

# BALANCED SCORECARD PERFORMANCE MEASUREMENT AND CONTRACTOR SELECTION USING A WEB-BASED SYSTEM

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## Abstract

In a very competitive construction business environment there is a need to measure and manage business performance across a wider spectrum of business success criteria. The Balanced Scorecard (BSC) and Triple Bottom Line (TBL) reporting concepts are emerging as champions in the race for sustainable business success. The construction business organisations are often judged based on their financial performance as well as wider performance. This paper aims at developing a universally accepted tool for assessing contractors' wider business performance in the construction industry. A prototype of web-based business performance measurement system has been developed to help contractors assess their own performance aimed at uplifting their performance. The consultants/clients can also use the tool to measure contractors' performance in a value-based contractor selection.

The system was developed based on the research conducted among 63 senior construction professionals and therefore further research with the participation of a large number of managers across different countries and also an upgrade of the system will be required.

**Keywords:** Business Performance Measurement, Balanced Scorecard, Web-based system

## 1. Introduction

Six widely reported 'real challenges' faced by facility procurement decision-makers, arising from relentless pursue of the cheapest initial cost and bottom-line profits are [19]:

1. The cheapest initial capital price is seldom the most economic long-term solution,
2. Negative conflict-ridden approaches result in a litigious atmosphere in which win-lose mentality prevails locking out many creative solutions and win-win possibilities,
3. Stakeholder-value generating possibilities are seldom revealed through a short-term profit gain or capital cost-reduction focus leading to win-lose outcomes,
4. Project participants and their supporting communities often experience detrimental quality-of-life impact and often pay high indirect cost through an unhealthy focus on profit maximization or initial cost reduction,
5. The environment is degraded and consequences of waste generation are borne by communities, and

6. Increasing number of project stakeholders including a diverse group of individuals such as project team participants and others who will be ultimately affected by the project.

According to Walker, *et al.* (2000), the given solutions to all of the problems stated above are the procurement of projects on the basis of 'best value' not 'cheapest initial price', partnership approach to project procurement, and focus on triple-bottom line or balanced scorecard performance. This paper proposes an approach for selection of project team members based on a balanced scorecard performance measurement with the focus on 'best value' and stakeholder management ability. In addition, a web-based contractor evaluation system has been developed. The research findings of a previous research has been used to design the system accompanied by some reflections of the practical experience gained by the authors in pre-qualification and tender evaluation processes. The web-based system is appropriate for use in the public sector as it ensures an effective selection system that is supported by a research, fair, encouraging competitiveness amongst service providers, and free of possibilities for deception and political influences.

## **2. Wider Performance Measurement and Management in the Construction Industry**

Financial accounting measures of performance have been the traditional mainstay of quantitative approaches to business performance in construction companies. However, it is a good sign that construction companies are now gradually moving towards non-financial measures of business performance. In the construction industry, much of performance management at the operational level is carried out using specific true indicators of performance, which are usually not measured in financial terms. At the top most levels, although financial performance is inevitably a major consideration, there has been increasing recognition that other important factors in the effective running of the organization can not be well captured by such financial measures. It is to be accepted that a business organization successfully operating in the construction industry has to properly address the pressing challenges imposed by the growing wider community concerns about organizational performance in terms of financial, environmental and social (known as 'Triple Bottom Line - TBL'). It has been recognized and thus emphasized in several research studies that in the present day business environment success of a project or an organization involved in a project is to be judged based on the TBL performance [20]. The Balanced Scorecard (BSC) approach, can be considered as a system that advances the concept of TBL and provides a better implementation mechanism and demonstration for TBL performance of the organization (and or projects) through effective measurement, reporting and management of the critical aspects of TBL including Intangible Assets (IA).

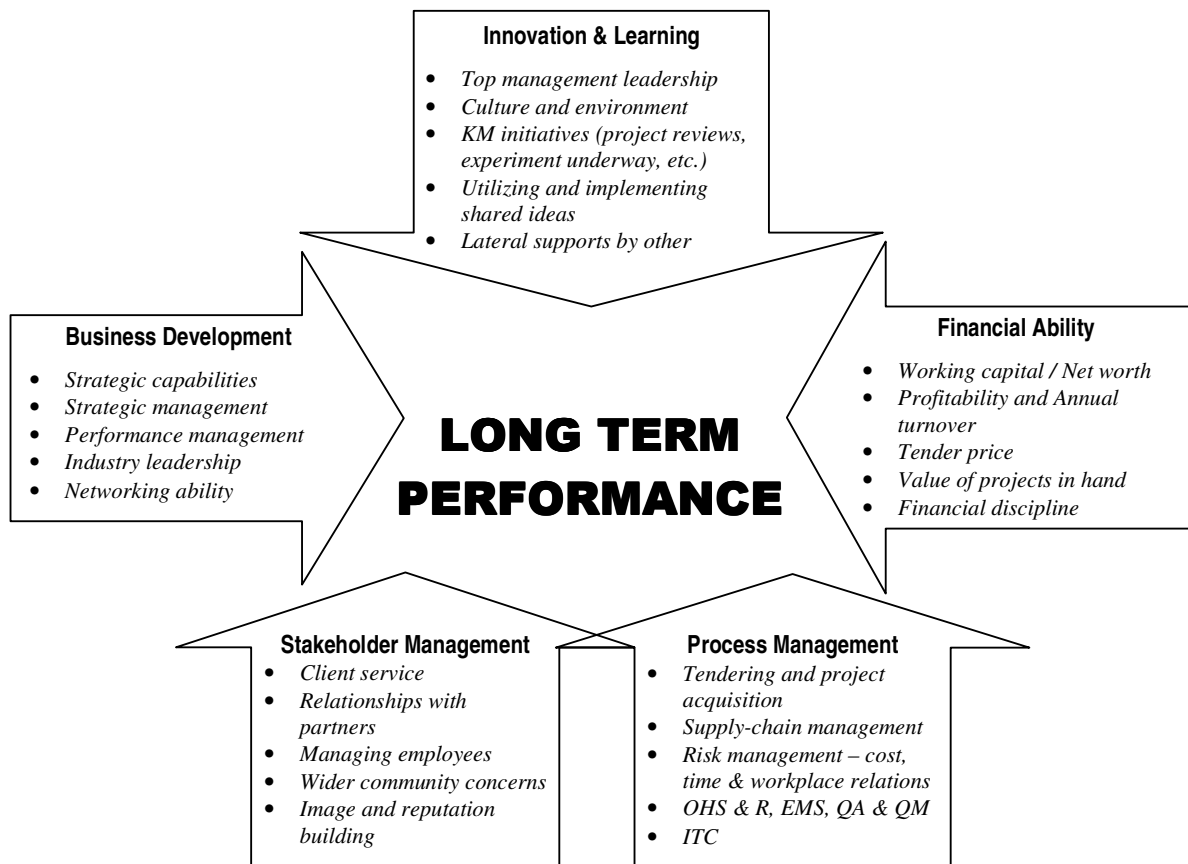
## **3. Balanced Scorecard System for Project Team Selection**

The BSC performance measurement and management system includes financial measures and operational measures on customer satisfaction, internal processes, and the organisation's innovation and learning activities. This set of measures gives managers and stakeholders a fast but comprehensive view of a construction business (9) and its true performance. It is based on the fact that the financial measures are lagging indicators and are the results of the other three leading indicators (also known as "operational measures") [10]. These three leading indicators while being drivers of financial performance of a

business provide an early indication of future financial performance of the business. Kaplan and Norton (1996a) state that the original BSC framework invented by them is only a template. Different perspectives can emerge depending on industry circumstances, organisational strategies, performance drivers, factors that create competitive advantage and breakthroughs for an organisation. Accordingly, the original BSC framework was amended considering all critical issues that influence contractors' business performance in the construction industry. The amended BSC is called the "Construction Balanced Scorecard" (CBSC) (See Figure 1).

The CBSC framework introduced above was developed based upon the following management (performance management) models:

- Evolving management models that are recommended for the 21<sup>st</sup> Century (As discussed in 17, 18 & 3).
- Tender-evaluation and pre-qualification models used in the procurement of public works in Australia and Sri Lanka (Refer Table 1).
- Business excellence models such as Malcolm Baldrige National Quality Award (1), and European Foundation for Quality Management Award [14].
- Conceptual performance measurement frameworks in construction, such as Project Delivery System framework [17], Stakeholder Performance Measurement [13], and Morrison Group's Operational Scorecards [16].
- Construction performance measurement models (conceptual), Contractors' Grading Systems, Construction Excellence Award Evaluation criteria, etc. (Refer Table 1).



**Figure 1:** The CBSC Framework (Source: Johnson, 2003)

Based on the information derived through the above mentioned literature review, a content analysis was carried out to map the essential performance measures in contracting organisations and a preliminary BSC framework was developed. It is essential that the criteria used in the selection of a contractor should comprise the measures that the contractors themselves also believe to be good indicators of their own performance. Thus, the perceptions of contractors and resource persons in regard to contractors' business success were examined and compared with the preliminary BSC framework to determine the final set of performance measures in the CBSC.

The BSC performance measurement benefits contractors enormously in their day-to-day business activities. It provides a framework for implementing and managing strategies at all levels which are usually aimed at achieving TBL performance.

Traditionally players in the construction industry have been more concerned about financial and process management of the construction organizations.

Therefore, the selection criteria used to assess a project team member (contractor and/or consultants) has been centred largely on these issues.

Research studies carried out in Australia and Sri Lanka has now revealed that top managers of construction companies are now very interested in stakeholder management and innovation & learning aspects of their performance [7 & 8] to market their services. Respondents believe that the challenge that every construction organization facing now is to successfully manage these two vital areas of performance to achieve sustainable success in the industry. Already organizational attention has been diverted to wider performance reporting at least in larger construction companies, such as Thiess Contractors in Australia. Therefore, on the other hand, in the construction industry, any procurement decision has to be made, whether it is the selection of the project parameters or project team members, on the basis of the long-term wider performance outputs and outcomes. This is crucial for all public sector procurements. The clients also need to demonstrate the transparency of the selection method in that it would not only encourage business and professional ethics of the client teams but also continuous learning on the part of the tenderers as well as other project stakeholders. This methodology would reward the better performer while encouraging the organisations to strive for continuous improvement which is beneficial for the construction industry (and its stakeholders) at large. This paper concentrates on the contractor selection.

#### **4. The Current Practice in Selecting a Contractor**

A review of literature on contractor selection revealed that the most frequently used criteria for selecting construction contractors are as follows:

**Tender price:** initial capital cost, annual life cycle cost (running and maintenance costs) (4).

**Financial capability:** annual turnover, net assets, credit ratings, liquidity, bank arrangements, bonding capacity, value of work-in-progress, etc. (4, 5 & 15).

**Technical ability:** experience, plant and equipment, personnel, construction methods and systems, etc. (4).

**Management capability:** past performance, planning, controlling, organisation, organisational arrangements, management of human resources, quality management, quality of work, and existence and application of quality control programs, etc. (4 & 15).

**Relationships:** prior business relationships with clients/their representatives, subcontractors, suppliers, local authorities, dispute and claim history, negotiation skill, etc. (2, 4, 5, 6 & 22).

**Resources:** physical resources, quality and quantity of human resources, training or skill level of craftsmen, quality and quantity of managerial staff, work load, etc. (2 & 22).

**Health and safety performance:** safety policy, safety system, frequency of safety audits, safety history, health and rehabilitation management, etc. (15).

It is important to note that the degree of emphasis and weight assigned to each criterion are different and are largely dependent on the circumstances and specifics of the project as well as the preferences of the decision makers and their different experiences (4 & 22).

Balanced Scorecard Performance Aspects	PQC (QLD)	CBPS (NSW – DPWS)	PASS (HK-HA)	CPIS (HK-HA)	NMA Template	PIPS(SHFG-DAGS /PWD)
1. Innovation & Learning	√ M	√ H	X	√ L	√ H	√ VL
2. Client Satisfaction	√ M	√ H	√	√ L	√ H	√
3. Internal Process Improvement	√	√ H	√	√	√ H	√
4. Social Responsibility & Corporate Citizenship	√	√ H	√ L	√ M	√ H	√ L
5. Business Development	√ M	√ H	X	X	√ H	X
6. Financial Performance	√	√	√	X	√ H	X
Extent of wider performance considerations (L – Low level, H – High level, M – Medium level, VL - Very low level) √ = yes, X = no, CBPS – Contractor Best Practice Scheme, CPIS – Contractor Performance Index System, DAGS – Department of Accounting and General Services, DPWS – Department of Public Works and Services, HK – Hong Kong, HA – Housing Authority, NMA – National Museum of Australia, PASS – Performance Assessment Scoring System, PIPS – Performance Information Procurement System, PWD – Public Works Division, SHFG – State of Hawaii Facilities Group						

**Table 1:** Tender Evaluation or Pre-qualification Models and the extent of wider Performance Considerations

On the other hand, there is no consensus as yet on a common set of criteria for contractor selection. It is stated that the strategy used for bid evaluation should reflect the clients' objectives usually in terms of cost, time, quality, functionality and security. As the clients' requirements vary from project to project the strategy (thus criteria) should be adjusted accordingly. This also requires decision makers and advisors to make some subjective assessment, **but it has been found that subjective approaches in these areas do not necessarily serve the best interests of the client** [4].

Owing to its importance in bringing about the most required change in the industry and most sophisticated clients' needs together with an increase in alternative forms of project delivery system, the contractor evaluation continues to receive close attention by construction researchers. Despite this, evaluation criteria themselves largely remain unchanged. This can be seen from the consensus towards contractors' financial, managerial, technical, health and safety, quality and past performance aspects [22].

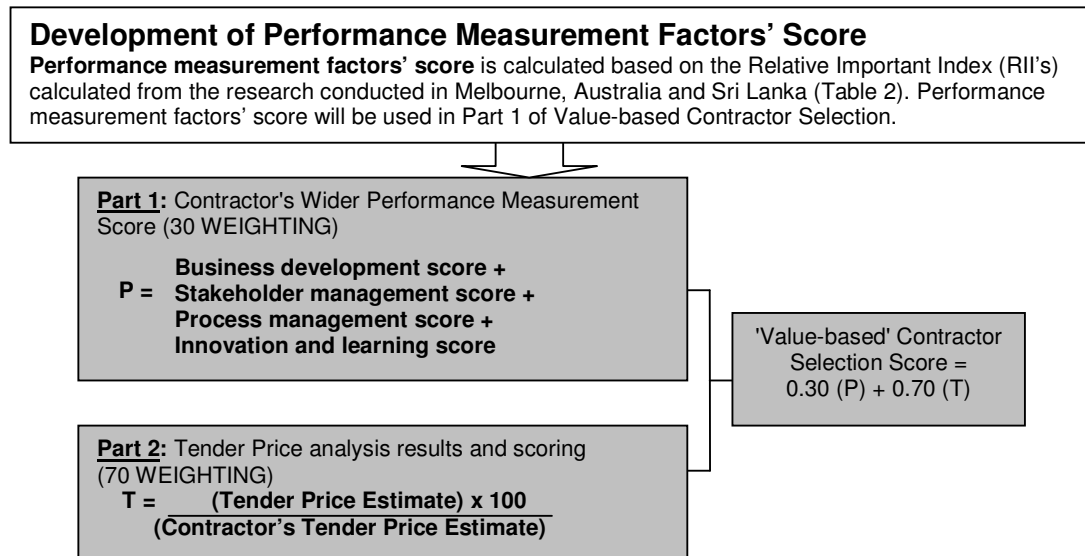
It has been emphasised by Kumaraswamy and Walker (1999) who argued that contractors should be assessed not only at the registration and pre-qualification stages but also at the final tender evaluation stage. Such practice to a certain extent is currently in existence in government sectors in countries like Hong Kong, Singapore, Australia and America (Refer to Table 1). This is contrary to some previously held view in the industry, that pre-qualification provides a list of capable tenderers who should thereafter be judged merely against price criteria [12]. In order to be successful in acquisition and execution of the projects, it is required that there should be a series of activities taking place at the background which supports the contractor's overall performance.

Therefore, in selecting a contractor it is essential that there is a scanning process which takes into account all critical elements and sub-elements of CBSC.

The research [7] participants reluctantly support a pure value-based selection methodology. However, they unreservedly supported a system that considers both tender price and contractor's wider performance with majority of them agreeing to 70:30 weighting, respectively.

## 5. The Framework of the Value-based Contractor Selection System

Based on research results [7 & 8] and reflections of the industrial experience the following system is proposed for a 'value-based' contractor selection. The wider performance measurement process consists of three main activities, such as selection of key performance measures, development of performance measurement factors' score and measurement of wider performance in terms of a qualitative figure (Figure 2). In order to achieve this, data was collected from a survey amongst 63 senior managers in contracting and consultancy organisations in Melbourne, Australia and Colombo, Sri Lanka. Table 2 shows the maximum factors' scores that are calculated based on their Relative Important Indices (RII). Contractors' performance in terms of each measure can be identified by evaluating relevant contractor performance based on four (4) scale value (0.25, 0.50, 0.75, 1.0) and multiplying the value with each maximum factor score. The wider performance measurement score can be calculated from all performance measures/factors and results can be integrated into Part 1 of value-based contractor selection system. The second process is the tender price analysis and calculation of the tender price score. The tender price score is calculated using the quantity surveyor's (or engineer's) estimate as the baseline. The tender price analysis as explained below is desirable where the cost estimate is precise and reliable. If the estimate is not reliable, other analysis techniques which use the deviation amongst the tender prices as the basis for scoring also can be used (see Table 3).



**Figure 2:** Framework of Value-based Contractor Selection System

PERFORMANCE MEASUREMENT FACTORS	RII	Maximum Factor Score
<b>1.0 Business Development:</b>		
1.1 Developing strategic capabilities:	0.76	4.819
1.2 Proactive strategic management:	0.79	5.010
1.3 Performance measurement and management:	0.83	5.263
1.4 Delivering value for money:	0.88	5.580
1.5 Networking with stakeholders:	0.71	4.502
<b>2.0 Stakeholder Management:</b>		
2.1 Client service:	0.89	5.644
2.2 Managing project team partners:	0.85	5.390
2.3 Managing employees:	0.81	5.136
2.4 Wider community concerns:	0.71	4.502
2.5 Image and reputation building:	0.77	4.883
<b>3.0 Process Management:</b>		
3.1 Responsive tendering:	0.89	5.644
3.2 Supply chain management:	0.78	4.946
3.3 Risk management:	0.81	5.136
3.4 OHS,EMS,QA & TQM:	0.78	4.946
3.5 Information and communication technology:	0.77	4.883
<b>4.0 Innovation and Learning:</b>		
4.1 Top management leadership:	0.78	4.946
4.2 Culture and environment:	0.75	4.756
4.3 Knowledge management initiatives:	0.73	4.629
4.4 Implementing shared ideas:	0.75	4.756
4.5 Lateral supports by other industries:	0.73	4.629
<b>TOTAL</b>	<b>15.77</b>	<b>100</b>

**Table 2:** Performance measurement factors' scores

The following analysis of the tender prices and scoring system is self explanatory.

<b>(Tender Price Estimate is \$10,500,000)</b>		
	<b>Tender Prices</b>	<b>Scoring (cost base line)</b>
<b>Tenderer A</b>	<b>\$10,205,000</b>	<b>102.89</b> (\$10,500,000 x 100/ \$10,205,000)
<b>Tenderer B</b>	<b>\$12,821,000</b>	<b>81.90</b> (\$10,500,000 x 100/ \$12,821,000)
<b>Tenderer C</b>	<b>\$11,900,000</b>	<b>88.24</b> (\$10,500,000 x 100/ \$11,900,000)
<b>Tenderer D</b>	<b>\$12,500,000</b>	<b>84.00</b> (\$10,500,000 x 100 / \$12,500,000)
<b>Tenderer E</b>	<b>\$9,750,000</b>	<b>107.69</b> (\$10,500,000 x 100 / \$9,750,000)

**Table 3:** Tender Price Analysis & Scoring system

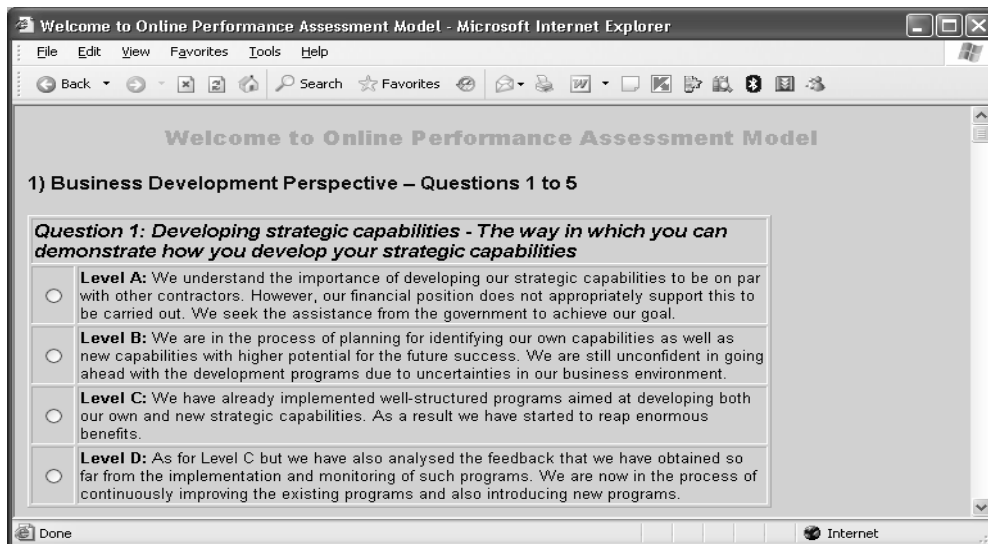
<b>CONTRACTORS</b>	<b>SCORE (Out of 100)</b>				
	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>
1. Contractor's Wider Performance Measurement Results (30 WEIGHTING) (results from the on-line system with 20 measures)	95	85	98	83	50
2. Tender Price analysis results and scoring (70 WEIGHTING) - (refer to Tender Analysis system provided below)	103	82	88	84	108
<b>COMBINED SCORING (Performance: Price = 30:70)</b>	<b>100.5</b>	<b>82.8</b>	<b>91.2</b>	<b>83.7</b>	<b>90.4</b>
<b>RANKING</b>	<b>1</b>	<b>5</b>	<b>2</b>	<b>4</b>	<b>3</b>

**Table 4:** 'Value-based' Contractor Selection System for Building Projects

## 6. Web-based System for Selecting a Contractor

This section illustrates the application of web-based technology to facilitate the value-based contractor selection process. The web-based system is based upon the value-based contractor selection framework (Figure 2). An interactive web-based solution is developed to perform the above analysis. This system allows tenderers to login into the system and submit their responses for questions related to selected wider performance measures. The scoring sheets are very much similar to on-line questionnaire where the tenderers select appropriate answers provided by clicking on them. There are twenty (20) questions and when the questions are fully answered, the wider performance score is calculated and displayed on screen. Thus, the contractor is educated about his performance while the score is recorded for use in the tender evaluation. It should be noted that the coefficient index (RII's) of formula embedded in the system.

Next, the system analyses the tender prices received in comparison with tender estimate to determine the scoring for tender piece. Subsequently, the system calculates a combined score for wider performance and submitted tender price based upon 30:70 ratios respectively to enable value-based ranking of contractors. The Web-based performance assessment system was developed by using Active Server Page (ASP) format instead of HTML format. The reasons of using ASP are following as (1) ASP supports Microsoft Access Database, (2) ASP format is compatible with HTML format, and (3) ASP supports Visual Basic script.



**Figure 3:** The example of users interface for evaluating contractors' performance

At the beginning of assessment, contractors will be asked to fill contact information and their authentication information, such as username and password. When the contractor answers each and every question, the system will calculate and show their overall performance score (see Figure 4).



Question	Score
Q10	4.594572
Q11	2.89735
Q12	2.607616
Q13	2.81457
Q14	3.787251
Q15	2.359272
Q16	2.214404
Q17	2.421358
Q18	2.31788
Q19	2.421358
Q20	2.297186
Overall Performance Score	65.458808

**Figure 4** Overall performance score of a contractor

## 7. Conclusions

In the present day construction business environment there is a need to measure and manage business performance across a wider spectrum of business success criteria.

This paper proposes a universally accepted tool based on BSC system for assessing business performance for contractor selection in the construction industry. The prototype of web-based business performance measurement tool was developed to help contractors and also consultants/clients. The developed CBSC performance measurement system has only four main components: business development, stakeholder management, process management, and innovation & learning. The web-based contractor selection system is simple. It utilises RIIs calculated through research to assign a performance score out of 100 for each contractor (or tenderer). In addition, the system analyses the tender prices received in comparison with tender estimate to determine the scores for submitted tender prices. Subsequently, the system calculates a combined score for contractor's wider performance and tender price enabling value-based ranking of contractors. A further research with the participation of a large number of managers across different countries is required. The possible upgrade of the system will be to systematically record each contractor's verified performance over a period of time to track the continuous performance improvement.

## References

- [1] BNQA (Baldrige National Quality Program) (2003), "Criteria for Performance Excellence", Available: [www.quality.nist.gov](http://www.quality.nist.gov) (Accessed 2003, December 20).
- [2] Fong, P. S. and Choi, S.K. (2000), "Final contractor selection using the analytical hierarchy process", *Construction Management and Economics*, 18: 547-57.
- [3] Galbreath, J. (2002), "Success in the relationship age: building quality relationship assets for market value creation", *The TQM Magazine*, 14(1): 8-24
- [4] Hatush, Z. and Skitmore, M. (1997a), "Criteria for contractor selection", *Construction Management and Economics*, 15: 19-38.
- [5] Hatush, Z. and Skitmore, M. (1997b), "Assessment and evaluation of contractor data against client goals using PERT approach", *Construction Management and Economics*, 15: 327-340.

- [6] Jennings, P. and Holt, G.D. (1998), "Prequalification and multi-criteria selection : a measure of contractors' opinions", *Construction Management and Economics*, 16: 651-60.
- [7] Johnson, A.J.J. (2003a), "Managing Construction Business Performance – Effective use of a Balanced Scorecard Approach", *Unpublished Master thesis, Department of Building and Construction Economics, Royal Melbourne Institute of Technology, Australia.*
- [8] Johnson, S.J. (2003b), "Measuring Contractors' Business Performance – Effective use of a Balanced Scorecard Approach", *Unpublished Minor thesis, Department of Building Economics, University of Moratuwa, Sri Lanka.*
- [9] Kaplan, R. S. and Norton, D.P. (1992), "Balanced Scorecard - Measures that Derive Performance", *Harvard Business Review*, January-February: 71-79.
- [10] Kaplan, R. S. and Norton, D.P. (1996a), "The balanced scorecard - translating strategy into action", *Harvard College, America.*
- [11] Kashiwagi, D.T (1997), "The Development of the Performance-Based Procurement System", *ASC Proceedings of the 33rd Annual Conference, University of Washington - Seattle, Washington: 275 – 84 , Available: <http://asceditor.unl.edu/archives/1997/kashiwagi97a.htm> (Accessed: 2003, November 22)*
- [12] Kumaraswamy, M. M. and Walker, D.H.T. (1999), "Multiple performance criteria for evaluating construction contractors", *Procurement systems in construction: A guide to best practice*, S. Rowlinson and McDermott, Routledge/E and FN Spon: 228-51.
- [13] Love, P. E. D. and Holt, G.D. (2000), "Construction Business Performance Measurement: the Stakeholder Perspective Measurement Alternative", *Process Management Journal*, 6(5): 408-16.
- [14] Neely, A. (1999), "The performance measurement revolution: why now and what next?", *International Journal of operations and production management*, 19(2): 205-228.
- [15] Palaneeswaran, E. (2000), "Contractor selection systems for design-build projects", *Department of Civil Engineering, The University of Hong Kong: 334.*
- [16] Sommerville, J. and Robertson, H.W. (2000), "A scorecard approach to benchmarking for total quality construction", *International Journal of Quality and Reliability Management*, 17(4/5): 453-66.
- [17] Walker, D. H. T. (2000), "A balanced scorecard approach to procurement - a wider stakeholder relationship perspective", *Unpublished paper.*
- [18] Walker, D. H. T. and Johannes, D. (2001), "Organisational learning intentions and joint ventures in Hong Kong infrastructure projects: a pilot study", *17th ARCOM Conference, University of Salford, UK.*
- [19] Walker, D. H. T. and Walker, B.M.L. (2002), "A Balanced Scorecard approach to stakeholder relationship management", *Unpublished paper abstract, Available: <http://dhtw.tce.rmit.edu.au> (Accessed: 2002, December 15)*
- [20] Walker, D.H.T., Hampson, K.D., and Peters, R. (2000), "Relationship-Based Procurement Strategies for the 21st Century", *AusInfo, Australia.*
- [21] Kumaraswamy M.M and Walker D.H.T. (1999) 'Multiple performance criteria for evaluating construction contractors' in *Procurement Systems: A guide to best practice in construction* edited by S. Rowlinson and P. McDermott, E & FN Spon, London, UK
- [22] Wong, C. H., Holt, G.D. et al. (2000), "Lowest price or value? Investigation of UK construction clients' tender selection process", *Construction Management and Economics*, 18: 767-74.