
| 10 | Identification of client's interest[2] | 30 | Organizational growth[2] |
| 11 | Satisfaction of project team[3] | 31 | Contract & legal disputes[2] |
| 12 | Cost predictability[2] | 32 | Productivity (organizational)[2] |
| 13 | Avoidance of unprofitable processes[2] | 33 | Market conditions[1] |
| 14 | Legal problems with Land[1] | 34 | Change of cost[2] |
| 15 | Cooperation with subcontractors[1] | 35 | Communication (project)[1] |
| 16 | Rework[2] | 36 | Deviations from standards[1] |

| | | | |
|---|---|---|---|
| 17 | Motivation[1] | 37 | Attitude to claims and debts[1] |
| 18 | Profitability[2] | | KPI – 1 |
| 19 | Continuity of work[1] | | KPO – 2 |
| 20 | Changes in project objectives[1] | | PerM – 3 |

ranked low, probably due to adverse interests of contractors and investors. Productivity, Motivation and Market conditions were at the bottom, probably because of investors' focus on effectiveness rather than on efficiency. It can be concluded that investors/owner were still spending a great deal of energy on financial indicators.

Contractors put Quality on the pole position KPI. Time and Cost also shared high rankings which indicated traditional perspective as well. Identification of clients' interests and Client satisfaction were ranked very high. This confirmed high economic pressures immanent to the construction. Cooperation with subcontractors was ranked very highly, which showed the trend and nature of their importance and share in construction projects. This fact should be of crucial importance when implementing performance scorecards in construction, such as The Balanced scorecard (Kagioglou *et al.* 2001). Motivation, Productivity and Innovation and learning were rated relatively high, probably because of high level of contractors' accountability. Number of investor interferences was ranked very high because of the opposite interests. Surprisingly, Cost increase and Market conditions were ranked very low. This could be explained with still a high level of traditional contracts within the industry. Communication (project), Contract & legal disputes and Improvement in organizational capabilities were ranked very low. This fact showed low perception of "management by projects" philosophy within construction sector in SEE. Motivation and Employees' satisfaction were of the greatest importance to contractors, then to investors, and generally, leading measures were ranked very low. This showed how contractors still prefer the traditional view of performance. Unlike investors, they showed higher interest for project level KPIs, and lower to organizational ones.

The consultants ranked Project support and Number of owner interferences (how many times was project delayed because of the owner) at the top, probably because of their accountability and authority in projects. Cost, Cost increase, Cost predictability and Profitability, just the opposite of the time group, were ranked relatively high as a logical indicator of their effectiveness and investors' profitability. Quality and Rework were also high, but not as high as within the investors' and contractors' set. Contract and legal disputes were ranked high as well, which can be explained with consultants' involvement in the earliest phases of projects and their awareness of the importance of procurement in construction projects. Communication (project) and Organizational capabilities were ranked in the upper section, probably because of consultants' distance and a broader view on improvement aspects. Conflicts and communication issues were ranked very low, which showed their focus on authority and responsibility for the project taken. Thus, Consultants showed more balanced perspective than others, regarding leading, lagging and perceptive measures, even though in most cases they were not aware that fact.

Table 3 shows final validated set of KPIs, which are ranked according to perception of all three management perspectives in the construction industry in SEE. Even though the top ten KPIs are mostly based on the Iron triangle the set introduces leading indicators as well, e.g.: Innovation and learning and Project support, and perceptive measures: Employees' satisfaction and Client satisfaction. Although the set is specially designed for construction companies in SEE, it can be applied to similar industries but with smaller adjustments of the indicators. KPIs must be constantly evaluated, aligned and benchmarked in order to be utilized successfully in the construction. At the end, the fact that surprised us the most was that none of the respondents did emphasize that Safety was missing from the initial set. That fact is even more surprising, if we take into account such a high rate of accidents at work in SEE (only in 2008, more than 4000 accidents on work had happened) and that safety performance is strongly related to companies that have superior planning and control, quality management, cost control, and subcontractor management policies (Ramirez *et al.* 2004). In further research this phenomenon should be further researched.

## 7. Conclusion

In this study we have found that:

- there is a commonly accepted KPI set;
- the construction industry still does not recognize performance management and KPIs as vital parts of their management processes;
- construction managers do not classify KPIs into leading, lagging and perceptive measures;
- KPIs differ among investors, consultants and contractors.

Furthermore, we have presented how different management perspectives in the construction industry in SEE perceive KPIs. Thus we have found that the industry does not recognize either the importance of a performance management system or importance of benchmarking, even though some companies were implementing KPIs. The top ten KPI's indicators that are appreciated among all three perspectives are: Quality, Cost, Number of investor interferences, Changes in project support, Time increase, Client satisfaction, Employees' satisfaction, Innovation and learning, Time and Identification of client's interest. This fact should serve as an encouragement in finding a commonly accepted set of KPIs that will be used for performance benchmarking of the construction industry. Quality had the largest influence on all project participants' perspectives. Perhaps this fact showed consciousness of the management in relation to the end-users. Also this study confirmed high influence of the Iron triangle perspective. Legal aspects seemed to be of low importance to SSE construction, where indicators like Contract and legal disputes and Attitude to claims and debts were ranked on the overall list on 31$^{th}$ and 37$^{th}$ place, respectively. Deeper analysis showed differences

in views among key project stakeholders. Thus, while Investors put their own interests in primary perspective, contractors do just the opposite (i.e. Contractors ranked Motivation, Productivity and Innovation and learning very high). Consultants' perspective was found to be of the broadest view. Thus, besides Profitability and Cost, they also consider leading indicators such as: Communication (on a project level) and perceptive indicators, such as Client satisfaction.

This research was conducted in order to stimulate further discussion and development of KPIs and serve as a foundation for developing a holistic performance management framework for the construction. KPIs have gotten much criticism in the area of target setting and selection of measures. This research has therefore provided a foundation for developing a KPI decision making platform and has also raised some questions for further research, e.g.: *How can managers determine KPI targets while taking into account market conditions? How can managers decide which indicators can create an unbiased image of organizational performance and, at the same time, reflect strategy implementation? Can construction companies be forced to use a predetermined set of KPI despite the turbulent market conditions?* However, the scope of this study did not include project level performance nor did it try to evaluate causal relationship between indicators, their influence on organizational performance, or efficiency and effectiveness of these measures in overall management processes. It is important to acknowledge that the construction environment is a turbulent one, where constant monitoring, control and benchmarking should be conducted continually (Yu *et al.* 2007). The industry should definitely manage performance better, taking into account a balanced set of indicators (KPI, KPO and PerM) and external market/client factors (Sommerville and Robertson 2000). For those who are planning to use this KPI set, it is highly recommended that they incorporate it into the specific situation regarding internal and external objectives of their organization.

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**Appendix A.** Relative importance index, t-test and F statistics applied to KPI set

| KPI | RII | RII – Inv. | RII – Contr. | RII – Cons. | Student's t-test | | | F test | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Inv | Contr | Cons | F | Sig. |
| Quality | 0.8043 | 0.8 | 0.7963 | 0.722 | 0.918 | 0.676 | 0.401 | 0.32 | 0.729 |
| Cost (per $m^2$ of similar objects) | 0.7826 | 0.833 | 0.7963 | 0.796 | 0.432 | 0.55 | 0.791 | 0.399 | 0.676 |
| Number of investor interferences | 0.7754 | 0.767 | 0.7222 | 0.796 | 0.728 | 0.9 | 0.504 | 0.219 | 0.805 |
| Changes in project support | 0.7569 | 0.733 | 0.7407 | 0.8 | 0.823 | 0.649 | 0.633 | 0.224 | 0.801 |
| Time increase | 0.7536 | 0.833 | 0.7407 | 0.704 | 0.791 | 0.7 | 0.878 | 0.086 | 0.918 |
| Client satisfaction | 0.75 | 0.867 | 0.7407 | 0.683 | 0.398 | 0.157 | 0.563 | 0.915 | 0.416 |
| Employees' satisfaction | 0.75 | 0.7 | 0.7222 | 0.767 | 0.944 | 0.875 | 0.909 | 0.016 | 0.984 |
| Innovation and learning | 0.7431 | 0.767 | 0.7407 | 0.683 | 0.781 | 0.367 | 0.328 | 0.78 | 0.471 |
| Time | 0.7391 | 0.733 | 0.7593 | 0.722 | 0.836 | 0.929 | 0.707 | 0.073 | 0.93 |
| Identification of client's interest | 0.7361 | 0.767 | 0.7778 | 0.733 | 0.719 | 0.165 | 0.242 | 1.329 | 0.286 |
| Satisfaction of project team | 0.7361 | 0.733 | 0.7222 | 0.767 | 0.603 | 0.834 | 0.654 | 0.198 | 0.822 |
| Cost predictability | 0.7319 | 0.767 | 0.7407 | 0.759 | 0.751 | 0.817 | 0.409 | 0.312 | 0.736 |
| Avoidance of unprofitable processes | 0.7246 | 0.8 | 0.7037 | 0.685 | 0.366 | 0.13 | 0.436 | 1.242 | 0.31 |
| Legal problems with Land | 0.7222 | 0.792 | 0.6667 | 0.708 | 0.239 | 0.217 | 1 | 0.934 | 0.411 |
| Cooperation with subcontractors: | 0.7153 | 0.7 | 0.7593 | 0.667 | 0.577 | 0.686 | 0.219 | 0.755 | 0.482 |
| Rework | 0.7101 | 0.8 | 0.6852 | 0.704 | 0.43 | 0.406 | 1 | 0.549 | 0.586 |
| Motivation | 0.7101 | 0.667 | 0.7593 | 0.741 | 0.52 | 0.592 | 0.837 | 0.403 | 0.673 |
| Profitability | 0.7014 | 0.467 | 0.7407 | 0.767 | 0.145 | 0.161 | 0.93 | 2.11 | 0.146 |
| Continuity of work | 0.6957 | 0.667 | 0.7222 | 0.685 | 0.956 | 0.629 | 0.436 | 0.322 | 0.728 |
| Change of scope | 0.6957 | 0.667 | 0.5556 | 0.759 | 0.572 | 0.743 | 0.107 | 1.059 | 0.365 |
| Ready to build | 0.6884 | 0.767 | 0.7222 | 0.63 | 0.769 | 0.309 | 0.23 | 1.059 | 0.366 |
| Defects | 0.6884 | 0.833 | 0.6852 | 0.611 | 0.43 | 0.234 | 0.565 | 0.904 | 0.421 |
| Time predictability | 0.6812 | 0.833 | 0.6481 | 0.685 | 0.4 | 0.666 | 0.51 | 0.543 | 0.589 |
| Units | 0.6812 | 0.733 | 0.6852 | 0.611 | 0.667 | 0.57 | 0.756 | 0.323 | 0.728 |

Continue of Appendix A

| KPI | RII | RII – Inv. | RII – Contr. | RII – Cons. | Student's t-test | | | F test | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Inv | Contr | Cons | F | Sig. |
| Improvement in organizational capabilities | 0.6806 | 0.733 | 0.6852 | 0.667 | 0.775 | 1 | 0.674 | 0.097 | 0.908 |
| Cost increase (% of increase of final against contracted cost) | 0.6739 | 0.667 | 0.6481 | 0.741 | 0.782 | 0.738 | 0.22 | 0.528 | 0.598 |
| Communication (organizational) | 0.6667 | 0.833 | 0.6296 | 0.611 | 0.117 | 0.079 | 0.906 | 1.951 | 0.167 |
| Productivity | 0.6522 | 0.5 | 0.7593 | 0.63 | 0.261 | 0.602 | 0.317 | 1.127 | 0.344 |
| Cost of work (per $m^2$) | 0.6522 | 0.567 | 0.6852 | 0.685 | 0.333 | 0.444 | 0.734 | 0.672 | 0.522 |
| Organizational growth | 0.6458 | 0.7 | 0.5556 | 0.65 | 0.65 | 0.92 | 0.376 | 0.375 | 0.692 |
| Contract & legal disputes | 0.6389 | 0.5 | 0.6481 | 0.65 | 0.636 | 0.676 | 0.903 | 0.18 | 0.837 |
| Productivity (organizational) | 0.6181 | 0.633 | 0.6111 | 0.617 | 0.959 | 0.93 | 0.845 | 0.018 | 0.982 |
| Market conditions | 0.5909 | 0.533 | 0.6481 | 0.63 | 0.63 | 0.872 | 0.64 | 0.188 | 0.83 |
| Change of cost | 0.587 | 0.533 | 0.5741 | 0.611 | 0.465 | 0.176 | 0.359 | 1.251 | 0.308 |
| Communication (project) | 0.5764 | 0.667 | 0.5926 | 0.567 | 0.856 | 0.689 | 0.782 | 0.097 | 0.908 |
| Deviations from standards | 0.5714 | 0.75 | 0.6875 | 0.463 | 0.921 | 0.398 | 0.169 | 1.126 | 0.346 |
| Attitude to claims and debts | 0.5625 | 0.7 | 0.5 | 0.55 | 0.291 | 0.667 | 0.248 | 1.131 | 0.342 |

**Appendix B.** KPIs ranked in regard to different management perspective

| N | Investors | Contractors | Consultants |
|---|---|---|---|
| 1 | Client satisfaction | Quality | Changes in project support |
| 2 | Cost | Cost | Number of investor interferences |
| 3 | Communication (organizational) | Identification of client's interest | Cost |
| 4 | Time increase | Time | Employees' satisfaction |
| 5 | Time predictability | Cooperation with subcontractors | Profitability |
| 6 | Defects | Motivation | Satisfaction of project team |
| 7 | Avoidance of unprofitable processes | Productivity | Cost predictability |
| 8 | Quality | Innovation and learning | Changes in project objectives |
| 9 | Rework | Time increase | Motivation |
| 10 | Legal problems with Land | Client satisfaction | Cost increase |
| 11 | Identification of client's interest | Changes in project support | Identification of client's interest |
| 12 | Innovation and learning | Profitability | Quality |
| 13 | Number of investor interferences | Cost predictability | Time |
| 14 | Cost predictability | Number of investor interferences | Legal problems with Land |
| 15 | Ready to build | Satisfaction of project team | Time increase |
| 16 | Deviations from standards | Continuity of work | Rework |
| 17 | Satisfaction of project team | Employees' satisfaction | Avoidance of unprofitable processes |
| 18 | Units | Ready to build | Continuity of work |
| 19 | Time | Avoidance of unprofitable processes | Time predictability |
| 20 | Improvement in organizational capabilities | Deviations from standards | Cost of work |
| 21 | Changes in project support | Cost of work | Client satisfaction |
| 22 | Employees' satisfaction | Units | Innovation and learning |
| 23 | Cooperation with subcontractors | Rework | Improvement in organizational capabilities |
| 24 | Organizational growth | Defects | Cooperation with subcontractors |
| 25 | Attitude to claims and debts | Improvement in organizational capabilities | Contract & legal disputes |
| 26 | Continuity of work | Legal problems with Land | Organizational growth |
| 27 | Changes in project objectives | Time predictability | Productivity |
| 28 | Cost increase | Contract & legal disputes | Ready to build |
| 29 | Motivation | Cost increase | Market conditions |
| 30 | Communication (project) | Market conditions | Productivity (organizational) |
| 31 | Productivity (organizational) | Communication (organizational) | Change of cost |
| 32 | Cost of work | Productivity (organizational) | Units |
| 33 | Market conditions | Communication (project) | Defects |
| 34 | Change of cost | Change of cost | Communication (organizational) |
| 35 | Productivity | Organizational growth | Communication (project) |
| 36 | Contract & legal disputes | Changes in project objectives | Attitude to claims and debts |

37 Profitability Attitude to claims and debts Deviations from standards

**PAGRINDINIŲ VEIKLOS RODIKLIŲ TAIKYMAS PIETRYČIŲ EUROPOS STATYBOSE**

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Santrauka

Šiuolaikinėje statybos įmonėje efektyvumu pagrįsto lyginimo svarba jau yra neišvengiama, o statybų pramonei tai reiškia nuolatinius iššūkius. Šiuo darbu siekiama išnagrinėti pagrindinių statybų sektoriaus veiklos rodiklių (PVR) reikšmę, vaidmenį ir rūšis bei pademonstruoti, kaip šie rodikliai vertinami remiantis skirtingais vadybos požiūriais. Apžvelgta literatūra, siekiant sudaryti akademinėje aplinkoje ir pramonėje naudojamų PVR sąrašą. Pasitelkus apklausas ir iš dalies struktūrinius pokalbius, buvo surinkti duomenys iš daugiau kaip 30 pietryčių Europos statybos įmonių. Išanalizavus rezultatus gautas galutinis 37 rodiklių rinkinys. Šiame tyrime nustatyta, kad įmonės menkai ką težino apie PVR modelius ir efektyvumo valdymo procesus. Be to, paaiškėjo, kad investuotojai, konsultantai ir rangovai PVR suvokia gana skirtingai, ir dėl to teko sudaryti PVR sąrašą. Dešimt pagrindinių PVR yra šie: kokybė, kaina, investuotojo kišimosi atvejų skaičius, pasikeitusi parama projektui, nukelti terminai, kliento pasitenkinimas, darbuotojų pasitenkinimas, naujovės ir mokymasis, laikas, kliento interesų nustatymas. Darbo pabaigoje pateikiamos baigiamosios pastabos ir PVR taikymo praktikoje rekomendacijos.

**Reikšminiai žodžiai:** pagrindiniai veiklos rodikliai, statybų sektorius, darbo efektyvumas, suvokimas, vadyba, požiūris.

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