

Construction Project Cost Management Tools In-use: a UK Perspective

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Abstract

The effective control of a construction project budget from project inception to completion and occupation is one of the primary tasks of any organisation employed to deliver construction project management services irrespective of the projects actual global location. This paper sets out the key issues and problems involved in the delivery of this service to construction industry clients in the UK.

The main features of a project cost management system are identified in the paper before it addresses the principal problem areas of initial cost budget or baseline setting and project cost performance management. The literature reviewed identifies the potential project management tools that can be used to contribute to the management of each of the principal problem areas. The paper reports evidence collected from previous data collection exercises with practitioners based in the UK that allows current practice to be illustrated. The data on project performance measurement reported in the paper have been collected by mailed survey from one hundred and fifty two organisations involved in delivering project management services in the UK in 2004. The survey achieved a 42% response rate and its results raises questions about the claimed benefits of a bespoke project cost performance management tool termed as earned value analysis. The paper concludes by considering the direction of future construction related project cost management education and the role that can be played by professional institutions to promote change in practice.

Keywords: project management, cost budgeting, cost performance, tools in-use

1. Introduction

The UK construction industry, like others around the world, has a reputation for delivering its projects over budget. The latest high-profile example of this phenomenon is the new Scottish parliament building that, when completed, was nearly ten times over its originally forecasted budget. The Fraser Report [1] on the public inquiry into the project highlighted, amongst other

issues, that a poor quality feasibility stage budget estimate and a poor level of cost control provided by the construction organisations involved were to blame for general dissatisfaction with the project. Other high profile instances of such poor performance were identified by Jackson [2] and include projects such as the British Library, Portcullis House, and the Welsh Assembly building. Jackson [2] reports repeated survey work by HM Treasury (1995), the Construction Clients Forum (1997) and the DETR (2000) that have shown clients to be generally dissatisfied with the service provided by practitioners involved in the provision of building project budget stage cost advice and subsequent construction phase cost performance management processes. Therefore the issue of poor project cost management is an ongoing problem for the construction industry and its clients. It is now timely to investigate the processes involved in this business advice function and determine the current state of the art in terms of cost control tools in-use so as to ensure clients' are better able to achieve value for money from their inter-actions with the UK construction industry.

This paper is structured to provide a review of relevant previously published material before it goes on to present the results of data collection exercises with UK based organisations that have enabled a snap-shot of current practice to be established. The paper concludes by considering the direction of future construction related project cost management education and research and the role that can be played in the development of this business service in the UK by professional institutions.

2. Context

Green and Simister [3] cite Hammer and Champy's (1993) definition of a business process as being, "a set of activities that, taken together produce a result of value to the customer". Currently, the processes used in the construction industry to deliver its clients' projects are being subjected to a period of re-design and accelerated change to ensure that they deliver greater value for money. Increasingly the assessment of value-for-money is being considered from a broader perspective that includes social, environmental, and economic features [4]. Winch and Carr [5] maintain that this the generation and communication of reliable early stage project budget estimates and the implementation of effective project cost control measures that are related to the construction and commissioning of building assets are sub-processes within their standardised project related process map. As such it has been asserted that industry would benefit from their further development and as a result of actually using the output of research. Similarly, the generic design and construction process protocol developed by Kagioglou *et al* [6] also indicates that such business activities would be considered as a sub-process within their model, namely the feasibility stage of a project's pre-construction cycle and the project's construction cycle. It can be seen that effective construction project cost management processes are a fundamental component in any project's value appraisal system.

Kerzner [7] and Lock [8] amongst others, identify the principal components of a construction project's cost management process as being; the establishment of a realistic budget, the

determination of a system of work authorisation and release, the collection and analysis of timely performance cost data across the project lifecycle, the establishment of effective cost change management systems, and the creation of meaningful cost account and variance reporting mechanisms. This broad analysis has a strong relationship to the main components of a cost control process set out by the Project Management Institute (PMI). The PMI indicates in its body of knowledge (BoK) that its cost management processes are concerned with creating what it terms as being a project cost baseline as well as managing changes to the cost baseline. For instance the PMI [9] indicates that the main features of such a project cost control system need to address cost inputs, the tools and techniques used to assess performance and the cost reporting mechanisms used to provide timorous information to decision makers. There seems to be broad agreement on the principal components of an effective project cost management process. As a result this paper addresses two features of any cost management system namely, the building project baseline budget estimating processes and then secondly, the tools and techniques used to assess the cost performance of the project during its production phase.

2.1 The Building Project Baseline Budget Estimating Process

Skitmore *et al* [10] considered pre-tender budget price estimates which within the construction industry form the project cost baseline position and asserted that the ‘dominating presence of uncertainty in the construction process militated against the production of accurate estimates by numerical analysis alone’. As a result building project budget estimating must involve a mixture of calculation and judgement. In order to develop an understanding of how building project budget estimates may have their quality enhanced it is necessary to identify the processes involved. Bowen [11] developed a communications based theory of building project price forecasting. That model was based on the Shannon and Weaver’s linear or process model of communications and it indicated a major divide in the process between the phases of forecast formulation and forecast transmission. The formulation phase of this theoretical process was divided into iterative cycles of investigation and application. There remains a need to fully investigate the construction project budget estimating process as a means of addressing the performance gap of practitioners that can result in the incidences of inadequate business services indicated above in terms of poor quality project cost advice. What is acknowledged is that an essential part the building project budget price advice process is the selection and use of the most appropriate tools or models.

Repeated surveys by Fortune and Hinks [12] and Fortune and Cox [13] have established the ‘state of the art’ in terms of building budget estimating models in actual use in the UK. In general these large-scale empirical studies have found that there were over twenty models currently in-use. The results of the surveys show that in general terms the paradigm shift towards the newer non-traditional models, called for by academics such as Brandon [14], has not been generally achieved. What can be seen is that the results of successive waves of the prevailing engineering or product or tool centred research that has been funded by government grant has not been found to be useful in practice. Examples of such an engineering or product-related research paradigm are the knowledge-based models, the regression models, the whole life cost models, the fuzzy logic and

neural network models, which have been developed over a period by academe for the industry to use. The repeated surveys show consistent evidence of low levels of usage of such models and the continued overwhelming use of manual, deterministic models that have been found to formulate inadequate cost advice over a period of time. Latterly there has been much research effort directed to the development of models or tools that can take account of the sustainable impact of proposed projects. The survey work reported in Fortune and [13] again reveals that such tools have not yet been adopted for widespread use in practice. Given the slow rate at which changes in practice can be achieved in the construction industry then it is too soon to suggest that these new models that address the assessment of sustainable impact of projects have been abandoned by practice. However, the same cannot be said for the paradigm change called for by Brandon in 1982. The results of the research reported above indicate that such a paradigm change has now been abandoned by practice and as such this finding will have implications for the education and training of future professionals.

2.2 Construction Phase Cost Performance Tools In-use

Lock [8] considers that the emphasis given to project management cost control is unique in the UK construction industry due to the existence of quantity surveyors and detailed bills of quantities. As a result the standard tools suspected as being in use in the construction industry to manage the construction phase project cost performance management process included milestone monitoring, variance analysis, valuation analysis and standard s-curves. Milestone monitoring uses predefined stages or phase completion of projects as the trigger mechanism for contract payments to be made. Lock [8] indicates that the data required to set up the milestone approach to construction project cost control are the project schedule or programme and the budgeted cost of the activities required to be completed to achieve the milestone. A potential drawback to the use of this approach to production cost control is the re-active and delayed nature of information availability. The cost information generated by this technique takes no account of the actual work achieved on site and assumes one hundred per cent efficiency of site operations. However, Abdomerovic *et al* [15] do acknowledge that the great advantage of using this approach is its simplicity and resource efficiency in operation.

The use of variance analysis as an approach to construction phase project cost performance management acknowledges that changes are endemic on construction projects. Ronald [16] asserts that this approach can be used to highlight the inefficiencies caused by such changes in terms of their cost consequences on the project's baseline budget figure. Pilcher [17] argues that this technique is well suited to construction project production phase cost control due to the prevalence of bills of quantities but nonetheless it is generally accepted that such a system is itself costly to set up and does not focus on overall project costs. The valuation analysis approach was asserted by Walker and Wilkie [18] as being the most popular in-use. This approach calls for the practitioner to carry out valuations of the work executed on the project at the end of a given period. Such an approach provides data for the contractor to use in benchmarking performance against payments received for each of the resource centres required

for project production, namely, labour, materials, plant, and sub-contractors. However, Pilcher [17] points out that the approach can lead to inaccurate data and that often contentious items are excluded from timorous payment although resource has been expended in their execution. In addition this approach does not facilitate the forecasting of overall project costs. This is a claimed advantage of the S-curve approach to providing construction phase project cost performance management. This approach provides data against the formation of standard cost curves for the project. Such curves are usually s-shaped and are derived from data from previous similar projects. Control can be achieved by plotting actual expenditure against budgeted costs on a periodic basis. Galley [19] pointed out that the main flaw with this approach was that the s-curves produced could indicate performance gaps but on their own it is not possible to say whether the project is behind or ahead of the planned schedule.

Wake [20] asserted that earned value analysis was an approach that was developed to overcome the combined problems of the conventional approaches to project cost management during the production phase of projects. Support for this position comes from the PMI which indicates that the main tools available to project managers looking to control project cost performance in general include tools such as performance reviews, variance analysis, trend analysis and earned value analysis. Of the tools indicated by the PMI BoK [9] as being generally available it was asserted that it was “*earned value analysis (EVA) in its various forms is the most commonly used method of project performance measurement*”. EVA is based on the combined work breakdown structure (WBS) and the organisational breakdown structure (OBS) for the project being constructed being drawn together so as to develop a task responsibility matrix (TRM). Winch [21] determines that such an analysis can facilitate what he terms as a cost control cube to be formed and that such an approach provides a disciplined framework for the organising, planning, budgeting, measurement monitoring, and reporting of a project’s performance.

Fleming and Kopplemann [22] asserted that if EVA was to be implemented efficiently then it was best employed from the earliest stages of the project’s development. If this was the case with the use of EVA on construction projects in the UK then it would be necessary for consultant quantity surveyors and other built environment professionals to develop appropriate skills to ensure its application. However, Baker [23] identified that many such practitioners see EVA as being a complex process, which is shrouded in terms, acronyms and formulae that can be intimidating to the uninitiated. On the other hand sources such as Webster [24] asserts that the use of EVA provides a uniform measure for reporting progress on a project and a consistent method of cost performance analysis. The benefits of using EVA as a tool for the measurement of project production cost performance was also given emphasis by its inclusion within the BS6079 and the PMI BoK [9]. Such sources maintained that the use of EVA would allow a more disciplined approach to planning and risk management, as well as providing good programme visibility, and encouragement to the objective and quantitative performance measurement on projects. It was asserted that such an approach would enable timely indications of problems to be developed which would facilitate a more reliable prediction of programme cost schedules.

As this paper is concerned with establishing the tools currently used in practice to manage construction phase cost performance it was now resolved to conduct a questionnaire survey amongst construction project management organisations in the UK. It was determined that the questionnaire should gain measures to determine the current usage of the tools indicated as being available to practice in the literature reviewed above. Accordingly a sample of one hundred and fifty two organisations drawn from both consultant and contractor based construction project management organisations was constructed from the 2003 yearbooks of the Association of Project Managers (APM) and the project management faculty of the RICS. The questionnaire was administered by surface mail and good practice ensured the questionnaire was appropriately piloted before dispatch. Similarly good practice required a covering letter and a stamped addressed return envelope to be included and each form had its own unique reference number that facilitated follow-up in the case of non-response. As a result the survey attracted a response rate of 43% which was considered adequate enough to provide meaningful data.

3. Questionnaire Survey – Results, Analysis and Discussion

Responses were evenly divided between those organisations that classified themselves as being a contractor based organisation and those organisations that classified themselves as being a consultant organisation and these classifications were later used as the principal variables to analyse the data. The first question in the questionnaire asked the respondents to confirm their involvement with construction project management. The results of the question showed that none of the respondents to the survey indicated that that they had no involvement in construction project cost management. This was essentially a checking question that provided data that confirmed the appropriateness of the sample and an indication of the validity of the results. Respondents were then asked to indicate the usual point in a project's lifecycle that they were engaged to provide their project cost management services. The results of the survey have been summarised below in Figure 1. It can be seen that generally respondent organisations start to provide their project cost management services during the pre-construction phase of a project's delivery cycle.

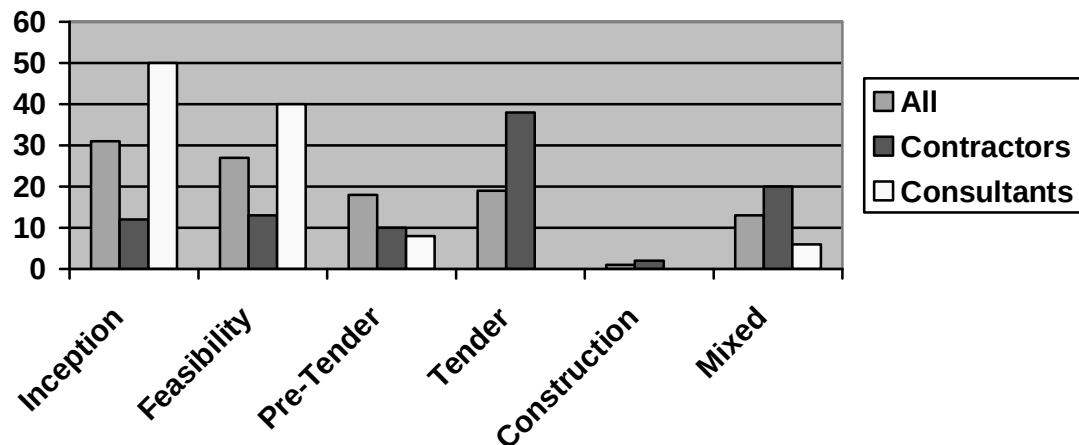


Figure 1: Project Cost management services and the project lifecycle

Figure1 shows that there is difference in approach between consultant and contractor based organisations that responded to the survey. It can be seen that contractor based organisations are more likely to start to provide project cost management services to their clients at the tender and construction phases of a project's lifecycle which would reflect the prevailing procurement pattern in the UK. As the changes in the operational practices of the UK construction industry alter following the calls for change made in recent UK government reports then it is likely that project cost management services will be delivered from project inception to completion and occupation. This change in practice should help UK construction industry clients to achieve better value for money from their business investment decisions.

Respondents to the survey were then asked to indicate the project cost control system they were using in practice. Figure 2 provides a summary of the results obtained and it shows that in general the most popular method is the conventional monthly valuation analysis (70%). The other techniques such as milestone monitoring, variance analysis, s-curves and earned value analysis were used by an approximately similarly sized minority of the respondents to the survey (15%).

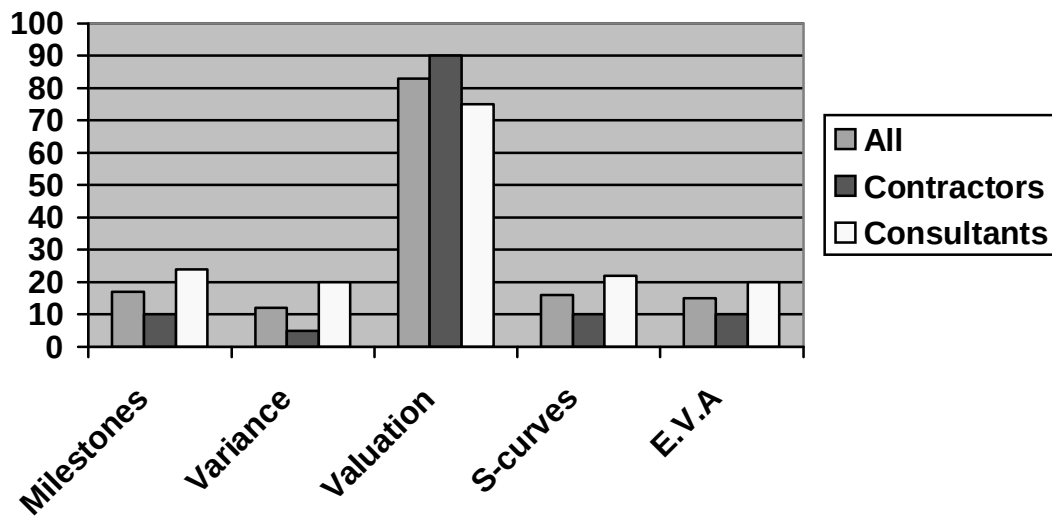


Figure 2: Types of cost control system in-use

This result indicates that the conventional approach to project cost control is still in widespread use despite the claimed advantages of the new wave tools such as earned value analysis. The literature reviewed above indicated that of the newer techniques that were available it was earned value analysis that offered the most to project managers involved with the provision of cost performance management services. The next question in the questionnaire explored the reasons why the respondents to the survey were not making use of earned value analysis as a cost performance measurement tool. Firstly the respondents were asked to indicate whether they were actually aware of the existence of earned value analysis as a tool to use in project cost control. Figure 3 indicates that the majority of respondents (73%) claimed that they had no awareness of earned value analysis. It can be seen that there was some difference between the consultant (80%) and contractor (65%) organisational types responding to the survey.

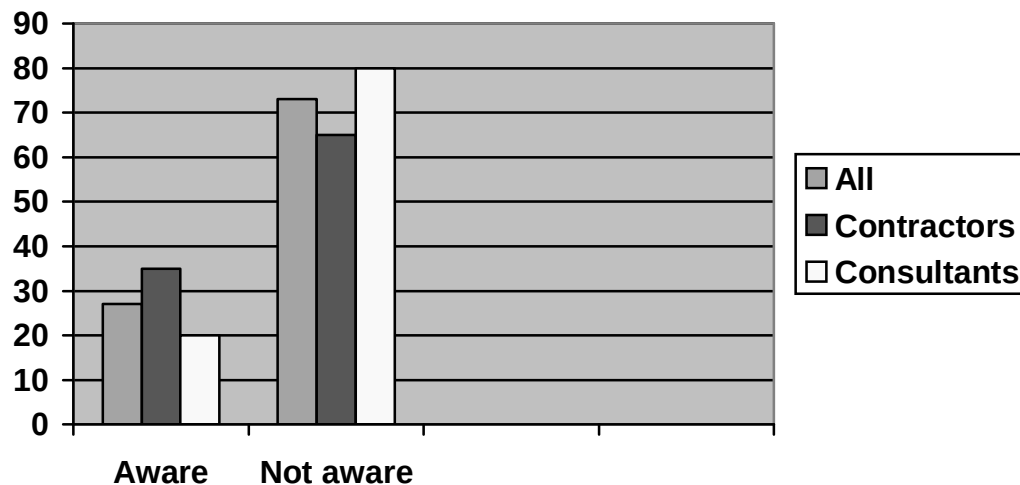


Figure 3: Level of awareness of EVA as a cost control too

This result indicated that contractor based respondents are more likely to be aware of EVA but as revealed above a concern must be that such organisations do not enter the project lifecycle under the tender and construction phases of a project's lifecycle. This late entry to the project was acknowledged to be a real disadvantage in terms of using EVA to its optimum effect. This result also confirmed the finding of earlier work undertaken by Brandon [25] which asserted that earned value analysis was little used in the UK construction industry due a lack of commercial awareness of its potential benefits. This was surprising to Brandon [25] as he pointed out that earned value analysis was indicated as being the preferred tool for project cost control in key documents such as BS6079. However, an earlier survey reported by Fortune and Lees [26] found that in the UK the majority of project managers did not adopt BS 6079 as the co-ordinating vehicle for their project documentation.

The respondents that indicated that they had made use of EVA as a technique to control project cost performance were then asked to give their assessment of the technique in-use in terms of the accuracy of the data it generated and the usefulness of the information it provided. Figure 4 shows that only 31% of respondents that had used EVA found that it was able to generate more accurate data than the other more conventional methods of cost control.

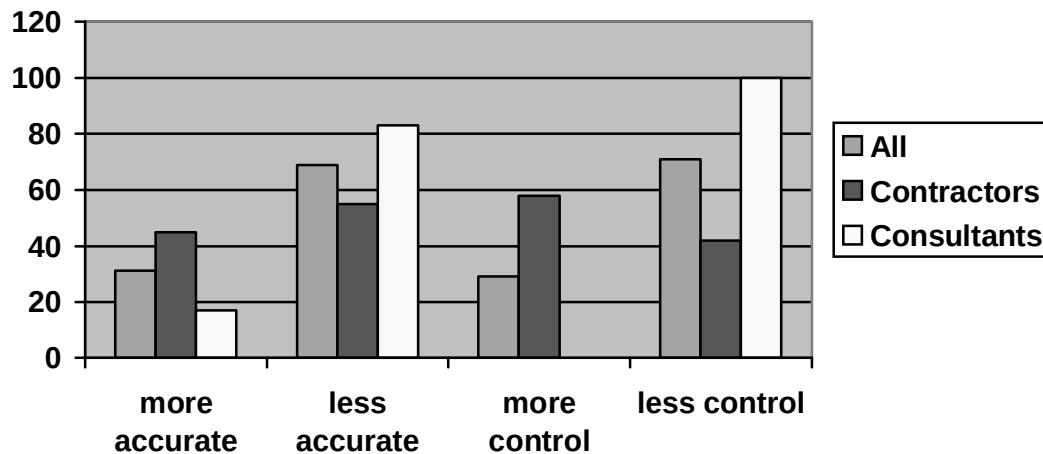


Figure 4: Capability of EVA to generate more accurate data and exercise budgetary control

The results show that there was some difference of opinion between the respondents to this question that were located in consultant and contractor based organisations. It can be seen that only 15% of respondents in consultant and 45% of respondents in contractor based organisations agreed that EVA was capable of generating better budgetary control for their projects. This difference in response was further tested using chi square test and it was found that the difference was not statistically significant. Nonetheless the overall result of this question is in direct contradiction of the finding found in the work of Fleming and Kopplemann (2001) who asserted that the use of such a tool enabled practitioners to generate more accurate data for use in project cost control. Figure 4 also shows that only 24% of respondents that had made use of EVA considered that the technique enabled them to exercise greater levels of project cost control than the other more conventional tools that they had previously used. The results of this question call into question the claims of Wilkens [27] that EVA was a tool that was better than other techniques at keeping projects within established budgets. The results shown in Fig 4 provide clear evidence that practitioners on the ground have not found that newer project cost control techniques such as EVA provide real improvement over their tried and trusted techniques. In such circumstances it is not surprising that EVA is not in widespread use in providing construction project cost management services to UK based clients.

The respondents to the survey that indicated that they had not yet used EVA as a tool for project cost management were asked to indicate the reasons why they had not as yet adopted the method as a tool for use. Figure 6 shows that of the reasons listed, namely cost to set up and maintain, high satisfaction levels with existing tools, and unfamiliarity with the technique. Of the options listed it was found that general unfamiliarity with the approach was the main reason for its non-adoption (58%) and that 30% of this type of respondent felt that their more conventional cost control technique was providing satisfactory levels of service.

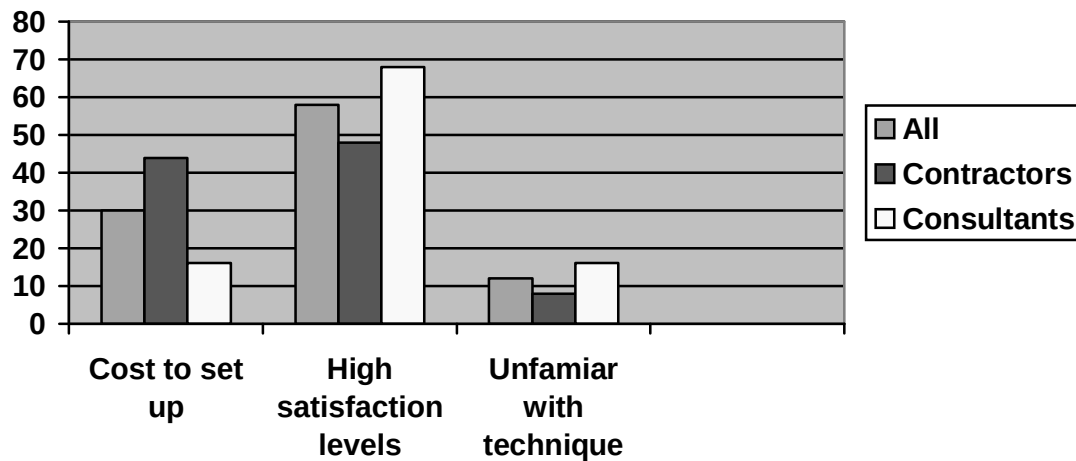


Figure 5: Reasons for non-use of EVA as a cost performance tool

Such results confirm the general level of response generated in response to earlier questions in the survey and provide a measure of internal consistency within the questionnaire which generates confidence in the survey' results.

4. Conclusions

The survey work reported in this paper indicates that the newer tools and techniques advocated by academe for use in UK construction industry for the delivery of project cost management services have so far been rejected. This finding applies equally to the tools used to generate the initial project budget and the tools used to provide data for effective construction phase project cost control. The paper focused on these two key aspects of project cost control as being central features that construction related project managers needed to get right to ensure the effective delivery of project cost management services. The finding in relation to the tools used to set the initial budget for the project is of concern given that academe has been calling for a move away from the conventional tools in-use for over twenty years. Such continued non-use of tools such as regression analysis, probabilistic models, neural models, and neuro fuzzy models raises questions about the effectiveness of previous research paradigms in this topic area. The non-use of sustainable assessment models for projects and the newer construction phase cost control tools such as milestone payments and earned value analysis do not as yet raise the same questions. In terms of the widespread non-use of sustainability models and EVA it is probably to soon to conclude that they have been rejected for use by practice. Rather it points out the time lag that can exist between academe and practice in terms of performance advancement. Nonetheless the survey rejects the findings of other non-construction focused investigations and helps make the case for the approaches adopted in construction related project cost management services to be seen as being non-generic in nature. The lack of awareness of the newer project cost performance tools such as EVA calls into question the effectiveness of the curricula driving courses of formal and informal education. Such lack of awareness also flags up to the relevant

professional institutions the need for greater emphasis to be given to this topic in terms of CPD type training programmes.

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