

# Factors affecting the selection of effective cost control techniques in the UK construction industry

## Abstract

**Purpose** - This paper aims to identify and analyse the factors affecting the selection of effective cost control techniques in the UK construction industry and assess their importance. The study examines these key areas; (i) the factors that have significant impacts on cost overruns, (ii) the most effective cost control techniques, and (iii) the factors for selecting cost control techniques for a project.

**Design/methodology/approach** - The study relies on a mixed-method research approach; a qualitative exploration of the most effective cost control techniques and the factors affecting the selection of cost control techniques, followed by a questionnaire survey and follow-up interviews. Relative Importance Index (RII) is used for ranking the factors.

**Research limitations/implications** - Although the scope of the study was limited to the UK construction industry, the results could be interpreted for critical learning in other developed/developing countries.

**Findings** - Budgeting technique is ranked first with-0.821RII, followed by cost forecasting-0.800RII and cashflow monitoring-0.733RII, as the most effective cost control techniques. On factors that influenced the choice of the techniques used, cost information/cost-related factors is ranked first with-0.611RII, followed by the size of the company-0.509RII and the effectiveness of the technique-0.572RII.

**Originality/value** – Identifying and ranking the factors affecting the selection of effective cost control techniques in the UK construction industry has been the focal point of this study. The study also proposes a simple but effective model which can be used for critical learning on mitigating cost overruns and the effective use of cost control techniques in the construction industry.

**Keywords:** cost control techniques, construction projects, cost overruns

## 32 Introduction

33 Construction projects have three main aims; projects delivered on time, within budget, and  
34 to the necessary quality (Potts, 2013). The problems associated with cost overruns cannot  
35 be overemphasised. A study by UK Construction Media indicates in the three years to 2015,  
36 less than one in three projects (31%) came within 10% of the originally planned budget (UK  
37 Construction Media 2017). A good example is the Wembley stadium where the cost of the  
38 project rose by 36% between the bid being accepted and the contract being signed. The  
39 stadium was “mired in controversy with questions over adequate cost planning and budget  
40 management” (Kirkham, 2015). The cost was expected to be approximately £200 million  
41 and the final project cost was £757 million. This could have been due to the failure of budget  
42 management (Kirkham, 2015). The cost overrun of the Scottish parliament was staggering,  
43 the planned cost was £50m and the final cost was £414m an increment of 730% (Global  
44 Construction Review, 2019). Due to the slender profit margins in the construction industry  
45 (2% to 7%), without adequate cost control techniques, substantial risk of cost overrun due  
46 to liquidated damages and delay is placed on the contractor (Oyegoke and Kiyumi, 2017).

47 The HS2 (High-Speed Railway) an ongoing project in the UK is a recent example, the  
48 expected final cost of the project is to be £56 billion, which is up 71% on the first estimate of  
49 £32.7 billion in 2010 (BBC, 2018). Although the reasons could be put down to poor cost  
50 planning at the planning stage and design stages, it is during the construction stage that the  
51 costs spiral out of control. According to Jayaraman (2016) and Oyegoke (2003), large  
52 projects can easily have cost overruns of several millions. Ensuring the project is within  
53 budget is crucial to the project’s success.

54 Selecting the most effective cost control techniques is vital to the overall cost control  
55 mechanism. It is evident from the study carried out by Olawale and Sun (2010) that many  
56 companies simply develop their own techniques from an individual’s experience of what

57 methods have been most effective for them. In turn, many different techniques are utilised  
58 within the industry, making it hard to establish which technique is most effective. There is no  
59 'set-in stone' technique that is viewed by all as the most effective (Jayaraman, 2016). A cost  
60 control system can be described as an overall approach a company takes to controlling  
61 costs. Cost systems, for instance, include life cycle costing, Kaizen costing, building  
62 information modelling (BIM), and traditional costing systems (Omotayo, 2017). All the cost  
63 control systems have their merits in controlling costs, but this study focuses on the factors  
64 used to make the cost control systems successful. Ranking the factors and the techniques  
65 is more important since techniques are often used across all the cost control systems.

66 The aim of this paper is to examine the most effective cost control techniques and the factors  
67 that affect the selection of cost control techniques in construction projects in the UK. The  
68 issue on cost overruns and controlling cost overruns has been a popular topic in academic  
69 literature since the 1980s. Many authors such as Chan and Kumaraswamy (1997); Jackson  
70 (2002); Olawale and Sun (2010); Memon *et al.* (2011); Park and Papadopoulou (2012);  
71 Rosenfeld (2013) have conducted research on identifying the factors affecting project cost  
72 overruns. However, the research carried out on identifying the effective cost control  
73 techniques to date is subject to a number of limitations. Olawale and Sun (2010) for example,  
74 conducted a study on identifying the cost overrun factors and the techniques used for project  
75 cost control in the UK construction projects, however, they did not identify the significance  
76 of factors affecting the selection of effective cost control techniques in construction projects.  
77 Therefore, this article extends the existing research gap by identifying factors affecting the  
78 selection of effective cost control techniques in the UK construction industry and proposing  
79 a simple but effective model that can be used for critical learning on mitigating cost overruns  
80 and the effective use of cost control techniques in the construction industry. This research  
81 utilises primary data as defined by Farrell (2016) and relies on a questionnaire survey that

82 utilised both open and closed questions producing quantitative and qualitative results. A pilot  
83 study was undertaken to ensure that the questionnaire is to the highest quality and easily  
84 understood by the participants. Additionally, 3 follow-up interviews were carried out to allow  
85 for a greater insight into the information provided. Thematic analysis is used to identify  
86 themes across the dataset to develop a conceptual model to identify the challenges for  
87 monitoring and controlling costs, factors with significant impacts, and the most effective  
88 techniques.

89 The general design of the study is to determine the challenges faced in monitoring and  
90 managing cost control, and the most appropriate techniques used to mitigate the challenges.  
91 It also examines the impacts of standardisation and digitisation in cost control and proposed  
92 a solution. The study was carried out in the UK with wider cost control and techniques  
93 application in different practices.

94

## 95 **Controlling costs in construction projects**

96 Controlling costs in construction projects to ensure the cost objectives are met has always  
97 been essential to any project's success. According to Ashworth and Perera (2015), in recent  
98 years there has been a need for a better understanding of cost control from both the client  
99 and contractor's perspectives. Cost overrun problem is affected by many factors which may  
100 include; psychological biases in estimating and monitoring costs, political intervention in  
101 decision-making, geological and weather conditions, contractor's profit margins being  
102 reduced, environmental aspects such as greater elimination of waste and more  
103 consideration on the environment, economic recession producing a shortage of funds  
104 available, high inflation and higher interest rates leading to construction prices soaring, etc.  
105 (Mansfield *et al.* 1994; Jergeas, 2008; Cantarelli *et al.*, 2010; Ahiaga-Dagbui and Smith,  
106 2014). These factors, together with a greater trend towards producing cost efficiency and

107 the availability of better tools and techniques, have led to greater importance being placed  
108 upon controlling costs as well as expecting more accurate results (Olawale and Sun, 2010).  
109 Seeley(1996), emphasises the importance of cost control, labelling cost management as the  
110 single most important role undertaken by a Quantity Surveyor (QS).

111 An extensive review of the literature was carried out to identify and categorised cost overrun  
112 factors into nine (9) broader themes of price and cost, delay and extension of time, project  
113 management, design issues, construction issues, payments, contractor specific factors,  
114 consultants' specific factors, and force majeure. In total, 35 cost overrun factors were  
115 identified as shown in Table 1.

116

117 **Insert - Table 1. Cost Overrun Factors**

118

## 119 **Cost control techniques - challenges of implementing effective cost** 120 **controls**

121 The three main aims of cost control are to give the employer value for money, distribute  
122 logically available funds between various parts of the building, and to keep the costs within  
123 the employer's budget (Seeley, 1984). A good cost control should ensure that the funds  
124 available are allocated effectively to various elements, ensure that the tender figure is as  
125 close as possible to the first estimate, and achieve good value at the desired level of  
126 expenditure (Kirham, 2015). Ashworth and Perera (2015), postulate that the purpose of cost  
127 control is to limit the client's expenditure to the desired amount, achieve a balanced design  
128 expenditure between the elements of the building, and to provide value for money.

129 Bergerud (2012), believes the main challenge faced when implementing cost control is  
130 controlling the costs. Indicating that merely monitoring and reporting can easily be done.  
131 Jayaraman (2016), believes that the reasons for difficulties in controlling costs lie in the

132 difficulty of estimating a budget. He concludes that even with knowledge of common cost  
133 overruns, the development of a “fool-proof” system in practice is extremely difficult. Likewise,  
134 Potts (2013), believes developing and operating effective cost control is challenging due to  
135 the unique nature of a project. Table 2 presents cost control techniques, merits and demerits.  
136 Lewis (2007) believes that techniques are not the main factor in how effectively costs are  
137 controlled, but the individuals within the business. He postulates further that the most  
138 effective way to control a project’s cost is for every person to control their own aspects,  
139 emphasising the ‘human aspect’ to cost control.

140 However, these factors reduce the influence that the cost consultants have on controlling  
141 the costs. Potts (2013) cites research conducted in 1994 which found that traditionally, a  
142 cost consultant would only monitor costs rather than control them. This would make the role  
143 of a cost consultant in controlling costs, reactive rather than proactive.

144

145 **Insert - Table 2.** Cost Control Techniques Description, Merits and Demerits

146

147 Digitisation has also played a role through advances in technology that has changed the  
148 way cost control techniques are used. Planning and budgeting, resource scheduling, and  
149 activity costing can all be done with software packages, making it easier than in the past  
150 and tasks have become increasingly time-efficient (Webb, 2017). Jayaraman (2016) agrees  
151 to note that tracking and monitoring costs in fine detail has become possible and easier.  
152 They both also agree that although the monitoring and tracking have been made easier, the  
153 same attention to detail is needed.

154

155 **Selecting cost control techniques**

156 When selecting a cost control technique, the balance between the technique and the  
157 benefits it offers the project is important (Potts, 2013). Potts (2013) postulates that operating  
158 an extensive cost control system can become a “monster”, deflecting other important tasks  
159 a cost consultant has on a project. Sears (2015) agrees, stating that how costs are controlled  
160 on a project is dependent upon the “size and character” of the business. A smaller project  
161 would require a simple easy to follow cost control technique, whereas a complex project  
162 would require a more elaborate technique. This shows that the most effective technique  
163 could depend on the type of project it is applied to. A cost control technique needs to be an  
164 investment, not an expense, it has no value to the business if the data produced is not used  
165 or not reported in the relevant time frame (Sears, 2015).

166 According to Sears (2015), “the details of a specific cost control system vary substantially  
167 from one construction firm to another, the ensuring treatment can be regarded as being  
168 reasonably typical of current practice” (Sears, 2015). This statement indicates that even  
169 though the specific cost control techniques are different, the overall cost control method is  
170 relatively typical of those in similar businesses. Jayaraman (2016), mentioning  
171 standardisation of cost control is difficult, he believes there is no unanimity in the industry to  
172 which cost control technique is most effective and therefore should be utilised. Sears (2015)  
173 believes that cost control systems of businesses are of the same nature could be sceptical  
174 as projects are unique and often have different demands meaning often different techniques  
175 are utilised. However, Bergerud (2012) disagrees, he concludes that companies are  
176 standardising methods across their business but allowing for flexibility at the project level.  
177 Table 3 presents the important factors for selecting cost control techniques.

178

179 **Insert - Table 3.** Important factors when selecting cost control techniques

180

## 181 **Research methodology**

### 182 **Questionnaire survey**

183 Selecting appropriate research methodology is vital in a study (Oyegoke, 2011; and Sahu,  
184 2013). This study relied on an extensive literature review to identify 35 cost overrun factors  
185 categorised into nine (9) broader themes, 10 cost control techniques, and 6 factors for  
186 selecting appropriate cost control techniques which were used in the questionnaire survey.  
187 Prior to conducting the survey, a pilot survey was conducted among three participants who  
188 are working as cost consultants in the construction industry in the UK with 35, 10, and 1-  
189 years' experience. Naoum (2013) suggests that a pilot study provides a test run for the  
190 questions, which involves evaluation of the wording of the questions, identifying any  
191 ambiguous questions, testing the technique that the researchers use to collect the data.  
192 Based on Naoum (2013), the pilot survey was used to achieve two things; to ascertain that  
193 the local cost overrun control factors are not excluded and to prevent misunderstanding and  
194 ambiguities. Few issues that were raised in the pilot to improve the clarity of the question  
195 were addressed before questionnaires were rolled out.

196 A non-random sampling technique – convenience sampling was used in the study. A  
197 convenience sample is a non-random sample containing individuals who can be accessed  
198 readily, where the researcher collects data from a conveniently available pool of  
199 respondents in a population who own qualities/experience that a researcher expects from  
200 the target population (Fellows, 2015). The selected sample of participants consisted of  
201 professionals with extensive construction experience in the industry personally known to the  
202 researchers. The questionnaire used for the survey contained a five-point Likert scale under  
203 two main categories: ranking of the cost control techniques and Usage of cost control  
204 techniques. The questionnaire also included a few open-ended questions for participants to  
205 elaborate more on their responses. The questionnaires were emailed to 50 Royal Institution

206 of Chartered Surveyors (RICS) accredited cost consultant firms and 30 large-scale  
207 contracting firms in the UK selected by the researchers. Additional 20 questionnaires were  
208 shared on LinkedIn with professionals with extensive construction experience in the industry  
209 known to the researchers. Out of 100 questionnaires distributed, a total of 57 individuals  
210 completed the questionnaire accounting for a 57 per cent response rate. In addition to this,  
211 3 respondents accepted a follow-up interview to further elaborate their answers and verify  
212 the results of the research.

### 213 **Analysis of data**

214 72% of participants work in the building industry, 19% in civil engineering, and 9% in other  
215 industries (e.g. local authority and wider client's organisations). 42% of participants work for  
216 contracting firms, 39% for consulting, 19% for the local authority. 49% of participants are  
217 quantity surveyors (cost consultants), 25% are project managers, 7% are company directors  
218 and 19% are others, which include; buildings surveyors, facilities managers, construction  
219 managers. 40% of participants have experience in £0-1 million projects, 30% with £1-10  
220 million, 16% with £10-30 million, and 14% with £30+ million. On participants' years of  
221 experience, 22% have 0-5 years, 18% have 6-10, 18% have 11-20 and 42% have 20+ years.  
222 This indicates that most participants have a wealth of experience that will enable them to  
223 give detailed insights into cost control techniques and cost overrun factors.

224 A five-point Likert scale was used for rating and the Relative Importance Index (RII) method  
225 was used for the analysis of data: ranking the level of perceived importance of the identified  
226 factors. This approach and the formula used in the analysis have been previously used by  
227 Oyegoke and Kiyumi (2017), Muhwezietal (2014), and Khoshgoftar *et al.* (2010), in their  
228 studies on ranking the most significant construction delay factors. The purpose of this study  
229 was to identify and rank the most effective cost control techniques, therefore, based on the  
230 previous studies, a five-point Likert scale and the Relative Importance Index (RII) method

231 and the formula (i) were deemed appropriate for the analysis of data. Responses were  
232 assigned numerical values of 1 to 5 to the ratings as follows: 'extremely important' = 5,  
233 'important' = 4, 'neither important/unimportant' = 3, 'unimportant' = 2, 'extremely  
234 unimportant' = 1.

$$235 \text{ Relative Importance Index} = \frac{\sum W}{A \times N} \quad (0 \leq RII \leq 0.8) \quad (i)$$

236

237 Where:

238 W = the weight given to each factor by the respondents ranges from 1 to 5 (where "1" is  
239 "lowest" and "5" is "highest");

240 A = highest weight which is 5 in this study; and

241 N = total number of respondents.

242 The relative range= 0.80.

243 The analysis was done and RII outputs were interpreted cautiously. After the ranking of 10  
244 different cost control techniques and 6 cost control technique determining factors, the  
245 researchers used thematic analysis which is a flexible analytic induction approach to identify  
246 patterns through clustering to arrive at themes based on triangulated data from the survey  
247 responses, follow-up interviews, and the literature review on cost overruns. An analytic  
248 inductive approach allows research findings to emerge from the frequent, dominant or  
249 significant themes inherent in raw data, without the restraints imposed by structured  
250 methodologies (Thomas, 2006). The approach adopted by the researchers followed the  
251 steps outlined by Braun and Clark (2006): 1. familiarisation with data, 2. the generation of  
252 initial codes, 3. search for themes among codes, 4. review of themes and the definition and  
253 naming of themes before the production of the final report. The thematic analysis started  
254 with identifying initial themes and concepts from literature on cost overruns and cost control  
255 techniques, continuously revising/developing the themes based on the survey responses

256 and the follow-up interviews, and sorting the themes into broad categories. Subsequently,  
257 a simple but effective illustration (Figure 3) base on the themes identifying the challenges  
258 for monitoring and controlling costs, factors with significant impacts, and the most effective  
259 techniques was developed and validated using the follow-up interviews with 3 survey  
260 participants.

261

## 262 **Findings and discussion of results Establishing the most effective cost** 263 **control techniques**

264 The results of this study illustrate that the most effective cost control techniques are  
265 budgeting and cost forecasting. As shown in Table 4, budgeting ranked first with 0.821 RII,  
266 followed by cost forecasting 0.800 RII and cashflow monitoring 0.733 RII. If successfully  
267 implemented and followed, budgeting will be effective in controlling costs as the cost will not  
268 overrun the budget (Kirkham, 2015). Participant three in the follow-up interview agrees with  
269 this point stating that if budgeting is undertaken correctly the project will not experience cost  
270 overruns. Cost forecasting gives an indication in advance of the expected costs. Identifying  
271 cost overruns early will allow for corrective action to be undertaken (Ashworth and Perera,  
272 2015). Agreeing with Ashworth and Perera (2015), participant one believes to effectively  
273 control costs, cost forecasting is the most effective as it allows for early identification of cost  
274 overruns, allowing for controls to be put in place to mitigate them. These techniques are  
275 cheap and simple to implement, which could be another explanation of why they are viewed  
276 as effective. Individuals will have experience utilising them and will understand them clearly.  
277 The techniques being cheap to implement will enable them to be used on all projects as they  
278 will be cost-effective.

279 The least used techniques are earned value ranked 10<sup>th</sup> with 0.579 RII, resources monitoring  
280 0.664 RII, interim valuation and payment 0.678 RII and value engineering ranked 7<sup>th</sup> with

281 0.684 RII. As earned value is not a traditional technique, some participants may not have  
282 used it, therefore viewing it as ineffective. Participant two in the follow-up interview solidified  
283 this point stating they have never used this technique, therefore, view it as the least effective.  
284 Additionally, as Webb (2017) states, this technique is more complicated and involves  
285 advanced software, therefore becoming costlier and only suitable for larger projects. Ranked  
286 the second least effective is monitoring labour, material, equipment, and overheads (costs).  
287 Potts (2013) postulates that only monitoring costs is ineffective as once the costs have been  
288 incurred there is nothing the cost consultants can do, indicating a lack of control. Participant  
289 one in the follow-up interview agrees, expressing the usefulness of monitoring costs to  
290 understand the project's progress but the ineffectiveness of the technique in controlling  
291 costs.

292

293 **Insert - Table 4.** Ranking of the cost control techniques

294

295 Figure 1 presents the usage of cost control techniques across different disciplines. In  
296 consulting ranking, cost forecasting and budgeting top the list with 0.762 RII, followed by  
297 variation/change management. the least ranked factors are: resources monitoring 0.524,  
298 earned value 0.552 RII, and interim valuation/payment 0.638 RII.

299 Budgeting also top in the contracting discipline with 0.861 RII, followed by cost forecasting  
300 0.843 RII and cashflow monitoring 0.791 RII. Budgeting also tops the local authority  
301 discipline with 0.836 followed by cost forecasting 0.818, cost reporting and cashflow  
302 monitoring 0.745 RII.

303

304 **Insert - Figure 1.** Usage of cost control techniques

306 The least rated are earned value 0.455 RII, value engineering 0.618, post-project review  
307 and site visits 0.691 RII. Earned Value is lowest ranked in all the disciplines except under  
308 contracting with 0.655 RII. As earned value is a technique used mainly by contractors (PMI,  
309 2005), it is unlikely that other disciplines will have used it and therefore may not understand  
310 its effectiveness. According to Webb (2017), earned value is not suitable for all project types,  
311 only projects with specific characteristics. Interim valuations and certificates for payments  
312 gains a low score across all projects illustrating that it is ineffective at controlling costs.  
313 Monitoring costs received a high rating on projects less than £10 million, however on projects  
314 over £10 million it is scored the lowest and second lowest, showing that on higher-value  
315 projects it is less effective. Therefore, on larger projects, more controls must be put in place  
316 to ensure the costs do not overrun, merely monitoring costs will not be enough.

317 On the different opinions relating to the experience of working on various project value  
318 ranges. Earned value is scored the lowest on £0-1 million and £1-10 million projects, and  
319 close to the lowest on £10-30 million and £30+ million projects. This demonstrates that  
320 earned value is viewed as the least effective, with it being more effective on larger projects  
321 than smaller projects. Similarly, post-project reviews and site meetings are viewed as more  
322 effective on larger projects than smaller projects, suggesting that even though collaboration  
323 and communication is important on all projects is it essential on larger projects. The  
324 effectiveness of interim valuation and certificates for payment is consistently scored lower  
325 as the projects increase in value, exemplifying the higher value the project, the less effective  
326 this technique. Using this technique on larger value projects may, therefore, be more of a  
327 hindrance than an advantage.

328 Figure 2 shows how insights differ depending on an individual's years of experience. Cost  
329 forecasting is scored the highest for all experience levels except those with 20+ years.

330 Budgeting is scored the highest by those with 20+ years of experience and second by those  
331 with less than 20 years of experience.

332

333 **Insert - Figure 2.** Individual's Years of Experience Comparison

334

335 This confirms that budgeting and cost forecasting are the most effective cost control  
336 techniques. However, those with 20+ years of experience view variation/change  
337 management as the second most effective technique. The opinion of those with 20+ years  
338 of experience should be valued highly as they have used the techniques more therefore  
339 their judgement was considered rational. Earned value is rated lower by those with more  
340 than 11 years of experience but received higher scores by those with less experience.  
341 Confirming that participants with more experience who use more traditional cost control  
342 techniques may not have experience with earned value, therefore, view it as ineffective.

343 When asked if there are any techniques the participants found effective but were not in the  
344 study, some different techniques were identified. Firstly, time management was listed,  
345 having effective time management will be effective at controlling costs as any delays will  
346 lead to cost overruns. Risk management was also identified as an effective technique.  
347 Effectively managing risks is an important and effective technique, as common causes of  
348 cost overruns have already been identified through risk management. Therefore, if these  
349 risks were successfully managed, fewer cost overruns would occur.

350 Finally, the technique that was identified multiple times was controlling the design. Avoiding  
351 complex design, less design changes, and the design being as complete as possible at the  
352 time of tender were all identified as ways to minimise cost overruns. As design related factors  
353 have been established as the main cause of cost overruns, controlling the design is essential  
354 to effectively control costs. However, at the post-contract stage, little can be done if there is

355 a complex design, therefore the cost consultants must be involved in the design stage to  
356 give cost advice. More emphasis must be placed on reducing design changes as these are  
357 the main factor causing cost overruns. As identified by participants in this study, controls  
358 must be put in place to effectively manage the design changes. Controlling design changes  
359 could be considered as one of the most effective techniques for reducing cost overruns.  
360 However, changes in design are often out of the cost consultants' control, therefore  
361 emphasis must be put on controlling the design changes and managing them properly.

362

### 363 **Selecting the most effective cost control technique**

364 The overall result as in Table 5 indicates that cost information/cost-related factors is ranked  
365 first with 0.611 RII, followed by the size of company 0.509 RII and the effectiveness of the  
366 technique 0.572 RII. The result for contracting discipline is similar except the third factor are  
367 resources available and project duration 0.496. The consulting discipline sees resources  
368 available, project duration and cost information/cost-related factors as equally important with  
369 0.619 RII. Under local authority, the effectiveness of the technique ranked first 0.709 RII,  
370 followed by size of company 0.673 RII and cost information/cost related factors 0.600.

371 A main factor listed by participants on the reason why cost control should change due to  
372 project requirements was because of the unique nature of construction projects. With each  
373 project being different, techniques must be able to adapt to suit project requirements, this is  
374 consistent with Sears' (2015) point that projects are unique and have specific demands  
375 therefore different techniques are utilised. The size of a project, contract type and different  
376 requirements are all factors that mean cost control should be flexible across a company.  
377 Additionally, contractors or individuals may have their own techniques, therefore a company  
378 with many individuals working for them using different techniques.

379

380 **Insert - Table 5.** Selection of Cost Control Technique Factors

381

382 **Standardisation of cost control**

383 The participants stated standardising cost control would allow for benchmarking and  
384 consistency. Standardising can improve accuracy as it allows for standards to be set. These  
385 results support Bergerud (2012) that there should be some standardisation of cost control  
386 across companies, but it should be flexible and be able to change due to a project's  
387 requirements. 28 per cent thinks that cost control should be standardised to maintain a  
388 consistent benchmark of cost and presentation to the client to set minimum standards. The  
389 respondents argued that it will improve accuracy, certainty, repetition of good practices, and  
390 avoid errors - *"Standardisation makes it easier to establish control across the entire  
391 company and projects can accurately be compared"*. Another respondent stated *"to support  
392 consistent and repeatable successful cost control utilising methods and reviews that the  
393 team are comfortable with. Whilst utilising a standard approach there should be a degree of  
394 tailoring to the project requirements around size, complexity, financial model, etc."*

395 72 per cent thinks changes should be made due to project requirements. The resources  
396 secured for the project, appropriateness of techniques, project specific demands, project  
397 peculiarities, resource availability, unforeseen circumstances, size of the contracting firm,  
398 size and type of the project, and client-specific requirements are the reasons according to  
399 the respondent to justify unstandardised approach to cost control. One of the respondents  
400 states that "larger projects can benefit from more procedural cost control methods. Smaller  
401 or fast projects may be hindered by cost control procedures. The uniqueness of each project  
402 requires flexibility. Changes in the design and contract team for each project requires re-  
403 thinking of approach each time. If a variable such as industry, client, laws and regulations

404 change then this may have an impact. Flexibility in contract and cost control management  
405 is needed to meet changing situations.”

406

#### 407 **Challenges for implementing effective cost control**

408 When asked about the main challenges faced when trying to monitor and control costs,  
409 common themes highlighted are; information issues, client changes, and project  
410 management issues. Distinctively the challenges faced in monitoring cost is different from  
411 controlling cost. Similarly, design changes were identified as the main cause of cost  
412 overruns, indicating that that client changes or design changes are a key issue in  
413 implementing effective cost control. A simple solution to this would be to limit design changes  
414 and ensure the client is happy with the design when the contract is awarded, however, this  
415 is sometimes impossible as changes may be necessary. Project management related  
416 factors featured more in the challenges of controlling costs, factors such as lack of  
417 communication, lack of experience and poor planning represented some of the main  
418 challenges of effective cost control. This demonstrates that when costs need to be controlled  
419 rather than monitored, effective project management is essential. Ensuring project members  
420 work collaboratively is essential in guaranteeing a project’s success and that the project  
421 does not experience cost overruns. If budgeting, forecasting and reporting are completed  
422 more effectively, costs could be better controlled but to undertake these methods correctly  
423 the cost consultant often must rely on the quality of information they receive, another  
424 challenge presented by the participants.

425

#### 426 **The impact of digitisation on cost control**

427 When asked if advances in technology have improved cost control, 84 per cent of  
428 participants believed it has made controlling costs easier. Participants expressed how data

429 had become easier to collect, easier to store, and easier to analyse. Advances in technology  
430 has allowed individuals to monitor costs more effectively and has made it more time-efficient.  
431 It has allowed faster and better communication between parties, therefore allowing for better  
432 collaboration and control. Measurement tools are also available, allowing for more accurate  
433 and easier measurement. Tools presented by participants included IT, Microsoft packages  
434 such as excel, Evolution M, online resources such as Building Cost Information Service  
435 (BCIS) and software programs such as CCS WinQS, CostX, Asta Power project, and EDMS.  
436 This indicates that there is a readily available supply of technology that can enhance cost  
437 control, making it easier and more effective. However, 16% believed technology had not  
438 made cost control easier, one reason given for this is tools are not being adopted widely  
439 enough. Nonetheless, with the majority of participants believing cost control is easier with  
440 advances in technology, it shows that technology is improving cost control.

441 Table 6 presents the challenges in monitoring and controlling costs. The thematic analysis  
442 described earlier was used to arrive at six themes.

443

444 **Insert - Table 6** Challenges in monitoring and controlling costs

445

446 Figure 3 presents the summarised illustration of the key findings and themes. It shows the  
447 factors with significant impacts and challenges in monitoring and controlling cost and  
448 suggests some key elements in managing cost overrun.

449

450 **Insert - Figure 3** Managing cost overrun in a project – controlling and monitoring

451

452 The illustration is based on the findings of the study and key determinant factors in selecting  
453 cost control techniques and the most appropriate techniques in different project types and  
454 sizes. The model was checked and verified using the follow-up interviews with 3 survey  
455 participants from the industry. As illustrated in the diagram, cost overrun can be managed  
456 through clear scope definition, client direct involvement, preconstruction cost planning,  
457 completeness of design and application of appropriate cost control techniques. Three key  
458 determining factors for selecting cost control are identified: size in terms of project and  
459 company, appropriateness of the techniques and availability of cost information. Three most  
460 significant techniques were identified: budgeting, cost forecasting, and cash flow monitoring.  
461 Although this is a simplified representation of the broad, complex issue of cost overrun and  
462 effective cost controlling techniques, the model can be utilised for critical learning on  
463 mitigating cost overruns and the effective use of cost control techniques in the construction  
464 industry.

465

## 466 **Conclusions**

467 It has been established that cost overruns occur on projects and there are effective cost  
468 control techniques that should be put in place. Design management, a thorough cost  
469 planning exercise, client's involvement and the use of digitisation can solve some of the  
470 problems associated with design leading to additional cost. To minimise cost overruns more  
471 accurate time and cost estimations must be produced and better coordination between  
472 parties is needed. If budgeting is done effectively and followed by the project team the cost  
473 of the project will come within budget. Cost forecasting is also an effective technique as it  
474 gives an early indication of costs therefore potential cost overruns can be detected and  
475 controls can be put in place to minimise overruns. Variation/change management is another  
476 simple and effective way to manage project costs to prevent overrun. The use of different

477 cost control techniques will depend on the different factors (project, size, time, etc.) as  
478 identified in the study. Therefore, selecting the most effective cost control technique  
479 depends on the nature and size of the project, resources available, and project duration.

480 Budgeting and cost forecasting are viewed as very effective and should always be utilised.  
481 Techniques such as earned value can only be used on specific projects and would not be  
482 cost-effective on lower-value projects therefore would be ineffective on most projects. Due  
483 to the unique nature of construction projects, a company's cost control techniques should  
484 not be standardised and should be able to change due to project requirements. Advances  
485 in technology have made controlling costs easier as data can now be collected, stored and  
486 analysed easier as well as making it more time-efficient and improving communication.

487 Building upon the scholarly works of Chan and Kumaraswamy (1997); Jackson (2002);  
488 Olawale and Sun (2010); Memon *et al.* (2011); Park and Papadopoulou (2012); Rosenfeld  
489 (2013), this study should be viewed as an extension of developing solutions for factors  
490 affecting the selection of effective cost control techniques in the UK construction industry.  
491 Although identifying and ranking the factors affecting the selection of effective cost control  
492 techniques in the UK construction industry has been the focal point of this study, clearly,  
493 further research is needed as this study is subject to a number of limitations. The study was  
494 only limited to the UK's construction industry and was based on a survey using the  
495 participants from the industry personally known to the researchers which may restrict the  
496 generalisability of its findings to be applied to other countries and specific project types. In  
497 addition to this, the effectiveness of these effective cost control techniques during the project  
498 execution phase needs to be thoroughly investigated in future research as it is evident that  
499 despite the use of cost control techniques many notable construction projects still  
500 experience cost overruns. Findings of this study and the proposed model, however, can be

501 used as a learning tool for mitigating cost overruns and the effective use of cost control  
502 techniques in the construction industry.

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