

THE DEVELOPMENT AND USE OF KEY PERFORMANCE INDICATORS BY THE UK CONSTRUCTION INDUSTRY

Salma Y Mahmoud¹ and Stephen Scott²

Civil Engineering Department, Newcastle University, Newcastle upon Tyne, NE1 7RU, UK

The UK construction industry is considered to be one of the pillars of the domestic economy, but the industry underachievement highlighted in recent government reports has urged it to rethink the way it executes its work and challenged it by setting targets for improvement. Associated with these proposals was a strong recommendation to create an industry-wide performance measurement system to enable good companies to demonstrate their abilities and allow clients to select contractors and consultants on the basis of reliable data. In this context, this paper will describe the development of the construction Key Performance Indicators (KPIs) and raise some issues that are considered to be important about their use. Through a series of discussions with professionals in the industry and a number of interviews, it has been possible to gain an insight into some of these areas. Preliminary results have shown that the most noteworthy problems with the use of KPIs relate to the extent of their use by the industry, their definition and their interpretation.

Keywords: Egan Report, key performance indicator, performance evaluation.

INTRODUCTION

The Latham Report, 'Constructing the Team' (1994), identified significant shortcomings in the competitiveness and working practices of the UK construction industry. It also stressed the need to develop a more stable environment for the industry to prosper, setting a target of 30% real cost reduction in its projects, which was to be achieved by the year 2000. In the Egan Report, 'Rethinking Construction' (1998), Sir John described low and unreliable rates of profitability, little investment in research and development and in capital, lack of training, client dissatisfaction and fragmentation as the most severe problems facing the industry. As a result, he proposed the initiation of a movement for change as a means of sustaining improvement and set year on year targets to be achieved by the industry. While the Latham Report identified the first steps towards reforms, 'Rethinking Construction' built on those foundations and identified more ambitious targets for the industry to achieve in order to improve its performance. Sir John Egan believed that driving dramatic performance improvements requires the industry to measure its performance over a range of activities against clear, measurable objectives. These measures were set in terms of annual improvement by a 10% increase in predictability, 20% reduction in defects and the number of accidents and 10% increase in productivity, turnover and profits. The report also recognised the need for the preparation of comparative performance data to be shared with other companies and clients. Thus, a system of

¹ S.Y.M.Mahmoud@ncl.ac.uk

² Stephen.Scott@ncl.ac.uk

independently monitored company scorecards that measure the company's progress towards objectives and targets, rather than simple benchmarking, was recommended. Responding to these challenges, a package of performance metrics which construction enterprises can use to measure their performance against the rest of the industry was launched..

DEVELOPMENT OF THE KEY PERFORMANCE INDICATORS

The construction industry KPIs were 'produced by a partnership of the Department Of Trade and Industry (DTI), the Construction Industry Board (CIB), and the Construction Best Practice Program (CBPP) using data from the DTI, Building Cost Information Service, Construction Clients Forum, Health and Safety Executive ... and [a] third party financial analyst' (Construction Statistics Annual 2001). These are often called the government KPIs. The first release of KPIs, related to performance in 1998, was published in early 1999. The Department of the Environment, Transport and the Regions (DETR), the CIB and the Movement for Innovation (M⁴I) have continued, through the CBPP, to publish annual wallcharts for the headline KPIs (KPI Report 2000). Four wallcharts have been produced with the latest presenting 2000 performance, published in June 2002. The indicators represent the industry's performance in seven key areas:

- | | |
|------------------------|-------------------------|
| 1. Time | 5. Client changes |
| 2. Cost | 6. Business performance |
| 3. Quality | 7. Health and safety |
| 4. Client satisfaction | |

The KPIs, produced to address these seven areas, present the industry's performance by 10 headline measures. Seven of the measures relate to project performance and three are measures of company performance. The project performance measures are:

- | | |
|--|--|
| Client satisfaction-product | 5. Predictability-time (design and construction) |
| Client satisfaction-service | |
| 3. Defects | 6. Construction time |
| 4. Predictability-cost (design and construction) | 7. Construction cost |

The company measures are:

8. Safety
9. Profitability
10. Productivity

The 10 headline KPIs are intended to be used to provide a measure of the overall state of health of the organisation concerned. To cover more specific performance areas, operational KPIs were also produced. They bear on specific aspects of the organisation's activities and hence are expected to enable managers to identify and

focus on specific areas for improvement. Examples of indicators under this category include: time to rectify defects, cost of rectifying defects in the maintenance period, profit predictability, etc. To provide information on why certain changes may have occurred in the headline or operational indicators, diagnostic indicators were also offered. They are meant to be useful for in-depth analysis. The value of repeated business, the number of change orders and the amount of total final account outstanding at the 'available for use' stage are some examples of diagnostic indicators.

The KPIs are presented graphically in a wallchart format with the wallcharts being arranged as a 'family tree'. The highest level comprises the 'All Construction' wallchart, which includes data from the major construction industry sectors, excluding material suppliers. The second level consists of 6 sector-specific wallcharts presenting new build housing (public and private), new build non-housing (public and private), infrastructure and finally repair and maintenance and refurbishment.

More sector specific KPIs have also been produced in response to the benchmarking issues affecting areas like Mechanical & Electrical Contractors, Consultants and Materials Suppliers. The M&E Contractors KPIs were initiated by the Building Services Research and Information Association (BSRIA). The first KPIs for Mechanical & Electrical were launched in November 2000. The initiative to produce KPIs for Consultants was led by the Association of Consulting Engineers in conjunction with the Royal Institution of British Architects and Royal Institution of Chartered Surveyors and supported by the (DTI) and the Institution of Civil Engineers. These KPIs focus on training, profitability, productivity and client satisfaction, timely delivery, health and safety, value for money, quality and capability. They will be presented in a format that complements the construction industry KPIs.

INVESTIGATING THE DEVELOPMENT OF THE CHARTS

Method

Although the Construction Industry Key Performance Indicators Handbook (1999) describes the KPIs themselves and how they should be used, it does not explain how the charts were developed. In the absence of literature about this particular aspect, it was deemed helpful to gather information about exactly how the charts were constructed by interviewing a member of the KPI Working Group. The understanding gained from this process is reproduced in this section.

How the charts were developed

To show the range of performance in the industry, a chart was produced for each headline KPI by plotting 'benchmark score' horizontally against 'performance rating' on the vertical axis. The former is a measure of the best performance achieved, while the latter refers to the measured performance of the project or company under consideration. To simplify the explanation of the charts' development procedure, they will be grouped into three categories and each category will be explained in turn. The first procedure applies to all the charts that use a 1-10 scale for the 'performance rating'. This includes the client satisfaction-service, client satisfaction-product and defects charts. To produce these charts, data compiled from client surveys was used. The surveys were based on clients' assessment on a 1-10 rating scale. From the raw data sets (116 were collected), the numbers of occurrences of each score was identified. By then recording the frequency with which each score was chosen, it was possible to calculate the weight of this value as a percentage of the total sample size,

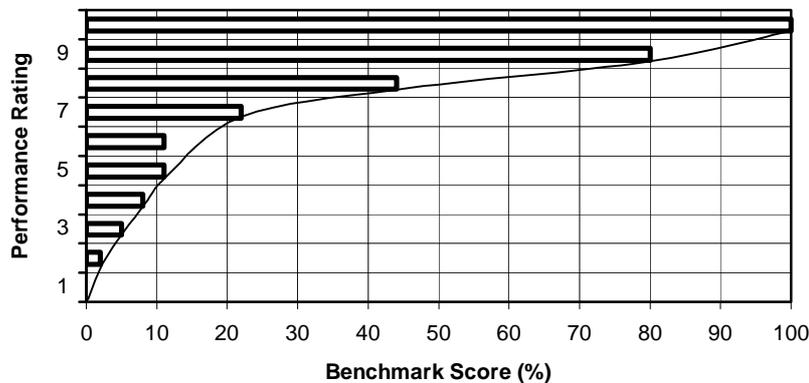
as shown in table 1. Consider, for instance, the case of the score 7. Among the 116 firms surveyed, 13 firms scored 7. That means that this specific score represents 11% of the total sample size. By recording the score frequency for the 9 different scores, it was possible to calculate the cumulative frequencies and consequently construct the 9 constituent bars of the chart.

Table 1: Histogram data

Score	Number of occurrences	Frequency	Cumulative Frequency
1	0	0	0
2	2	2	2
3	3	3	5
4	4	3	8
5	3	3	11
6	0	0	11
7	13	11	22
8	26	22	44
9	42	36	80
10	23	20	100
Total	116	100	

A histogram was then developed displaying these values. Having developed the histograms, a curve was then drawn joining the right-hand corners of all the histogram columns as shown in figure 2. This is the curve used on the charts.

Figure 1: Developing the KPI Chart from the histogram



The second procedure applies to the safety chart. For the production of this chart, good data was not available. However, from what was available, it was recognised that one point on the curve would be the ‘best accident rate’ and it was found that on some projects there were no records for on site accidents, thus (0) was considered as the ‘best accident rate’. It was also recorded that accident incident rate (the measure of the number of reportable accidents per 100,000 employed) was 1037 for the year 1999 (KPIs Handbook 1999). By arguing that the industry average should be at a benchmark score of 50%, a second point on the graph was determined. The worst rate of accidents for the industry was expected to equate to a (0) benchmark score. A straight line joining the two previously identified points, crossed the 0% benchmark at a value that is greater than 2000. The safety graph was thus shown as a dotted line based on an extrapolation from the industry’s best accident rate (0) and its mean (1037).

The third procedure applies to the remaining 6 graphs: predictability-cost, predictability-time, construction time, construction cost, productivity and profitability. To produce these charts, data gathered was arranged from worst to best, forming for some KPIs hundreds and for others thousands of data points. These data points were then plotted in a curve that was drawn to the best fit across all the points, producing a cumulative frequency curve. In all the graphs, the number of points used to draw any curve depends on the size of the data sets, as previously intimated. For instance, the client data was the hardest to get, therefore, only a few hundred data sets went on to these charts. On the contrary, for financial information and profitability curves, thousands of data sets were used.

INVESTIGATING THE USE OF KPIs BY THE UK INDUSTRY

Method

The findings presented in this paper are part of a preliminary investigation into the use of KPIs by the UK construction industry. The main aim of the investigation is to research the theoretical and practical aspects affecting the use of KPIs. Discussions with professionals in the industry and the study of specific examples of organisations, who have been willing to provide information on their approach to KPIs, have given an insight into some of the areas of interest concerning the way in which KPIs are being used. Two forms of interviews were carried out. The first was conducted with individuals responsible for collating/calculating KPIs in their organisations. These people were chosen because it was felt that they would understand the intricacies of acquiring and manipulating data needed by the process. The interviews focused on exploring the procedures followed by these organisations to calculate their benchmark scores. The interviewees were asked about the detailed procedures they follow to do this and the sources of the information used. In this process they were also asked to give an account of the difficulties encountered. Methodological notes were produced after tracking and observing how actual calculations and interpretations of the measures were accomplished in the organisations studied. The second form of interviews took place with those at higher levels in the organisations. The aim here was to get an overview of the organisations' intentions about KPI use, now and in the future.

Early findings

Findings are presented in the form of views about the way in which KPIs are being used by the industry. It should be recognised that the study that informs this work is in its early stages so the views proposed are only preliminary and may be subject to change when the study has been completed. Three main areas will be addressed and further considered in turn. These areas are:

- Extent of use of the government KPIs
- Problems with definitions of the government KPIs
- Interpretation of KPI results

Extent of use of the government KPIs

Only companies who are already using KPIs have been interviewed to date, but all of these organisations, although using the government KPIs, have also developed their own performance indicators. These indicators are sometimes referred to as 'local indicators' or 'detailed indicators'. The companies argued that the need to develop

these local PIs stemmed from their feeling that the government set of KPIs does not serve them fully. For instance, companies that are adopting new strategies to improve their performance (e.g. partnering) are interested in gauging how well they are doing and what has been the effect of the new strategies they have introduced. For these organisations, new indicators were therefore developed to allow the measurement of their specific objectives. In this way, they claimed that they would be able to measure their performance internally- using their own measures - and externally against the rest of the industry using the government KPIs. Future study in this area will survey the extent of use of KPIs by the industry as a whole and the additional indicators that organisations are using.

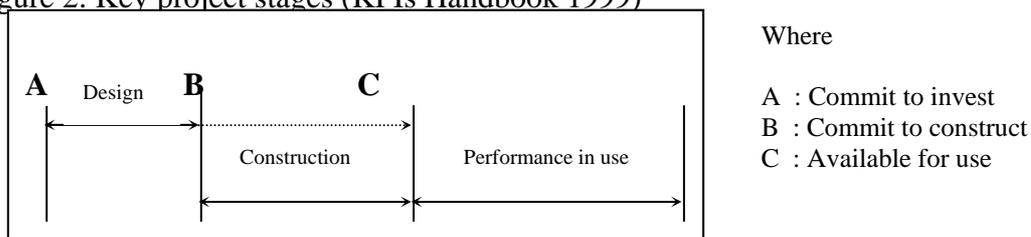
Problems with definitions of the government KPIs

To standardise the calculation process, the KPI handbook accompanying the charts gives definitions and example calculations for each of the ten headline indicators. Despite that, all the interviewees expressed concerns about the way in which KPIs were defined. In general, users feel that there is insufficient detail in the definitions to ensure that all who use them generate comparable figures.

Clearly, if the definitions allow of different interpretations, there is a risk that different organizations and even different sites in the same organizations may produce different figures for the same indicator. Therefore, the assessment will not compare like with like, which is one of the aims of KPIs. It would be a serious failure if a substantial majority of the KPI users were experiencing this problem with definitions. An example is given from one of the organizations studied, to show how the definitions allow different interpretations for the same indicator, measuring the same project.

Consider the project KPI, predictability-cost (construction). According to the definition, predictability-cost is defined as the actual cost at available for use (C) less the estimated cost at commit to construct (B) expressed as a percentage of the cost at commit to construct (B), (see figure 2). That means, the indicator calculation formula includes two main parts: the estimated construction cost and the actual construction cost.

Figure 2: Key project stages (KPIs Handbook 1999)



To determine the estimated cost of construction, the sample company considered two options: the first (case1) was an estimate of the works as known at the end of the design period (point B) and the second (case 2) included the cost of client variations (called by them, the final authorised spend). As a result, different values for the project performance rating and the subsequent benchmark were calculated as shown in table 2.

The generation of two alternative results (cases 1 and 2), from the calculation of the same indicator, has stemmed from the different ways in which this company perceived the estimated cost might be calculated. This difference introduced a noticeable impact on the resulting performance rating factors (9.58 & 0.93) and consequently in the benchmark scores (20% & 51%). Both alternatives seemed convincing for the

organization concerned but there was a worry about which value to consider. There is also a greater concern that this will lead to unrepresentative results due to the inconsistency in the way individual organisations generate the indicators. Any failure of the produced set of KPIs to allow consistent performance assessment contradicts one of the purposes for which the indicators were produced (see the KPI Report for the Minister for Construction 2000 for the purpose of the KPIs).

Table 2: The sample calculation the predictability –cost (construction) KPI

	Case 1	Case 2
Estimated Cost of Construction	£577,688	-
Final Authorized Spend	-	£627,188
Final Cost of Construction	£633,041	£633,041
Performance Rating	9.58	0.93
All Construction KPI	20.00 %	51.00 %

Interpretation of KPI results

It was noticed that among the people interviewed, the main concern was on how to produce these data (company and project performance KPIs) rather than considering how the information produced might be interpreted and used to the benefit of the organisation. If a company can generate KPI data over a number of years, it is argued that this will allow the company to see whether improvements are being made. However, if the successive data sets show improvement in some areas, while other areas have got worse, how will this be viewed? Another stated use of KPIs is to allow the impact of major changes in organisation structure/operating practices, etc., to be assessed, but again the KPIs produced may not allow an easy interpretation. Productivity may have increased slightly, but profitability may have fallen. As reported, the companies interviewed have not, as yet, spent much time considering this vital part of the process and the research undertaken will attempt to gain an understanding of how these issues will be addressed in the future.

CONCLUSION

Discussions with individuals involved in developing the government KPIs have allowed a better understanding of the production of the KPI charts to be provided. This should be helpful to all those who are trying to use and understand this data. At this stage in the research, the early findings to date indicated that those who use the government KPIs are also likely to keep their own sets of indicators. It was also found that all those interviewed were concerned that the definitions of the government KPIs were not tight enough, hence allowing different interpretations to flourish. In addition to that, the results have conveyed the notion that most of the efforts of the organisations using KPIs have been spent on deriving the KPI figures themselves, with little focus on how these figures should be used. Further study will investigate these areas more fully and recommendations will be made as to how the government KPIs can be improved.

REFERENCES

Construction Statistics Annual (2001)

<http://www.dti.gov.uk/construction/stats/stats2001/pdf/constat2001.pdf>

Department of the Environment, Transport and the Regions (DETR), (2000) *The Construction Industry KPIs Handbook*, DETR, Norwich

Egan, J, (1998) *Rethinking Construction: Report of the Construction Task Force to the Deputy Prime Minister*, Department of the Environment, Transport and the Regions (DETR), Norwich

Latham, Sir Michael, (1994) *Constructing the Team: Final report of the government/industry review of procurement and contractual arrangements in the UK construction Industry*, HMSO

Raynsford, Nick, (2000) *KPI Report for the Minister for Construction*, Department of the Environment, Transport and the Regions (DETR), Norwich.