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An exploratory study of information technology evaluation and benefits management practices of SMEs in the construction industry

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Abstract

While the number of articles on IT evaluation and benefits management has been substantial, limited attention has been given to these topics in small and medium-sized enterprises (SMEs), particularly the construction industry. This paper presents findings from a questionnaire survey that sought to examine the approaches used by 126 construction organisations to evaluate and justify their IT investments, as well as the benefits and costs that they have experienced due to IT implementation. The analysis of their responses identified three key findings. Firstly, different organisation types significantly differ in the amount they invest in IT and their firm size (in terms of turnover and number of employees) does not influence investment levels in IT. Secondly, the evaluation process adopted by construction SMEs is used as for both control and learning. Thirdly, a major barrier to justifying IT investments was attributed to having no strategic vision. While organisations experienced no significant differences in the tactical and operational benefits incurred after the adoption of IT, differences were found with respect to the strategic benefits. If construction SMEs are to leverage the benefits of IT, then this should form an integral part of their business strategy. Considering this, recommendations for IT evaluation for construction SMEs that are also pertinent for SMEs operating in other industry sectors, are presented.

Keywords: Australia; Construction; IT benefits and costs; Evaluation; SMEs

1. Introduction

The deployment of IT within businesses has often resulted in the replacement of old problems with new, and the expected business benefits of IT not realised [5,23,27,42,43,44,49–51,54–58]. Despite increasing expenditure on IT, productivity has not increased and this has given rise to a 'productivity paradox' [6,20–22,39,48]. The difficulties of identifying benefits have been discussed and it has been suggested that some businesses may not have received any [40,57]. According to David, there is often a time lag before the benefits are achieved [12]. In fact, his research has shown that productivity benefits begin to emerge once the diffusion rate of technology in the industry surpasses 50%. Brynjolfson and Hitt and Stirroh have also shown that it takes time for the productivity benefits to be achieved [7,46]. Stirroh noted that the construction sector in the US did not experience

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increases in productivity between 1995 and 1999; this industry sector lagged behind others in embracing IT. Like the US, the construction sector in Australia is a 'laggard' in terms of its productivity output and adoption of IT when compared to other sectors of the economy [13,37,60]. Considering this, we examined the approaches used by construction small medium-sized enterprise (SME) to evaluate and justify their IT investments, etc.

2. Background to the Australian construction industry

SMEs represent a major business sector in the industrial world and it has been widely recognised that they make a significant contribution to an economy's well being [14]. Yet, scant attention has been paid to IT evaluation and benefits management in SMEs [4], especially in Australia [38]. There are approximately 158,000 construction firms in Australia, and an overwhelming majority are micro-businesses, employing an average of 2.3 people. Moreover, 94% of businesses in this sector employ fewer than five people and only 800 firms—or less than 1%—employ more than 20 people. Less than 5% account for 90% of the industry's total output; yet it provides employment for 9% of the total Australian workforce.

The construction industry, through the products that it creates, its size, and its ability to create employment, is likely to influence an economy's gross domestic product (GDP) more than any other service industry. An increase of 10% in the Australian construction industry's efficiency, would improve the economy's service industry contribution to GDP by over 2.5% [47]. Consequently, it is essential that the industry operate efficiently and productively. The Latham Report, which investigated ways of improving the UK's construction industry, suggested that the effective implementation of IT could reduce project costs by as much as 30% [31]. Calls for organisations in the Australian construction industry have also been made in the publication of a number of government-initiated reports. Yet, IT benefit and costing in construction is a complex process [2] and the problems associated with assessing benefits, and costs seem to be more acute in construction than any other industry [35]. Some reasons are the peculiar size and structure of the construction industry, its fragmented supply chain, and under capitalisation.

3. IT investment justification

Weill and Olson quoted a figure of 2% of revenue as being a nominal figure for IT investment and specifically noted that such as estimate was likely to be an underestimate due to the decentralised nature of organisations and the purchasing of end-user equipment from revenue rather than capital [53]. In some organisations, the investments may exceed 50% of annual capital investment and it has been suggested that, by 2010, the average IT expenditure will be 5% of revenue [19]. In contrast, construction contractors' investments in IT have been found to be less than 1% of their turnover [52].

The process of investment justification has been identified as a major barrier to implementing IT in many construction firms [3,8,9,32,33]. A lack of awareness about information and communication technologies coupled with the importance of cash flow contributes to making the evaluation processes burdensome, requiring considerable resources. Managers often view the justification process as a barrier to be overcome and not as a technique contributing to competitive advantage in the marketplace [10]. The inability of construction organisations to quantify the full implications of their investments in IT, results in serious implications in not carrying out rigorous evaluation. Lack of management guidelines to support investment decision making may force organisations to adopt one of several dubious positions [29,45]:

- a refusal to implement an IT infrastructure that could aid the firm's long-term profitability;
- an investment in IT as an act of faith; or
- use of creative accounting (assigning arbitrary values to benefits and costs) as a means of bypassing the justification process.

It is widespread practice during the investment process to account for the upper estimates for costs and the lower estimates for benefits. But still IT projects run over budget, as much of the problem lies in lack of management understanding of IT cost. Andresen et al. found that construction organisations

regarded the use of evaluation techniques as a costly ritual of legitimacy that did not generate value to the decision-making process. Construction organisations using traditional approaches to appraise their IT often do not know how to evaluate the impact of IT investments on their organisation. Furthermore, it has been suggested that generic evaluation techniques exclusively based on standard accounting methods simply do not work, an application specific approach recommended [17,28].

4. Identification of IT costs

4.1. Direct costs

Direct IT costs are often underestimated [25,41]. They may include unexpected additional hardware and installation and configuration are often classified as direct costs.

4.2. Indirect costs

The indirect costs are more significant than direct costs. Organisational costs can arise from the transformation from old to new work practices. At first, a temporary loss in productivity may be experienced. Additional organisational costs may be experienced once the basic functions of the system are in place. These are associated with management's attempts to capitalise on the wider potential of the system at the business and project level. Companies with extensive IT infrastructures in place, tend to change their corporate shape, by reducing the number of management levels [24]. The costs of organisational restructuring are expensive, particularly when isolated groups within the company resist change.

Management time has been the most significant indirect cost experienced by construction organisations. Invariably, time is spent leading, planning, and organising the integration of new systems into current work practices. The result of implementing newly adopted technologies may also force management to spend time revising, approving, and subsequently amending their IT strategies. In addition, significant resources are used to investigate the potential of IT and in experimenting with new information flows and modified reporting structures.

Another indirect cost may result from employees who have developed new skills requesting revised pay scales or leaving to go to competitors. Clearly, such 'indirect' costs need to be captured and brought into the IT decision-making process.

5. Research method

A review of the literature revealed that only a limited number of studies examined the evaluation process, benefits and costs of construction organisations. The industry is project-based and therefore there is a high degree of interdependency between organisations. Thus, different evaluation and benefits management practices of organisation types, such as architects, consulting engineers, consulting project managers, quantity surveyors (QS) and contractors were examined to provide an overview of IT management practices. With the exception of a few contracting organisations, almost all are SMEs and are typically defined by the number of people they employ. Here, we defined an SME as employing less than 250 people.

As the construction industry has been slow to embrace IT, we examined the evaluation practices as well as the costs and benefits incurred. More specifically, however, we tested the following hypotheses:

1. there are no significant differences in IT investments with firm size and type;
2. there are no significant differences between organisations in their approaches to evaluating and justifying their IT investments;
3. there are no significant differences between organisations motivations for IT adoption;
4. there are no significant differences in the benefits and costs incurred by organisations.

Larger construction organisations have been found to invest more in IT than their smaller counterparts. However, as the construction industry has a low adoption rate, there should be *no significant difference* between firms in terms of their investment. Similarly, we suggest that this also applies to the motivation for adopting IT, approaches to evaluation and the benefits and costs incurred.

In testing these hypotheses, a questionnaire was developed and distributed to construction organisations

Table 1
Reliability and consistency measures for scales

Scales	Mean ($N = 126$)	Cronbach's alpha (α)	Pearson correlation
Strategic benefits	2.73	0.88	0.46
Operational benefits	2.92	0.78	0.28
Tactical benefits	3.01	0.89	0.37
Direct costs	2.95	0.84	0.37
Indirect costs	2.52	0.91	0.47
Justification inhibitors	2.21	0.82	0.83
Evaluation process	2.32	0.92	0.53
Motivation	3.36	0.75	0.258

throughout Australia. Eight research variables were included in the study to test the hypotheses. The research variables and their operationalisation as items are presented in Table 1. The variables were derived from the literature [26]. Respondents were asked to indicate, using a 5-point Likert scale, the extent to which the eight factors were undertaken or had been experienced with 1 indicating 'not at all' and 5 indicating 'to a very large extent.' The responses were subjected to reliability and validity tests.

5.1. Questionnaire survey

Stratified random sampling was used to select the study sample from telephone directory "Yellow Pages." Prior to determining the sample size, a pilot survey of 25 selected organisations, which consisted of architects, consulting engineers, consulting project managers, contractors and quantity surveyors from the Metropolitan region of Melbourne, in the State of Victoria, Australia. This was undertaken to test the potential response rate, suitability and comprehensibility of the questionnaire. Each organisation was contacted by phone and informed of the aims of the study. On obtaining their consent, the proposed questionnaire was mailed, with a stamped addressed return envelope enclosed, for respondents' returns, including comments and feedback. The respondents were also asked to review the design and structure of the survey. All comments received were positive, and, as a result, the questionnaire remained unaltered for the main survey. The response rate for the pilot survey was 100%. In the main survey, 50 questionnaires were mailed to each of the organisation types throughout Australia; this equated to 250 questionnaires distributed. One hundred and one valid responses were received. As the pilot questionnaire required no change, they were added to the sample, resulting in 126 valid responses representing a total consolidated response rate of 42%.

5.2. Sample characteristics

Figs. 1 and 2 provide a breakdown of the responses by organisation type and state. Figs. 3 and 4 provide

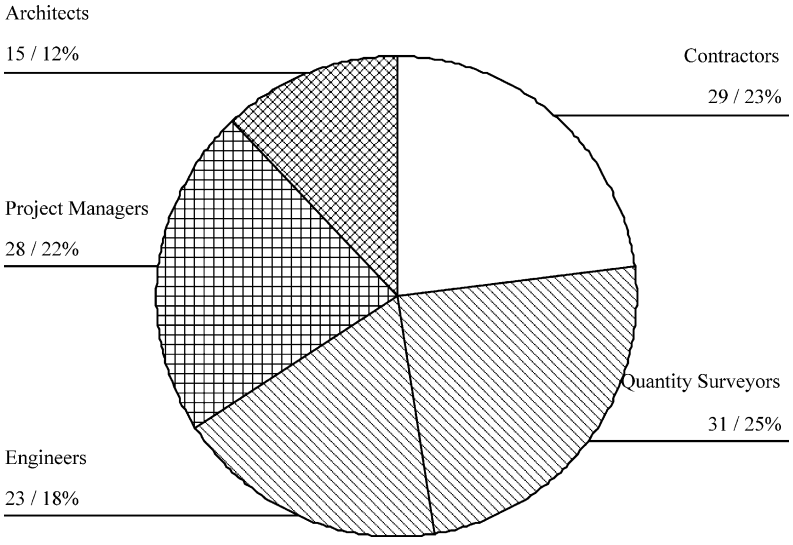

Fig. 1. Respondents by organisation type.

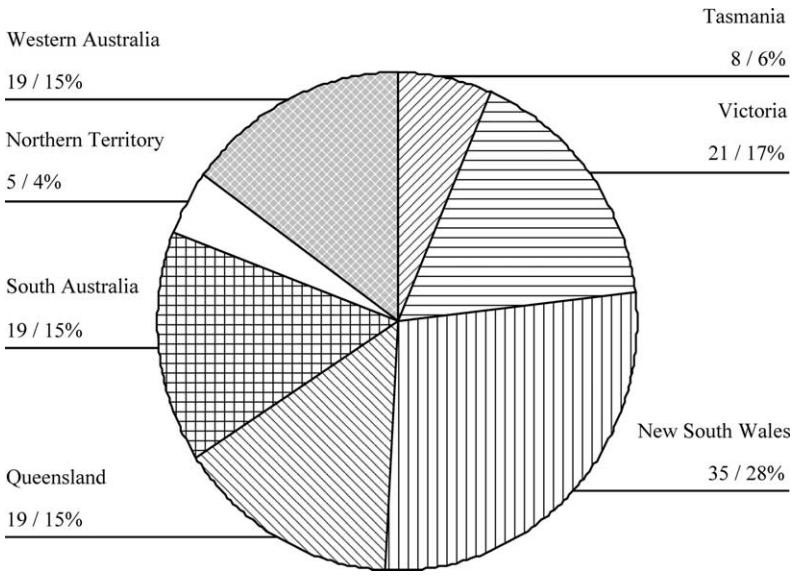

Fig. 2. Respondents by State.

details about the distribution of the sample in terms of the number of people employed in it and their turnover. Of the 126 organisations, 75% employed less than 30 employees and 79% had a turnover less than A$10 million. Thus, most of the sample consisted of small and micro organisations.

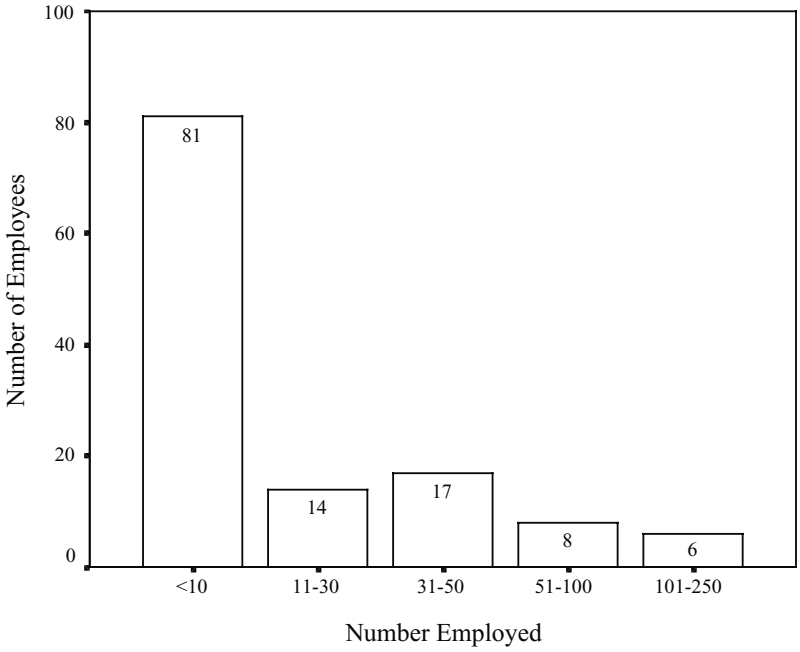

Fig. 3. Firm size by number of employees.

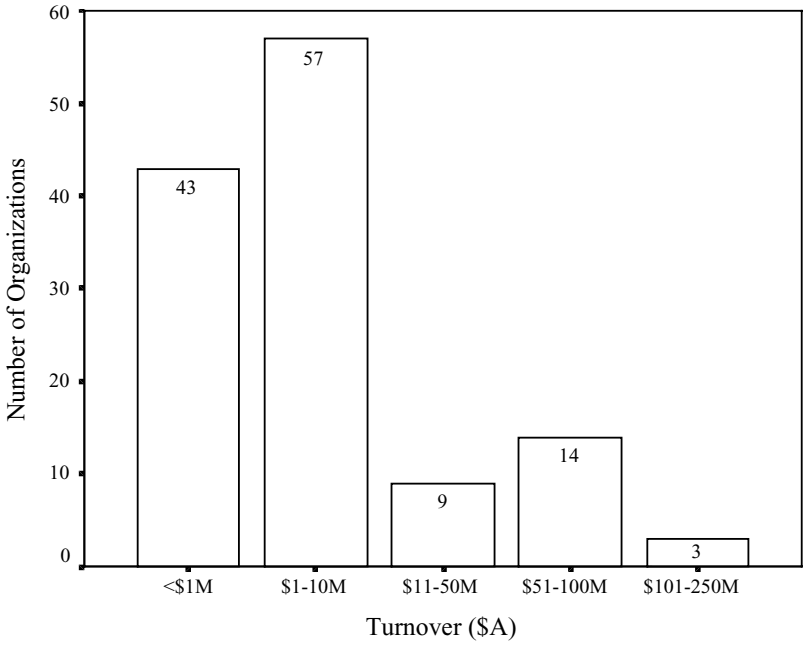

Fig. 4. Turnover of organizations sampled.

6. Data analysis

The data collected were analysed using SPSS for Windows, Version 11.00. Prior to undertaking detailed analysis, each of the eight constructs were tested for reliability using Cronbach's coefficient alpha (α). An α value of 0.70 or above indicates a reliable measurement instrument. The α level for each of the constructs examined are shown in Table 1. Internal consistency requires homogeneity of the questionnaire. As a measure of internal consistency, the inter-item Pearson correlation coefficients of the eight multiple item factors were calculated. The inter-item correlations for each of the constructs were significant at the $P < 0.000$ level.

A measure has *content validity* if there is general agreement among subjects and researchers that the instrument has measurement items that cover all aspects of the variable being measured. Content validity was not evaluated numerically and was therefore subjectively judged by the researcher. The measures of the constructs developed for this study have content validity: the selection of measurement items was based on an exhaustive review of the literature. Furthermore, pre-test subjects indicated that the content of each factor was well represented by the measurement instruments employed.

One-way analysis of the variance (ANOVA) was used to compare the means of respondents IT investment as a percentage of turnover and to determine if there were any significant differences among them. The Kruskal-Wallis test, a non-parametric equivalent to the ANOVA, was undertaken to test whether there were differences between respondents' rankings of the independent variables. This was undertaken because variables had a continuous distribution and was measured using an ordinal scale of measurement. To interpret the output from the Kruskal-Wallis test it is important to look at the Chi-square, degree of freedom, which is corrected for ties. These are used to indicate whether there is a difference between respondents and if the value of P is less than 0.05, then there is a significant difference between groups.

7. Findings and discussion

7.1. There are no significant differences in IT investments with firm size and type

Tables 2 and 3 provide a summary of organisational investment in IT as a percentage of their turnover.

Table 2
Organizations types in relation to IT investment as a percentage of turnover

Organisation type	IT investment as a percent of turnover				
	< 1%	1–5%	6–10%	11–20%	Total
Contractor	27 (93%)	2 (7%)	–	–	29 (100%)
Quantity surveyors	8 (26%)	16 (52%)	6 (20%)	1 (3%)	31 (100%)
Engineering consultants	6 (26%)	15 (65%)	2 (9%)	–	23 (100%)
Project management consultants	8 (29%)	18 (65%)	2 (7%)	–	28 (100%)
Architects	6 (40%)	7 (47%)	2 (13%)	–	15 (100%)
Total	55 (44%)	58 (46%)	12 (9%)	1 (1%)	126 (100%)

Table 2 reveals that almost all the contractors sampled (93%) invested less than 1% of their turnover on IT, whereas over 50% of the other organisations sampled invested between 1 and 5% of their turnover.

Table 3 indicates that 90% of the organisations surveyed invested less than 5% of their turnover on IT, with 44% investing less than 1%. Only 10% of organisations sampled invested more than 5% of their turnover in IT, most of these were architects and QSs. The ANOVA revealed that investments in IT did not significantly vary with firm size (turnover and number of employees) ($P < 0.05$). However, differences in IT investments were found between organisation types, $F\ (4,\ 126) = 10.48$; ($P < 0.05$). A Tukey's *honestly significant difference* (HSD) post-hoc test was undertaken but did not identify differences between organisations ($P < 0.05$). Thus, investments in IT have not increased despite the widespread use of e-business and e-commerce applications throughout the economy.

7.2. There are no significant differences between organisations in their approaches to evaluating their IT investments

Table 4 provides a summary of the extent to which methods for ex-ante evaluation were used. Here it can be seen that such methods are not used by more 40% of organisations who make investments in IT and then only a relatively small percentage use the techniques, albeit 'to some extent.' Based on our experience, we suggest that this is not due to a lack of knowledge of the available techniques, but rather that IT does not form an integral part of their business strategy for competitive advantage.

At a tactical and operational level, however, IT is being used. The emergence of e-business applications, however, for the procurement of materials [30] and sharing information between project participants [1,16] are beginning to be embraced by some organisations. The adoption and implementation of such technology requires significant capital outlay and as a result,

Table 3
Number of employees in relation to IT investment as a percentage of turnover

Number employed	IT investment as a percent of turnover				
	<1%	1–5%	6–10%	11–20%	Total
<10	39 (48%)	34 (42%)	7 (9%)	1 (1%)	81 (100%)
11–30	7 (50%)	6 (43%)	1 (7%)	–	14 (100%)
31–50	3 (18%)	10 (595)	4 (24%)	–	17 (100%)
51–100	2 (25%)	6 (75%)	–	–	8 (100%)
101–250	4 (67%)	2 (33%)	–	–	6 (100%)
Total	55 (44%)	58 (46%)	12 (9%)	1 (1%)	126 (100%)

Table 4
Ex-ante methods used for evaluating IT investments

Evaluation method	Mean ($n = 126$)	S.D.	Not at all	Some extent	Moderate extent	A large extent	Very large extent
Return on investment	2.11	1.17	56 (44%)	20 (16%)	32 (25%)	15 (12%)	3 (2%)
Discounted cash flow and IRR	1.72	1.03	73 (58%)	27 (21%)	18 (14%)	4 (3%)	4 (3%)
Net present value (NPV)	1.69	0.09	74 (59%)	25 (20%)	18 (14%)	9 (7%)	–
Profitability index	1.78	1.08	73 (58%)	23 (18%)	15 (12%)	14 (11%)	1 (1%)
Payback period	2.19	1.23	55 (44%)	18 (14%)	30 (24%)	19 (15%)	4 (3%)
Present worth	1.98	1.08	57 (45%)	28 (22%)	30 (24%)	8 (6%)	3 (2%)

ex-ante evaluation will have to form an integral part of their IT management strategy if they are too remain competitive. Apparently, construction organisations are less likely to adopt a formal ex-ante evaluation process. In contrast, it has been suggested that financial techniques are more appropriate for evaluating IT investments in SMEs than large organisations.

Table 5 identifies the formative evaluation processes adopted by the sampled construction organisations. Over 50% prepare an IT benefits delivery plan prior to, and during, system design and implementation. There is considerable divergence in the use of formative evaluation processes within the sample. A Kruskal-Wallis test was undertaken to determine if there were any significant differences between the size of the organisation, the type, and the evaluation processes employed. In the case of turnover, there were significant differences between turnover and all evaluation processes, with the exception of the 'use of IT to develop future processes' ($\chi^2 = 7.06$, $P < 0.13$). This implies that when construction organisations do implement IT, they aim to utilise its value adding potential. There were also significant differences between the number of people employed and all of the evaluation process adopted ($P < 0.05$). However, no significant differences between organisation types where evaluation processes adopted were identified ($P < 0.5$). The size of the organisation therefore influences the extent of evaluation processes implemented. Ballantine et al. proposed that SMEs were

Table 5
Evaluation processes implemented

Evaluation process	Mean ($n = 126$)	S.D.	Not at all	Some extent	Moderate extent	A large extent	Very large extent
Prepare a benefits delivery plan	2.40	1.51	49 (39%)	21 (17%)	26 (21%)	22 (18%)	8 (6%)
Prepare a benefits delivery plan during system design	2.00	1.20	61 (48%)	27 (22%)	19 (15%)	14 (11%)	5 (4%)
Prepare a benefits delivery plan during the implementation of IT	1.92	1.17	63 (50%)	30 (24%)	19 (15%)	7 (6%)	7 (6%)
Prepare a benefits delivery plan once the technology is implemented	1.81	1.06	67 (53%)	30 (24%)	16 (13%)	11 (9%)	2 (2%)
Plan organisational changes associated with the implementation of IT *before approval*	2.47	1.26	37 (29%)	32 (25%)	25 (24%)	24 (19%)	8 (6%)
Plan organisational changes associated with the implementation of IT *during system design*	2.23	1.18	47 (37%)	25 (20%)	37 (30%)	11 (9%)	6 (5%)
Plan organisational changes associated with the implementation of IT *during implementation*	2.45	1.28	42 (33%)	23 (18%)	31 (25%)	22 (18%)	8 (6%)
Plan organisational changes associated with the implementation of IT once the technology is implemented	2.61	1.28	37 (29%)	18 (14%)	34 (27%)	30 (24%)	7 (6%)
Conduct reviews during the implementation of IT	2.50	1.23	38 (30%)	25 (20%)	28 (22%)	32 (25%)	3 (2%)
Conduct post implementation reviews	2.60	1.15	30 (24%)	26 (21%)	37 (30%)	30 (24%)	3 (2%)
Use IT to develop future processes	2.80	1.23	29 (23%)	16 (13%)	40 (32%)	33 (26%)	8 (6%)

Table 6
Justification inhibitors

Justification inhibitors	Mean ($n = 126$)	S.D.	Not at all	Some extent	Moderate extent	A large extent	Very large extent
Limited managerial and technological knowledge	2.19	2.19	43 (34%)	37 (29%)	28 (22%)	15 (12%)	3 (2%)
Lack of strategic vision	2.07	2.07	52 (41%)	33 (26%)	27 (21%)	8 (6%)	6 (5%)
Unable to identify financial benefits	2.28	2.28	45 (36%)	25 (20%)	36 (29%)	15 (12%)	5 (4%)
Limited organisational resources and resistance to technology related change	2.23	2.23	44 (35%)	34 (27%)	25 (20%)	21 (17%)	2 (2%)
The need to show quick financial returns with minimal risk	2.52	2.52	27 (21%)	40 (32%)	35 (28%)	14 (11%)	10 (8%)
A multiplicity of justification and implementation paths	2.34	2.34	34 (27%)	37 (29%)	35 (27%)	18 (14%)	2 (2%)
An ability to account for the full business benefits	2.36	2.36	36 (29%)	35 (28%)	34 (27%)	15 (12%)	6 (5%)
Unable to identify and manage the scope of IT/IS related costs	1.93	1.93	53 (42%)	42 (33%)	20 (16%)	8 (6%)	3 (2%)
Reluctance of employees to adapt to new technology	1.69	1.69	69 (55%)	39 (31%)	9 (7%)	6 (5%)	3 (2%)
Inability to select an appropriate IT appraisal technique	2.27	2.27	52 (41%)	33 (26%)	27 (21%)	8 (6%)	6 (5%)

more likely to focus on control rather than learning. Thus, the evaluation process is used by many construction SMEs as both a control and learning mechanism, even though it may not form an integral part of their business strategy.

Factors inhibiting the evaluation process are identified in Table 6. A significant proportion of the organisations indicated that they encountered some difficulty when determining their IT investment, particularly the need to demonstrate quick financial returns. Significant differences between turnover and the justification inhibitors were identified for the following variables:

- 'limited managerial and technological knowledge' ($\chi^2 = 20.77$, $P < 0.00$);
- 'lack of strategic vision' ($\chi^2 = 29.49$, $P < 0.00$); and
- 'reluctance of employees to adapt to new technology' ($\chi^2 = 18.15$, $P < 0.01$).

There was also significant difference between the number of people employed and justification inhibitors for the following variables:

- 'inability to select an appropriate IT appraisal technique' ($\chi^2 = 11.06$, $P < 0.02$);
- 'lack of strategic vision' ($\chi^2 = 14.79$, $P < 0.05$); and
- 'an ability to account for the full business benefits' ($\chi^2 = 10.84$, $P < 0.02$).

In addition, to examining differences with respect to the size of the organisation, differences between organisation types were analysed to determine where differences fundamentally lie. Several were identified:

- 'limited managerial and technological knowledge' ($\chi^2 = 18.99$, $P < 0.01$);
- 'lack of strategic vision' ($\chi^2 = 11.69$, $P < 0.02$);
- 'unable to identify financial benefits' ($\chi^2 = 11.69$, $P < 0.01$);
- 'an ability to account for the full business benefits' ($\chi^2 = 17.83$, $P < 0.01$);
- 'reluctance of employees to adapt to new technology' ($\chi^2 = 22.15$, $P < 0.00$); and
- 'inability to select an appropriate IT appraisal technique' ($\chi^2 = 11.63$, $P < 0.02$).

Considering the evidence provided, a lack of strategic vision is a key factor inhibiting the justification process for organizations. As construction organizations now need to embrace IT to gain a competitive advantage, it is expected that they will begin to evaluate their investments in a more systematic and structured manner.

7.3. There are no significant differences between organisational motivations for IT adoption

Table 7 identifies the motivations for organizations adopting IT. SMEs embraced IT to improve productivity (cost efficiency) and performance of business processes. To gain a competitive advantage,

Table 7
Motivation for adopting IT

Motivation for adopting IT	Mean ($n = 126$)	S.D.	Not at all	Some extent	Moderate extent	A large extent	Very large extent
Improve productivity (i.e. cost efficiency) of business processes	4.02	1.03	6 (5%)	4 (3%)	17 (14.0%)	53 (42%)	46 (37%)
Improve performance of business (effectiveness) processes	4.13	0.85	1 (1%)	6 (5%)	14 (11%)	59 (47%)	46 (37%)
Seemed like a good idea at the time	2.00	1.11	56 (44%)	31 (25%)	26 (21%)	9 (7%)	4 (3%)
To gain a competitive advantage	3.73	0.98	1 (1%)	15 (12%)	31 (25%)	49 (39%)	30 (24%)
Improve profitability	3.66	1.01	2 (2%)	13 (10%)	42 (33%)	37 (29%)	32 (25%)
Pressure from rivals who are implementing IT	2.32	1.10	32 (25%)	47 (37%)	26 (20%)	16 (13%)	5 (4%)
Support the strategic direction of the organisation	3.27	1.17	9 (7%)	27 (21%)	29 (23%)	42 (33%)	19 (15%)
Improve service quality	3.92	1.01	17 (14%)	18 (14%)	48 (38%)	43 (34%)	–
Improve market share	3.1	1.29	15 (12%)	25 (20%)	30 (24%)	32 (25%)	24 (19%)

the improvement of service quality and firm profitability were also identified as primary motivations for IT adoption. Unexpectedly, over 70% of the organizations suggested that a motivation for adopting IT was to support the strategic direction of the organisation.

Differences were found between the number of people employed and motivation factors, with the exception of 'to gain a competitive advantage' ($P < 0.05$). With respect to turnover, the only significant differences were with 'support the strategic direction of the organisation' ($\chi^2 = 18.07$, $P < 0.01$) and 'improve service quality' ($\chi^2 = 17.75$, $P < 0.01$). Noteworthy, the only significant difference between organisation types for motivation factors was 'to improve service quality' ($\chi^2 = 13.83$, $P < 0.00$).

IT can be used for an array of services provided by construction organizations. For example, at an operational level, computer aided design (CAD) can be used to improve the quality of contract documentation, especially when design professionals integrate and co-ordinate their outputs. This appears to be a relatively straightforward process, but cultural and behavioural barriers, juxtaposed with problems associated with interoperability have hindered the production of effective contract documentation and thus had an adverse affect on the service quality of organizations [34].

7.4. There are no significant differences in IT investment with respect to the benefits and costs incurred by organizations

At the heart of the evaluation is the notion of benefits management. If firms are not obtaining the benefits sought then the processes used for investment justification are inadequate and/or organizations need to re-think their approach to IT adoption, perhaps by re-engineering business processes. Tables 8–10 present the benefits of IT adoption at a strategic, tactical and operational level.

'Improved organisational and process flexibility' was a strategic benefit that 95% of organizations considered had been achieved through the adoption of IT. Likewise, 94% of organizations identified 'improved customer/supplier satisfaction' as a strategic benefit. A key motivation for adopting IT was to improve service quality and as a result, perceived 'improvements in customer/supplier satisfaction' have been acquired. At the tactical level, 'improved service quality' was found to significantly differ between organisational types ($\chi^2 = 24.66$, $P < 0.00$). Improved market share was found to be significantly different between the size of the organisation with respect to turnover ($\chi^2 = 10.09$, $P < 0.03$) and number of people employed ($\chi^2 = 15.42$, $P < 0.04$). In addition, differences between organisation types and the level of strategic benefits attained were:

- 'reduced marketing costs' ($\chi^2 = 9.65$, $P < 0.04$);
- 'leader in new technology' ($\chi^2 = 12.40$, $P < 0.01$);
- 'improved market share' ($\chi^2 = 13.42$, $P < 0.01$);
- 'market leadership' ($\chi^2 = 16.02$, $P < 0.03$); and
- 'improved customer/supplier satisfaction' ($\chi^2 = 16.24$, $P < 0.03$).

At a tactical level, 'improved service quality,' 'improved contract administration,' and 'improved response' to changes were identified as being experi-

Table 8
Strategic benefits of IT

Strategic benefits	Mean ($n = 126$)	S.D.	Not at all	Some extent	Moderate extent	A large extent	Very large extent
Improved growth and success	2.81	0.97	17 (14%)	18 (14%)	66 (52%)	21(17%)	4 (3%)
Reduced marketing costs	2.01	1.08	49 (39%)	45 (36%)	17 (14%)	11 (9%)	4 (3%)
Leader in new technology	2.34	1.28	39 (31%)	44 (35%)	13 (10%)	20 (16%)	10 (8%)
Improved market share	2.34	1.06	34 (27%)	34 (27%)	43 (34%)	11 (9%)	4 (3%)
Market leadership	2.47	1.23	33 (27%)	38 (30%)	26 (21%)	20 (16%)	9 (7%)
Improved customer/supplier satisfaction	3.29	1.02	7 (6%)	17 (14%)	49 (39%)	38 (30%)	15 (12%)
Improved customer relations	3.06	1.04	10 (8%)	23 (18%)	54 (43%)	27 (21%)	12 (10%)
Enhanced competitive advantage	2.95	1.15	14 (11%)	30 (24%)	44 (35%)	24 (19%)	14 (11%)
Improved organisational and process flexibility	3.34	1.01	6 (5%)	16 (13%)	48 (38%)	30 (32%)	16 (13%)

Table 9
Tactical benefits of IT

Tactical benefits	Mean ($n = 126$)	S.D.	Not at all	Some extent	Moderate extent	A large extent	Very large extent
Improved response to changes	3.23	1.06	6 (5%)	24 (19%)	48 (38%)	30 (24%)	18 (14%)
Improved service quality	3.38	0.90	3 (3%)	15 (12%)	51 (41%)	45 (36%)	12 (10%)
Improved teamwork	2.78	1.14	22 (18%)	23 (18%)	50 (40%)	22 (18%)	9 (8%)
Promotes pro-active culture	2.73	1.12	22 (18%)	29 (23%)	42 (33%)	27 (21%)	6 (5%)
Improved integration with other business functions	3.00	1.14	16 (13%)	24 (19%)	38 (30%)	39 (31%)	9 (7%)
Improved planning times	2.29	0.94	29 (23%)	45 (36%)	38 (30%)	14 (11%)	–
Reduced time to compile tenders	2.65	1.24	31 (25%)	24 (19%)	36 (29%)	27 (21%)	8 (6%)
Reduced time to prepare cost plans	2.85	1.29	27 (21%)	22 (18%)	31 (25%)	34 (27%)	12 (10%)
Improved contract administration (e.g., effectiveness and efficiency)	3.40	1.11	7 (6%)	24 (19%)	24 (19%)	53 (42%)	18 (14%)

Table 10
Operational benefits of IT

Operational benefits	Mean ($n = 126$)	S.D.	Not at all	Some extent	Moderate extent	A large extent	Very large extent
Improved data management	3.88	0.98	4 (3%)	6 (5%)	26 (21%)	54 (43%)	36 (29%)
Improved communication	3.34	1.06	4 (3%)	17 (14%)	27 (21%)	50 (40%)	28 (22%)
Improved decision-making	3.05	1.00	16 (13%)	42 (33%)	44 (35%)	20 (16%)	4 (3%)
Reduced paperwork	2.88	1.20	49 (39%)	27 (22%)	29 (23%)	16 (13%)	5 (4%)
Reduced bottlenecks	3.02	0.91	33 (26%)	40 (32%)	48 (38%)	3 (2%)	2 (2%)
Reduced labour costs	3.64	1.12	39 (25%)	31 (25%)	43 (34%)	14 (11%)	3 (5%)
Reduced rework	2.63	1.17	32 (26%)	31 (25%)	43 (34%)	14 (11%)	6 (5%)
Improved quality of output	2.21	0.95	9 (7%)	14 (11%)	35 (28%)	39 (31%)	29 (23%)
Improved ability to exchange data	2.21	1.06	5 (4%)	5 (4%)	28 (22%)	61 (49%)	27 (21%)
Improved response time to queries	2.26	1.10	9 (7%)	10 (8%)	54 (43%)	34 (27%)	19 (15%)
Improved forecasting and control	2.45	1.20	8 (6%)	34 (27%)	35 (28%)	36 (29%)	13 (10%)
Improved control of cash flow	3.51	1.31	20 (16%)	28 (22%)	34 (27%)	34 (27%)	10 (8%)
Reduced lead times for financial planning	3.79	1.21	19 (15%)	31 (25%)	22 (18%)	36 (29%)	18 (14%)

Table 11
Direct costs of IT adoption

Direct costs of IT	Mean ($n = 126$)	S.D.	Not at all	Some extent	Moderate extent	A large extent	Very large extent
Hardware accessories	3.68	0.87	1 (1%)	5 (4%)	53 (42%)	41 (33%)	26 (21%)
Upgrades to increases in processing power	3.51	0.99	4 (3%)	13 (10%)	42 (33%)	46 (37%)	21 (17%)
Consultancy support	2.77	1.15	17 (14%)	41 (33%)	30 (24%)	29 (23%)	9 (7%)
Installation engineers	2.50	1.12	25 (20%)	47 (37%)	22 (18%)	29 (23%)	3 (2%)
Networking hardware and software	3.32	1.01	6 (5%)	17 (14%)	48 (38%)	40 (32%)	15 (12%)
Overheads (include running costs, etc.)	3.01	1.08	33 (26%)	38 (30%)	29 (23%)	20 (16%)	6 (5%)
Training costs	2.42	1.17	7 (6%)	42 (33%)	29 (23%)	38 (30%)	10 (8%)
Maintenance costs	2.82	0.97	12 (10%)	33 (26%)	49 (39%)	29 (23%)	3 (2%)
Networking security (e.g., firewalls)	2.53	1.19	31 (25%)	34 (27%)	30 (24%)	25 (20%)	6 (5%)

enced by more than 90% of the organizations sampled. No significant differences between organisational size and organisational types for tactical benefits were revealed ($P < 0.05$). Likewise, no significant differences between organisation size and organisation types and operational benefits were identified ($P < 0.05$). Because SMEs in construction are cash flow dependent and tend to focus on securing the next project, the expectation is that IT should produce immediate benefits and improve both performance and productivity.

The costs (direct and indirect) of IT can be seen in Tables 11 and 12. Hardware costs, upgrades (increases in processing power) and networking of hardware and system were the major direct costs. No significant differences between different organisation types and direct costs were found ($P < 0.05$). However, significant differences were found between turnover and number of people employed (organisational size) and hardware accessories and networking security ($P < 0.05$). Smaller organizations do not appear to invest in networks and issues related to security are not considered an issue. Nonetheless, organisation linked to the Internet are prone to 'cyber-attacks' and therefore security is important. A large amount of respondents (67%) indicated that, because of the adoption of

Table 12
Indirect costs of IT adoption

Indirect costs of IT	Mean ($n = 126$)	S.D.	Not at all	Some extent	Moderate extent	A large extent	Very large extent
Management and staff resources (e.g., integrating computerised administration and control into work practices)	3.00	1.05	11 (9%)	27 (22%)	47 (37%)	32 (25%)	9 (7%)
Management time	2.98	0.99	9 (7%)	30 (24%)	47 (37%)	34 (27%)	6 (5%)
Cost of ownership (e.g., system support and troubleshooting costs)	3.03	1.03	7 (6%)	33 (26%0	46 (37%)	29 (23%)	11 (9%)
Management effort and dedication to exploring the potential of the system	3.00	1.08	9 (7%)	36 (29%)	38 (30%)	32 (25%)	11 (9%)
Employee time in detailing, amending and approving computerisation	2.92	1.08	13 (10%)	32 (25%)	41 (33%)	32 (25%)	8 (6%)
Employee training	2.67	1.12	18 (14%)	43 (34%)	36 (29%)	20 (16%)	9 (7%)
Employee motivation (e.g., maintaining employees interest in computer aided tasks)	2.35	1.02	30 (24%)	40 (32%)	39 (31%)	15 (12%)	2 (2%)
Changes in salaries as a result of improved flexibility	1.86	0.93	60 (48%)	31 (25%)	27 (21%)	8 (6%)	–
Staff turnover (e.g., increases in interview and training costs)	1.73	0.88	64 (51%)	39 (31%)	16 (13%)	7 (6%)	–
Productivity increases	2.15	0.98	38 (30%)	43 (34%)	35 (28%)	8 (6%)	2 (2%)
Strains on resources	2.45	1.14	33 (26%)	33 (26%)	33 (26%)	24 (19%)	3 (2%)
Organisational restructuring	2.09	1.09	47 (37%)	38 (30%)	28 (22%)	8 (6%)	5 (4%)

IT, organisational restructuring was not addressed, albeit to a minor extent. This could explain, in part, why only tactical and operational benefits are being achieved. No significant differences between different organisation types were and indirect costs were found ($P < 0.05$). Significant differences, however, were found between turnover and number of people employed and 'strains on resources' and 'organisational restructuring' ($P < 0.05$). The adoption of IT by smaller organizations may require employees to undertake training and thereby increase their immediate workload. Additionally, in the smaller organizations less attention may be given to organisational restructuring, as there may be limited reflection on the way work is carried out after the adoption of IT.

8. Research limitations

Some limitations need to be acknowledged. First, the inconsistent definition of ''SME'' between studies makes research findings difficult to compare and generalise. The concern for generalisabiltiy is also brought about by the relatively small sample sizes of IT adoption studies in the SME domain. The 126 valid responses obtained in this study is comparable with sample sizes of 50 [15], 68 [11], 83 [36], 87 [18], and 96 [59] reported in previous studies on SMEs. Second, our choice of variables is problematic, because they may not capture the complex nature of the evaluation and benefits management process of the project environment within which construction organizations operate.

9. Conclusion and recommendations

The research reported here examined the IT evaluation and benefits management practices of construction SMEs. To date, there has been limited research undertaken in this area and so the findings should provide an impetus for organizations to re-consider their approach to IT evaluation, notwithstanding the plethora of material that has already been published. The inherent difficulties in identifying and assessing the benefits and costs are often a cause for uncertainty about the expected impact that the investment might have on the business. As a result, it is all too easy to ignore the issues.

We have sought to identify the evaluation practices as well as the costs and benefits associated with the adoption of IT by construction firms in Australia. The key findings suggest that:

- organisation types significantly differ in the amount of turnover they investment in IT;
- IT investment levels were not influenced by organisational size;
- the scope of purpose of *ex-ante* IT evaluation was considered broader than a financial control mechanism. Instead, the SMEs used *ex-post* evaluation as an opportunity for learning and thus regenerated knowledge;
- having no strategic vision is a major barrier to justifying IT investments; differences were found with respect to strategic benefits acquired; and
- indirect costs were identified as being far-reaching and considerable after investment decision-making.

As noted by Latham, significant cost savings can be made by organisations when implementing IT. Yet, before they decide to embrace an IT enabled business strategy they should adopt a rigorous evaluation process, otherwise strategic benefits and some tactical benefits may not materialise. To leverage the benefits from IT we recommend that construction SMEs:

- conduct an assessment of the IT available to their organisation so that features and costs can be readily identified;
- develop an expected IT benefits and costs management plan that also incorporates anticipated indirect costs; and
- determine if sufficient IT benefits exist and if organisational culture is supportive of adopting IT and other technologies.

Fundamentally, the competitiveness of construction SMEs depends on the basic role of the owner/manager, intangible investment (intellectual capital), tangible investment in information and communication technology, and strategic capability (ability to be innovative and adapt to change).

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