

Australian Construction Industry KPIs

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Abstract

The Australian Construction Industry Forum (which is a peak industry association) and the Australian Procurement and Construction Council (which is a peak government organisation) have jointly agreed on a set of KPIs for the Australian Construction Industry. The goal of such a process is to work collaboratively in order to lift industry performance overall, and thereby bring about economic and social benefits to the industry and broader community. This paper seeks to underpin the process of KPI measurement by providing: an overview of international approaches to KPI measurement, summary of difficulties identified in performance measurement together with possible responses to these problems, and finally a discussion on the various methods for reporting KPIs. A number of findings throughout the paper, based on the review, made in order to advance the goal of performance measurement in the construction industry in Australia. Such findings would be relevant to other countries considering a KPI measurement process as well.

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Keywords: construction industry, KPIs, performance management system

1. Introduction

1.1 Background

The Australian Construction Industry Forum [ACIF] (the peak industry body for the construction industry in Australia) and Australian Procurement and Construction Council [APCC] (the peak government body for construction in Australia) have jointly prepared a set of national goals for the construction industry in Australia. It is envisaged that a National Performance Framework will be established based on this set of Key Performance Indicators [KPIs] and metrics for the building and construction industry.

The purpose of this paper is to provide a review of international approaches to measuring KPIs in the construction industry, together with some of the advantages and limitations of these approaches, and discuss the main ways in which KPIs can be reported. Lessons can be learned from these summaries for the implementation of a national KPI measurement and reporting system in Australia (as well as in other countries).

It is not within the scope of this paper to report on any KPI measurement undertaken to date. This is envisaged as forming the basis of a subsequent paper.

A key reason for undertaking KPI and other forms of performance measurement is so that management can assess progress towards goals and take appropriate action should performance fall below anticipated targets (Fernie et al. 2006). Such a process ensures that KPIs move from being merely an external marketing exercise, to an internal quality improvement exercise – a performance management system (Beatham et al. 2004). In order to be effective, a number of authors have advanced key aspects of any performance management system for the construction industry. Particularly, the following list of such aspects is compiled from the work of Anderson (1996) and El-Mashaleh et al. (2007) and the United States Airforce (1991). These authors argue, to be effective, the measures and reporting mechanisms for performance management systems should be:

- (1) Acceptable (Anderson 1996; United States Air Force 1991);
- (2) meaningful to industry (El-Mashaleh, Minchin and O'Brien 2007; United States Air Force 1991)
- (3) easily understood (Anderson 1996) (i.e. are simple, understandable and logical (El-Mashaleh, Minchin and O'Brien 2007)
- (4) repeatable, (El-Mashaleh, Minchin and O'Brien 2007, United States Air Force 1991);
- (5) show a trend over time (United States Air Force 1991);
- (6) suitable – they measure important things (Anderson 1996);
- (7) feasible – they are easy (Anderson 1996) and economical to collect (United States Air Force 1991);
- (8) effective – they concentrate on encouraging the right behaviour (Anderson 1996) and are unambiguously defined (El-Mashaleh, Minchin and O'Brien 2007; United States Air Force 1991);
- (9) aligned – must link to national goals for the industry (Anderson 1996);

- (10) timely (El-Mashaleh ,Minchin and O'Brien 2007; United States Air Force 1991).
 (11) drives appropriate action (United States Air Force 1991);

1.2 Proposed process

There are various processes for performance measurement systems which are advanced in the literature. One which would seem to follow the process envisaged by ACIF and APCC is set out below – based on (Camp (1989) and Alarcón et al. (2001)). The first step has already been undertaken by ACIF and the APCC in their agreement on the initial set of KPIs, and methodology for reporting these KPIs. A future project is envisaged which will collection and report data (the second stage). The CRC for Construction Innovation, soon to enter a new life as the Sustainable Built Environment Centre, has developed a number of tools which can assist construction firms to address short falls in specific areas (the third stage in the diagram).

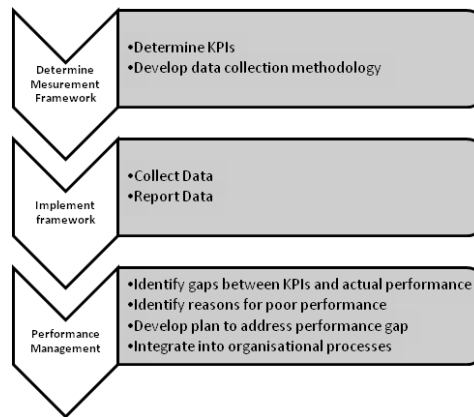


Figure 1: Australian Construction KPIs as a performance management system (based on Camp (1989) and Alarcón et al. (2001)).

The rest of this paper is devoted to examining international approaches to KPI measurement, and possible reporting formats for such data. Please note that all data used in the preparation of this paper is fictional, and does not represent actual industry performance, and is only meant to represent what such data might look like. In order to put such processes into perspective, the next section of the paper provides an overview of construction KPI measurement in other countries.

1.3 Summary of international approaches to KPI measurement¹

Bakens, Vries and Courtney (2005) undertook a comprehensive survey of approaches to benchmarking and KPI measurement across a number of countries. A number of different options clearly emerged from their study are summarised below:

¹ Data in this table is drawn from Bakens, W., Vries, O. and Courtney, R. (2005) *International Review of Benchmarking in Construction*

Table 1: Options available in KPI measurement¹

Unit of Analysis for data collection	Reporting levels	Data collection process	Data collection source	Data collection methodology
• Project • Firm • Industry	• Project • Firm • Sector • Industry	• Continuous • Longitudinal • Cross-sectional	• Internal • External • (to company)	• Voluntary surveys • Compulsory surveys • Professional assessment • National statistical data

The proposed Australian KPI process would include:

Industry. Future stages may extend to the firm	Industry. Future stages may extend to the firm level	Longitudinal	External (possibly internal)	Nationally statistics, supplemented with surveys (if necessary)
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A number of issues should be noted from this international comparative approach. Firstly, the **unit of analysis**. Bakens, Vries and Courtney (2005) found that most current approaches to Construction KPIs around the world are conducted at the firm or project level. Consequently, the methodology for data collection requires the extensive use of surveys of firms. Such an approach certainly allows for fine grained analysis of data at the project or firm level, and allows for firms to compare their performance against national averages. However, it is reliant upon self reporting of data, and requires significant resources to maintain. Additionally, analysis of the performance of the industry as a whole is reliant upon aggregating up from the specific voluntary responses of individual firms, so is fraught with sampling issues. This is the source of numerous difficulties noted in Section 2.

The EUROSTAT approach is different, as it uses existing statistical data for its reporting. However, the available EUROSTAT reports do not make for easy reading apart from by economists. The other approaches– including the UK model – do provide simple reporting mechanisms.

Finding 1: Ideally the Australian model would obtain data from available data sources (such as the Australian Bureau of Statistics) in order to be cost effective. However, data should be reported in a format which is readily understandable by industry (charts).

As the most widely imitated, and critiqued, the Constructing Excellence approach from the UK deserves further attention. The UK system of KPI assessment initially included **10 KPIs** (Kagioglou, Cooper and Aouad 2001) . 1) Client satisfaction – product; 2) Client satisfaction – service; 3) Defects; 4) Predictability – cost; 5) Predictability – time; 6) Profitability; 7) Productivity; 8) Safety; 9) Construction cost; and 10) Construction time. More recently these KPIs have been broadened to include social and environment performance as well as economic performance (an example of triple bottom line reporting). For example, the 2006 data collection involved the following set of 30 KPIs and was derived from 12 separate numerous sources(Constructing Excellence 2006).

Table 2: Current set of UK KPIs being measured and reported (Source: Constructing Excellence 2006).

<i>Economic KPIs</i>	<i>Social KPIs</i>	<i>Environment KPIs</i>
<i>Client satisfaction – product</i>	<i>Employee satisfaction</i>	<i>Environmental impact</i>
<i>Client satisfaction – service</i>	<i>Staff turnover</i>	<i>Energy use – product</i>
<i>Defects</i>	<i>Sickness absence</i>	<i>Energy use – process</i>
<i>Predictability – Cost</i>	<i>Safety</i>	<i>Water use – product</i>
<i>Predictability – Time</i>	<i>Working hours</i>	<i>Water use – process</i>
<i>Safety</i>	<i>Qualifications & skills</i>	<i>Waste removed from site</i>
<i>Productivity</i>	<i>Equality and diversity</i>	<i>Commercial vehicle movements</i>
<i>Profitability</i>	<i>Training</i>	<i>Impact on biodiversity</i>
<i>Construction Cost</i>	<i>Pay</i>	<i>Area of habitat created / retained</i>
<i>Construction Time</i>	<i>Investors in people</i>	<i>Whole of life performance – product</i>

Two important elements should be noted here – firstly, **the number of KPIs** being measured and reported has increased over time. As with any process, the involvement of multiple stakeholders can tend to increase the number of issues being measured.

Finding 2: Future extension to the Australian Construction KPI project could include additional measures to facilitate international comparisons.

Secondly, there are **numerous sources of data** for the various KPIs being measured (Constructing Excellence 2006). While this can increase the rigor of the results, it also increases the resources required to measure. Some of these issues have resulted in critiques of the UK approach to KPI measurement from industry, which are discussed in Section 2 below.

2. Difficulties with measuring and reporting KPIs

In order to properly provide advice on KPIs for the industry, a review of some of the drawbacks of current implementations is necessary. The purpose of this summary is not to argue against the implementation of KPI measurement in Australia, but rather to summarise perceived difficulties with other approaches, and learn from this discussion. Numerous authors have identified difficulties with KPI implementation in various countries, although critiques of the UK models are the most prevalent². Critiques include such matters as:

- Subjective assessment of some of the key measures (particularly satisfaction and some approaches to the assessment of quality) (Chan and Chan 2004)
- Some of the measures are crude and open to interpretation (Fernie, Leiringer and Thorpe 2006), or lag behind activity so far as to not be very useful (Costa et al. 2006)
- While raising the profile of benchmarking in the industry - attempts to improve industry performance have largely failed due to lack of involvement with top level coordinating agencies (Fernie, Leiringer and Thorpe 2006) or failure to engage significant numbers from industry (Costa et al. 2006)

² To be fair the UK model has also been the most widely adopted and may yet prove to have the widest impact of all the schemes reviewed here

- Large number of KPI schemes under way at the same time leading to fragmentation, frustration in the industry (Kagioglou, Cooper and Aouad 2001)
- data overload³ (Robinson et al. 2005) and
- large investment (cash and in-kind) required to implement, measure and report on the data (Robinson et al. 2005)

It would be wise to consider how to respond to such criticisms for any implementation of a KPI based performance management system in Australia. In order to respond to these criticisms raised in relation to implementation of KPIs in other countries the following recommendations are made:

Table 3: Summary of Criticisms to KPI Measurement and Proposed Responses

<i>Criticism</i>	<i>Proposed Response</i>
<i>Subjective assessment</i>	<i>Rely on objective measures collected by independent organisations / sources</i>
<i>Crude / questionable measures</i>	<i>Use measures which are agreed to by all stakeholders, and are valid</i>
<i>Lack of coordinating agencies</i>	<i>Engagement of peak bodies (ACIF and APCC)</i>
<i>Large number of schemes → fragmentation</i>	<i>Engage peak bodies (ACIF / APCC)</i>
<i>Data overload</i>	<i>Report results simply (perhaps with indexes of multiple KPIs)</i>
<i>Large (cash and in-kind) investment required</i>	<i>Where possible, use data which is already collected to reduce costs</i>

It should be noted that these solutions involve some trade-offs. While cheaper to implement and resulting on less demands on industry, using available statistical data collected external to firms means that the reporting occurs at an industry level⁴. Consequently, this high level of ‘granularity’ means that it will be difficult to single out individual entities which may be contributing significantly to poor performance against a particular metric. Largely this is due to the Privacy Act, which prevents individual entities from being identified in government statistics. In specific cases through (such as OH&S) jurisdictions would take logically take action against specific firms which contributed to the death or injury of workers, so this may not prove to be as significant an issue in the reporting of KPIs. In other words, using and reporting data collected at the industry level:

- is efficient – the majority of data is already collected and is publicly available;
- can be sustained over the long haul, as significant high level funding is not required for this specific activity
- is less suspect to respondent error, and controls are in place to ensure quality of data collection in the various agencies;
- lends itself readily to time series analysis– which are critical to establishing trend data;

³ An example of this is a report to a minister which proposed KPI measurement and reporting at multiple levels (headline, operational and diagnostic), across all levels in the supply chain, and at multiple points in the project life cycle.

⁴ Externally collected statistics have long been advocated in the benchmarking literature (Fernie, Leiringer and Thorpe 2006), so should not be seen as ‘second best’ to surveys. However, the majority of construction specific KPI implementations around the world have relied upon internal assessment reporting by companies

- enables the performance of the construction industry to be compared to the performance of other industries, which is a goal in the current KPI framework.

Finding 3: Where possible data from existing national data sets should be used

3. Methods of reporting KPIs

A number of possibilities exist for the reporting of KPI data. The main options (line charts, Venn diagrams, bar charts, tables and graphic representations, are reviewed below.⁵

3.1 Line charts

Depending on the data being represented, a number of possible formats exist. For numerical data, the KPI target can be represented as a straight line with the actual data shown against the goal. Such charts can be shown for individual KPIs and a graph is needed for each KPI.

This type of reporting mechanism is used for individual measures reporting in the UK by Constructing Excellence (Constructing Excellence 2006), although the data is represented in order for individual companies to benchmark their performance against other organisations. In order to represent the entire set of KPIs, a wall chart of A3 size is needed in order to display the multiple graphs (Packham and Print 2007)

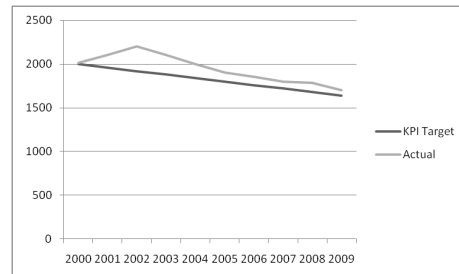


Figure 2: Actual performance versus KPI (individual KPI)

The Scottish Construction Forum provides a useful example of this, which is similar to that of Construction Excellence in the UK. The advantages of this approach are that the trend over time can be seen – although the amount of data shown may be overwhelming if large numbers of KPIs are reported

3.2 Venn diagrams

For a summary graph which reports the performance of a company against all of the KPIs a Venn diagram is often useful. Many existing KPI researchers use Venn diagrams such as that used by the Centre for Construction Innovation (CII 2006). A similar approach is used in the Scottish Construction Forum, which reports overall performance against multiple criteria.

⁵ Data in all of the graphs in this report is based on fictional data and is for representation purposes only. No actual or future industry performance against of KPIs is implied or intended.

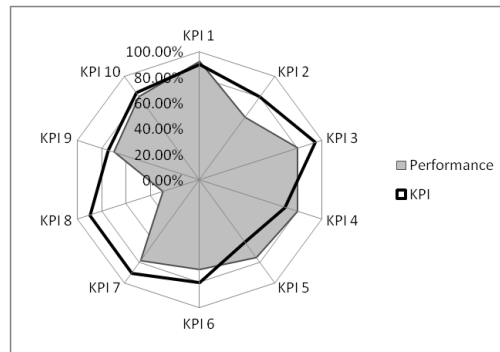


Figure 3: Venn Diagram showing multiple KPIs (Based on Packham and Print 2007)

This approach has the advantages of providing a summary of the performance against multiple KPIs at once, so that the strengths and weaknesses of a company become readily apparent.

The advantage with this approach is that all of the performance against individual KPIs is reported in a single diagram. The down side with this approach is that the historical trend data is not shown , just a snapshot over time.

3.3 Data tables with colour coding

The USA based Construction Industry Institute also conducts KPI reporting, although at the project and organisational level (CII 2006). Below is an example of the types of graphs they use to report against various KPIs. The colour coding indicates areas which are performing well (white and light grey), or poorly (dark grey and black). (CII actually use various colours for their charts). With this type of diagram, multiple KPIs are reported, but the trend data is not shown.

KPIs	Target	Actual	Difference between target and actual
KPI 1	1600	1400	0.875
KPI 2	1400	1300	0.928571
KPI 3	1600	400	0.25
KPI 4	1400	1350	0.964286
KPI 5	1600	1200	0.75
KPI 6	1400	1200	0.857143
KPI 7	2000	1500	0.75
KPI 8	1200	600	0.5

Figure 4: KPI performance scorecard (Based on CII 2006)

3.4 Bar chart with graphic symbols

Another example from the Scottish Construction Forum is the use of bar charts, with additional graphic symbols. The advantage of the bar chart is comparison with other states can be undertaken, and those targets which are being met, or are not being met can be highlighted with simple graphical elements.

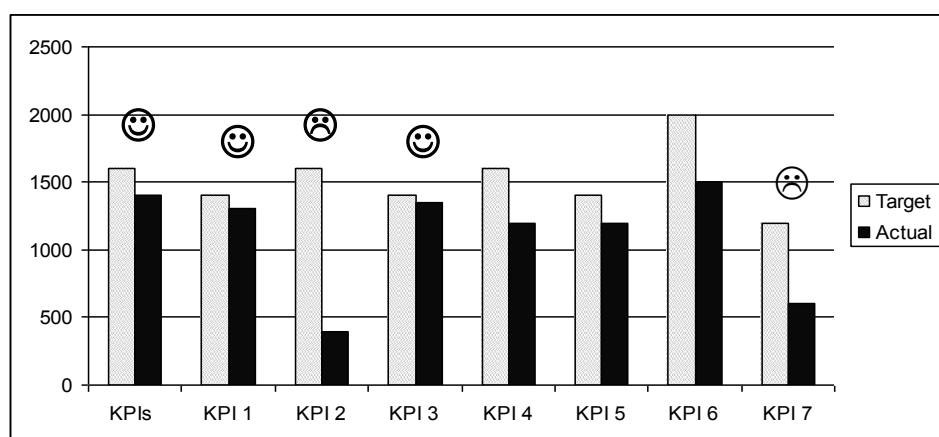


Figure 5: Bar Chart with Graphic Symbols (Based on Packham and Print 2007)

3.6 Graphical symbols with trend data

The final option presented here is the methodology for reporting on Sweden's environmental quality objectives. Under this system a set of national targets for the environment have been agreed to at a national level, and a simple reporting system indicates whether the targets will be met 😊, can be met if additional measures are put in place 😐; and the objective will be very hard to meet in the defined time frame ☹️. Trend data is also included. Sub goals and overall goals are all reported on the one page. Full details for each KPI are presented in subsequent sections of the report.

KPI	Performance for 2014	Trend	Legend: 😊 - KPI has been met 😐 - KPI can be met with additional resource ☹️ - KPI unlikely to be met even with additional resources ↗ - trend in KPI is positive ⇔ - there is no trend evident ↘ - the trend in KPI is negative
KPI 1	😊	↗	
KPI 2	😊	⇔	
KPI 3	☹️	↗	
KPI 4	😊	↗	
KPI 5	😊	↘	
KPI 6	☹️	⇔	
KPI 7	😊	↗	
KPI 8	☹️	↘	

Figure 6: Report card using trend and summary graphics (Based on Swedish Environmental Objectives Council 2007)

3.7 Summary of dashboard approaches

In this section we have reviewed a number of possible ways of reporting KPIs – particularly the graphical approaches. As noted in the text there are strengths and weaknesses with each approach and these are summarised below:

Table 4: Summary of Graphical Reporting Method

Reporting style	Positives	Negatives	Comments
Line graphs	Able to show historical perspectives and compare KPI goals with actual performance	One graph per KPI, means that a large amount of space is required if multiple KPIs are being measured.	The line graph provides an excellent way of showing industry performance against the KPI. Can only show performance of a single KPI per chart. May be best suited for the detailed reporting of KPIs.
Venn Diagrams	Able to show performance of companies or industry against multiple KPIs	Unable to report on trend data	Venn diagrams show performance of multiple KPIs at the same time, although trend data is not available
Colour coded tables	Colour coded tables provide a higher level of detail. Multiple KPIs can be reported	Unable to show trends. May not be attractive to people who prefer visual representation (graphics)	Colour coded tables can provide significant amount of data. However, not graphical and does not show trends
Bar chart with graphic symbols	Bar charts provide another way of showing performance against targets. Multiple KPIs can be reported	Not able to show trend data.	While able to show multiple KPIs, trend data is not available.
Graphical symbols	Graphical approaches provide simple ways of reporting performance and trends	Some people may regard 'smiley faces' as trivialising the data.	Simple reporting of multiple KPIs and trend data, although alternative graphics need to be identified.

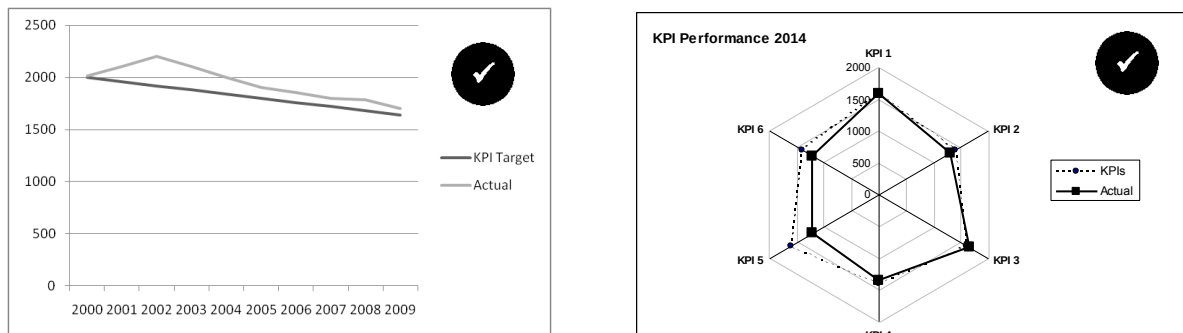
Ideally, dashboard reporting should be able to demonstrate both performance as well as trend data against a goal. While the line graphs can do both of these tasks easily, where a large number of KPIs to be measured and reported, then this can result in an overload of charts and diagrams, and therefore be counterproductive. As an example, the UK chart now comprises some 30 KPIs (Constructing Excellence 2006), and reporting of this number of KPIs using line diagrams requires an A3 poster, which is reflected in the criticism of data overload. With 30 charts and diagrams to review, the data load can be overwhelming. One possible way around this is for the one page dash board report envisaged, to report KPIs at an aggregate level – to create indexes around the key areas identified by ACIF – safety, productivity, economic security, skills and training, and environmental sustainability. This would reduce the number of charts on the page, while still providing a robust assessment of the performance of the industry against the KPI.

Obviously there are a number of options available for reporting KPIs. The option below is recommended, as it attempts to provide the best of each of the reporting formats identified above.

3.8 Recommended reporting format

The following sample does not exist but demonstrates how various elements can be combined in an attempt to provide a best of breed for the Australian context Venn diagram and line diagram with

graphical symbols. Obviously each KPI would have its own graph. A tick is used instead of a smiley face as this provides top level overview of the KPI.



Legend:

- ✓ On target to reach goals
- ✗ Needs attention to achieve goals
- ✗ Significant effort needed to achieve goals

4. Conclusion

This paper has set out to advance the goal of establishing an Australian Construction Industry KPI measurement process. To this end, a review of current international approaches to KPI measurement has been undertaken, together with a summary of perceived weaknesses of current approaches. Potential responses to minimise or address these perceived weaknesses have been advanced. Subsequently a review of approaches to the reporting of KPIs has been advanced. This review also resulted in a suggested format for reporting on Australian Construction KPIs at a national level.

While focussing on the implications of these findings for Australian context, other countries and industries can also derive information from this paper which would assist them as they consider implementing a KPI measurement system.

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