Key drivers of discrepancies between initial and final costs of construction projects in New Zealand[1]

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ABSTRACT

Construction projects and the environment within which they are implemented are complex, dynamic and over-regulated. As a result significant discrepancies are introduced between initial contract prices and final accounts for most projects. These discrepancies introduce enormous risks and uncertainties with consequences such as disputes, high cost of project finance and low profit margins. Previous studies have looked at the myriads of discrepant factors, but little attempt has been made to quantify and segregate them along lines of responsibilities and accountability in the building development process. This research aimed to fill this knowledge gap by examining the nature and contributions of the key cost escalators from the actions/ inactions of the key stakeholders as well as wider factors. Feedback from a two-stage survey of consultants and contractors in the New Zealand construction industry was analysed using content analysis and multi-attribute methods. Results revealed 6 sources of discrepant factors. These comprised issues related to the owner or owner's principal agent, designers, contractors and subcontractors, project & environment, quantity surveyors/ estimators, and external parties such as local councils and utility companies. Change orders and quality of design information were perceived as the most significant sources of cost escalations which were attributed to the owner and designers, respectively. The report presents the priority factors under each broad category. It is recommended that project teams should proactively address the priority factors identified in the study with a view to effectively mitigating project cost overruns and ensuring more reliable outcomes in the project delivery process.

Keywords: Construction project, cost overrun, final costs, initial costs, variations

[1] *Second Editions are previously published papers that have continued relevance in today's project management world, or which were originally published in conference proceedings or in a language other than English. Original publication acknowledged; authors retain copyright. This paper was originally presented at the 2nd annual University of Maryland Project Management Symposium in College Park, Maryland, USA in June 2015. It is republished here with the permission of the authors and conference organizers.*

INTRODUCTION

Construction projects and the environment within which they are implemented are complex (Kartam and Kartam, 2001), dynamic (Mohammed et al., 2010) and over-regulated (Mbachu, 2012). As a result significant discrepancies are introduced between initial contract prices agreed at the onset and the adjusted final accounts for most projects (Olatunji, 2008; Ko, 2009). These discrepancies introduce enormous risks and uncertainties with serious consequences such as disputes, high cost of project finance and low profit margins (Zakaria et al., 2013). Mbachu (2012) argued that, as an obligation of duty of care and the basis for rewards, clients, financiers and other stakeholders expect consultants and contractors to careful consider risks that may affect outcomes in their operations and provide informed advice that the interested parties can rely on to make decisions such as commissioning projects or lending project finance. When proper risk analysis is not done and outcomes deviate from initial expectations, the reputation of the construction professionals suffers great damage. This is more so that, on account of *attribution theory*, clients will always put all the blame on the service providers, notwithstanding that they contribute to the risks; the justification being that service providers are paid for shouldering the risks inherent in their services. It is therefore critically important that risk factors, especially in relation to cost advice, are investigated so that appropriate risk response measures are put in place at the onset.

Research objectives: The specific objectives of the study were as follows.

1. To determine the recurring factors that account for the variance between the initial contract price as agreed at the outset, and the final account values of construction projects at completion.
2. To prioritise the factors in terms of their relative levels of influence on the cost variance.
3. To explore ways of eliminating or narrowing the variance in order to minimise risks and improve reliability of price/ budget forecasts in the construction industry.

Scope: This study focused on factors that could account for cost overruns from the initial tender price for which the project owner has obligation to bear under the construction contract. Factors underlying cost increases for which the contractor is not entitled to payment claim such as defective work or poor coordination are not covered in the study. Investigations were limited to views expressed by building consultants and contractors in New Zealand comprising quantity surveyors/ estimators, project managers/ site managers and contractors who are registered members of the New Zealand Institute of Quantity Surveyors (NZIQS), New Zealand Institute of Building (NZIOB) and the Registered Masters Builders Federation (RMBF), respectively.

RESEARCH METHOD

The descriptive survey method was adopted for this study since observation via interviews and questionnaire surveys were relied on as sources for primary data (Cooper and Schindler, 2006). Two stages were adopted in the primary data gathering process. In the first stage, personal

interviews were held with two subjects in each of the 3 sampling frames for the study who were willing to grant request for two hour in depth interviews. Constructs generated at the interviews were used to design a questionnaire. After pre-testing the questionnaire for clarity, reasonableness and conciseness, it was hosted online at SurveyMonkey website. Links to the online questionnaire were provided in emails sent out to members by the secretariats of the four trade and professional associations delineated for the study. The assistance of the association secretariats was sought as it was not possible to obtain the membership directories due to the New Zealand Privacy Act. Moreover, the secretariats' email invitations to their members to participate in the surveys lent credibility and impetus that improved the response rates. Three reminders were also used to encourage further responses before the cut-off date set for the survey. Providing opportunities to members of each sampling frame to participate in the survey via their institutional email invitations ensured census surveys which obviated the need to do random sampling and computation of representative sample sizes.

Data analysis: Given that the empirical data for the research comprised survey respondents' ratings, multi-attribute analytical method was recommended (Mbachu and Nkado, 2006) as being an appropriate analytical tool. The analysis aimed to compute the average rating point of the Likert scale as the representative of the respondents' combined ratings for a particular variable in a subset. Equation 1is an expression for computing the average or mean rating point (MR_j) for the j^{th} attribute in a subset.

$$MR_j = a_1 b_1 + a_2 b_2 + \dots + a_n b_n = \sum_{i=1}^{n} a_i b_i \quad (1)$$

Where:

- a_i entries are the proportions of the responses associated to a rating point, and
- b_i entries are the Likert rating points ranging from 1 (i.e. the lowest value) to n (the highest value).

Sorting the *MR* values in diminishing order of magnitude provides the ranks of the variables which can be used to prioritise them according to their relative levels of impact or importance.

RESULTS AND DISCUSSION

Survey responses and respondents' demographic profiles: By the survey cut-off date, 150 responses were collected. It was not possible to establish the extent to which the responses represented the views of the target sampling frames of consultants and contractors. This was because the secretariats of the respective trade and professional associations participating in the survey could not release their membership directories due to concerns about the Privacy Act.

Analysis of the respondents' demographic profiles showed that majority (i.e. 39%) were quantity surveyors/ estimators, 30% were project managers/ site managers/ site engineers; 17% were main contractors, 4% were designers, while 3% belong to the 'other' category which included land surveyors and planners. The views expressed were therefore largely influenced by quantity surveyors/ estimators.

Results of analysis of other aspects of the demographic data showed that majority (85%) occupied senior management levels in their organisations and had over 20 years of experience in those roles. The decision-making authority and rich experience of majority of the respondents therefore added to the quality of the responses.

Thirty six contractors, consultants and clients agreed to participate in the second stage quantitative interviews. These comprised 13 directors of medium to large contracting firms, 12 construction project management consultants and 11 clients. The client group comprised 7 directors of property development companies and 4 facilities managers of education facilities. However, feedback was received from only 30 interviewees, as 3 contractors, 1 consultant and 2 property directors requested that the interviews be rescheduled at a later date due to urgent commitments that surfaced within the interview period. All the 30 interviewees had over 15 years of experience in their various roles. They also had qualifications in construction related disciplines: 10 had degrees, 15 had diplomas while 5 had certificates. Their senior management status, depth of experience and education added to the quality of their feedback on the key issues

KEY FACTORS ACCOUNTING FOR PROJECT COST OVERRUNS

The first and second objectives of this study focused on identifying the factors that account for the variance between the initial contract price as agreed at the outset, and the final account values of construction projects at completion, as well as prioritizing the factors in terms of their relative levels of influence on the cost variance. The recurring factors identified during the pilot interviews showed that these factors could be segregated into the following broad categories: Owner/ principal, designers, quantity surveyors/ estimators, contractor/ subcontractors, project and environment, and external parties.

Feedback from the interviews suggested that the initial contract price versus final contract sum variance is caused by factors other than those of the internal stakeholders (i.e. owner and his or her principal agent, the designers, quantity surveyors, estimators, contractors, subcontractors, and suppliers). The interviewees suggested that the factors should include external dynamics beyond the control of the internal stakeholders such as the local councils, utility companies, and project environment. Recurring factors under each of the broad categories were rated for relative levels of influence by respondents in a survey using a 5-point Likert scale. The results and analysis of the survey responses are presented in the following sections.

Owner/ principal related factors underlying project cost overruns: Table 1 presents the recurring constructs generated during the interviews and the analysis of respondents' rating of each construct's relative level of influence on cost overrun.

Table 1: **Owner/ principal related factors causing project cost escalation**

		[a]Levels of impact							
	Contractor's payment risk factors relating to the employer's profile and financial status	VH 5	H 4	M 3	L 2	VL 1	[b]TR	[c]MRi	[d]Rem
1	Change orders resulting in variations to the contract	53%	35%	10%	2%	0%	150	4.390	Vhi
2	Length of time allowed for proper risk analysis at the onset and for quality execution of the job	42%	39%	16%	2%	1%	150	4.190	Hi
3	Choice of procurement system impacting on workflow integration and relationships in the development process	40%	36%	20%	2%	2%	150	4.100	Hi
4	Choice of contract strategy impacting on risks and risk allowances	39%	34%	21%	3%	2%	150	4.035	Hi
5	Choice of tendering and contract strategy impacting on risks and risk allowances	36%	32%	24%	5%	3%	150	3.930	Hi
6	Speed and quality of decision-making and responsiveness to requests for information (RFI)	18%	32%	25%	18%	7%	150	3.360	Mi
7	Extent of fulfilment of contractual obligations	8%	16%	18%	48%	10%	150	2.657	Mi
8	Additional work to be executed at daywork rates	2%	8%	15%	55%	20%	150	2.170	Li

[a]Level of impact: 5 = Very High (VH); 4 = High (H); 3 = Moderate (M); 2 = Low (L); 1 = Very low (VL)

[b]TR = Total responses

[c]MRi = Mean impact rating for the risk factor in the subset (see Equation 4).

[d]Rem (i.e. Remarks) = interpretation of the MRi value as ordinal scale rating point: MRi > 4.2 = VHi (Very high impact); 3.4 <MRi ≤ 4.2 = Hi (High impact); 2.6 < MRi ≤ 3.4 = Mi (Moderate impact); 1.8 <MRi ≤ 2.6 = Li (Low impact); MRi ≤ 1.8 = VLi (Very low impact).

Table 1 shows that out of the 8 factors identified during the interviews, only 7 were rated as having moderate to very high impact on cost overruns. The most influential factor was perceived as owner or principal's change orders that could result in variations to the initial contract agreed with the contractor at the outset. This result is consistent with the findings of Mohammad (2010) and Arain and Pheng (2005) that changes initiated by the project owner or owner's agents are key causes of the discrepancies between the initial contract price and the final project costs. Dominic and Smith (2014) also observed that client change orders could significantly affect initial budget, scope of work and the completion time for a project.

Designer related factors underlying project cost overruns: The recurring constructs generated during the interviews under this category are presented and analysed in Table 2. Results show

that 6 out of the 7 constructs were rated as moderate to very high impact factors. Respondents perceived that quality of design information and its documentation and communication to the project team is the most influential factor under this group. This agrees with the argument advanced by Odeyinka et al. (2012) that the quality and completeness of the information provided at the beginning of a project have far reaching implications on the outcomes in the project delivery process. Though buildability issues appeared to be most popular cause of project cost overrun in the literature (Mohammad, 2010; Zakaria et al. (2013).

Table 2: Designer related factors causing project cost escalation

		[a]Levels of impact							
	Designers' acts or omissions causing project cost escalations	VH 5	H 4	M 3	L 2	VL 1	[b]TR	[c]MRi	[d]Rem
1	Quality of design information, documentation & communication	50%	38%	10%	2%	0%	150	4.360	Vhi
2	Buildability issues resulting in slow pace of work and loss of productivity	52%	33%	12%	2%	1%	150	4.330	Vhi
3	Errors or omissions in design drawings and specifications	42%	34%	20%	2%	2%	150	4.120	Hi
4	Not undertaking proper site analysis and geotechnical tests resulting in designs and drawings being inconsistent with site conditions or requirements of the Building Code	45%	20%	28%	5%	2%	150	4.010	Hi
5	Delay in giving instructions or responding to contractor's requests for information (RFI)	37%	31%	24%	5%	3%	150	3.940	Hi
6	Inability to minimise variations by failing to comprehensively capture owner's stated and future needs and requirements at the inception stage and effectively translate these into final design & specifications	17%	32%	25%	19%	7%	150	3.330	Mi
7	Ambiguous or conflicting information in the contract documents	10%	12%	16%	42%	20%	150	2.500	Li

Quantity surveyor/ estimator related factors underlying project cost overruns: Ratings on the acts or omissions of quantity surveyors/ estimators with cost overrun potential are presented and analysed in Table 3. Results show that 3 out of the 5 constructs were rated as having medium impact on cost overruns. The most impacting factor based on the mean rating scores is failure to adequately analyse contractual risks at the onset and apply sufficient contingencies to cover imminent cost escalations arising from future increase in scope of work. It is surprising that none of the factors were rated high or very high. This could mean that some of the influences of the quantity surveyors or estimators were not captured in the research, or that the respondents did not consider these professionals as key contributors to project cost overruns. The latter explanation may not be convincing since quantity surveyors are at the forefront of cost and financial administration of projects and so should have profound influence on cost overruns (Mbachu, 2012). Perhaps, this should be investigated further in future research.

Table 5: Quantity surveyor/ estimator related factors causing project cost escalation

Acts/omissions of the quantity surveyor/ estimator causing project cost escalations	[a]Levels of impact: VH 5	H 4	M 3	L 2	VL 1	[b]TR	[c]MRi	[d]Rem
1. Failure to adequately analyse contractual risks at the onset and apply sufficient contingencies to cover imminent cost escalations arising from future increase in scope of work	20%	25%	28%	15%	12%	150	3.26	Mi
2. Failure to detect unbalanced bidding at the tender evaluation stage where tenderers put high rates to those items of work with prospects of significant scope increase and low rates to those that may not change in scope.	18%	20%	27%	20%	15%	150	3.06	Mi
3. Failure to advise the owner or owner's other agents on the cost implications prior to instructing the contractor to carry out variation works.	10%	15%	25%	30%	20%	150	2.65	Mi
4. Inability to use negotiation skills to avoid some potential claims and disputes for which the contractor has rights under the contract.	5%	15%	20%	45%	15%	150	2.50	Li
5. Inability to dispute some of the contractor's claims, especially those not supported by accurate records or factual evidence.	3%	10%	25%	34%	28%	150	2.26	Li

Contractor/ subcontractor related factors underlying project cost overruns: Respondents' ratings of the relative levels of impact of the various ways through which the main contractor and the subcontractor could influence project cost overrun are presented and analysed in Table 6. Seven factors under this category were rated moderate to very high. Lack of involvement of the contractors and specialist trades people in the design development at the design stage was rated the second most influential factor. This result supports Mohammad's (2010) conclusion that early contractor involvement in the design development could help to address many problems which could constrain productivity and escalate costs during the construction phase such as buildability issues, design and specification errors and missing information.

Table 6: **Main contractor/ subcontractor related factors causing project cost escalation**

Acts/ omissions of main contractors and subcontractors causing project cost escalations	[a]Levels of impact: VH 5	H 4	M 3	L 2	VL 1	[b]TR	[c]MRi	[d]Rem
1) Unbalanced bidding at the tendering stage: Putting high rates to those items of work with prospects of significant scope increase and low rates to those that may not change in scope.	50%	38%	10%	2%	0%	150	4.36	Vhi
2) Little contributions by contractors and specialist trades people in the design development.	35%	25%	35%	3%	2%	150	3.88	Hi
3) Delays by nominated subcontractors prolonging the completion time for the project	18%	32%	25%	18%	7%	150	3.36	Mi
4) Uncooperative attitudes and rivalry resulting in erosion of teamwork, loss of productivity and costly and time-consuming dispute resolution processes.	13%	36%	30%	15%	6%	150	3.35	Mi
5) Cash flow problems and inability to continue with the project, resulting in the employment of other contractors to complete the job.	15%	32%	25%	21%	7%	150	3.27	Mi
6) Lack of innovation and initiatives for cost and time-saving in the project execution	13%	30%	26%	15%	16%	150	3.09	Mi
7) Disposition to '*claiming all claimables*' especially in lowest tender, lowest margin contracts.	2%	8%	25%	45%	20%	150	2.27	Li

Project and environment related factors underlying project cost overruns: Respondents' ratings of the relative levels of impact of the factors under this category are presented and analysed in Table 7. Results show that collectively, the respondents rated unforeseeable underground conditions as the most influential factor under this category due to the cost and delay implications of the associated changes to the design or work method. Mbachu and Seadon (2013) observed that depending on the scale and complexity of a project, unexpected underground conditions could result in 15 – 25% cost overrun. The authors argued that majority of the problems associated with underground conditions arise due to lack of thorough geotechnical investigations and site analysis prior to the design. It is therefore worth the while to allow sufficient time for thorough geotechnical investigations so as to minimise the costs and delays associated with re-consenting process and variations where the design and construction method need to change to address any underground problems that present during the construction phase.

Table 7: Project and environment related factors causing project cost overrun

Project and project environment characteristics causing project cost escalations	[a]Levels of impact VH 5	H 4	M 3	L 2	VL 1	[b]TR	[c]MRi	[d]Rem
1) Unforeseeable underground conditions requiring changes in design or work method, e.g. contamination or rock.	50%	38%	10%	2%	0%	150	4.36	Vhi
2) Inclement weather conditions	42%	39%	16%	2%	1%	150	4.19	Hi
3) Innovative project with no known precedents to follow	42%	34%	20%	2%	2%	150	4.12	Hi
4) Congested/ restricted site presenting site planning and logistic challenges.	18%	32%	25%	18%	7%	150	3.36	Mi
5) Constraints from neighbourhood characteristics - traffic congestion, topographical features, logistic issues	15%	35%	26%	10%	14 %	150	3.27	Mi
6) Project scale and complexity	8%	15%	35%	25%	17 %	150	2.72	Mi

External stakeholder and condition factors underlying project cost overruns: Interviewees at the pilot study phase of this research identified cost overrun factors other than those relating to the acts or omissions of the clients, consultants and contractors. These comprise the external environment or other parties' acts or omissions. At the quantitative survey stage, respondents rated the relative levels of impact of the identified constructs. The ratings and the multi-attribute analysis of the responses are presented in Table 8. Results show that the most influential factor under this category relate to costs or delays associated with processing and obtaining building consents, permits and routine inspections from council officials. Mbachu and Seadon (2013) observed that this is usually the case where any design or proposed changes do not fit into the district plan, are not aligned with the Acceptable Solutions of the Building Code or may require public notification under the Resource Management Act.

Table 8: **External stakeholder & condition related factors causing project cost escalation**

External factors or acts/omissions of third parties causing project cost escalations	[a]Levels of impact VH 5	H 4	M 3	L 2	VL 1	[b]TR	[c]MRi	[d]Rem
1) Costs/ delays due to council officials in relation to consents, permits or inspections.	20%	32%	25%	16%	7%	150	3.42	Hi
2) Costs/ delays by utility companies in relation to reticulation services	16%	35%	23%	18%	8%	150	3.33	Mi
3) Delays associated with sudden change in regulations or legislations having impact on the work execution, e.g. workplace health &	10%	26%	30%	22%	12%	150	3.00	Mi

safety.

4)	Costs/ delays by the nominated suppliers	15%	32%	25%	21%	7%	150	3.27	Mi
5)	Costs and delays relating to unforeseeable and uninsurable incidents which are borne by the owner e.g. lightning strike.	5%	10%	20%	35%	30%	150	2.25	Li
6)	Statutory fines or penalties resulting from owner's negligence or work related levies for which the owner is responsible.	2%	8%	18%	45%	27%	150	2.13	Li

MITIGATING PROJECT COST OVERRUNS

In addition to rating the identified subcomponents of each broad category of factors underlying cost overruns, the survey respondents were also requested to indicate in the open-ended sections of the questionnaire further measures for mitigating the discrepancies between the initial and final contract values. Content analysis of their responses showed that some of the suggested measures were re-wordings of the factors already identified under the broad categories. The following are somewhat different or additions to the identified factors.

1. Alliancing procurement model should be used or partnering clause included in the contract agreement which requires the owner and contractor to agree on sharing risks and benefits equally and to work collaboratively to achieve win-win outcomes for all.
2. Owner should allow sufficient time for proper risk analysis to be carried out by the designers and the tenderers in order to minimise risk perceptions and addition of high risk margin to the contract
3. Owner should avoid lowest tender selection which allows little or no margin to the contractor; this practice could result in high claim disposition of the contractor.
4. Designers should carry out thorough site investigations to ensure that their designs and specifications are well informed and hence minimise the need to re-design to site conditions at the construction phase.
5. The owner, principal and designers should respond quickly to contractors' requests for information to avoid slowing down the pace of work and loss of productivity.
6. Sufficient contingencies should be allowed for in the contract price to cover variation orders and other incidentals which may 'blow the budget'

CONCLUSIONS

This study has investigated the factors underlying discrepancies between the initial and final contract prices of construction projects. Emphasis was placed on segregating and prioritizing the factors along lines of responsibilities and accountability in the building development process.

Results revealed six broad sources of discrepant factors. In diminishing order of influences, these comprised issues related to the owner, designers, main- and sub-contractors, project & environment, quantity surveyors/ estimators and other external parties such as local councils and utility companies. Change orders and quality of design information were perceived as the most significant sources of cost escalations which were attributed to the owner and designers, respectively. Unbalanced bidding at the tendering stage was the most influential factor attributed to the contractors and subcontractors, while unforeseeable underground conditions were the most influential factor under the project and environment category. Inability to adequately analyse contractual risks at the onset and allowance of sufficient risk contingencies in the budget was the most influential factor attributed to the quantity surveyors and estimators, while costs and delays associated with processing and granting of consents, permits and undertaking routine inspections were the most influential category under the external parties' category. In addition to addressing the priority factors identified under each broad category, further mitigation measures were suggested, the most recurring being the use of alliancing or partnering procurement models which requires the parties to agree on sharing risks and benefits equally and to work collaboratively to achieve win-win outcomes for all. If the project team could proactively address the priority factors and implement the additional measures suggested in the study, project cost overruns could be effectively mitigated to ensure more reliable outcomes in the project delivery.

REFERENCES

Cooper, D. R. and Schindler, P. S. (2006). *Business Research Method,* New York, USA, McGraw Hill/Irwin.

Dominic, A.D. & Smith, S.D. (2014). "Rethinking construction cost overruns: cognition, learning and estimation". *Journal of Financial Management of Property and Construction, 19*(1), 38-54.

Kartam, N. A., & Kartam, S. A. (2001). "Risk and its management in the Kuwaiti construction industry: A contractors' perspective". *International Journal of Project Management, 19*(6), 325-335.

Ko, C. K. (2009). "Study of important factors affecting final account settlement satisfaction of Hong Kong Civil Engineering Projects: Contractor's Perspective*", Unpublish PhD Thesis*, City University of Hong Kong, Hong Kong

Mbachu, J. (2012). "Sources of contractor's payment risks and cash flow problems in the New Zealand construction industry: Project team's perceptions of the risks and mitigation measures". *Construction Management & Economics*, 29(10), 1027-1041.

Mbachu, J. and Nkado, R. (2006). "Conceptual framework for assessment of client needs and satisfaction in the building development process". *Construction Management and Economics,* 2(1)**,** 31-44.

Mbachu, J. and Seadon, J. (2013) *Productivity improvement in the building life cycle: Development process, role-players and efficiency improvement*, Ventus Publishing, Denmark.

Mohammad, N., Che Ani, A.I., Rakmat, R.A.O.K. & Yusof, M.A. (2010). "Investigation on the causes of variation orders in the construction of building project – A study in the state of selangor, Malaysia", *Journal of Building Performance, 1*(1), 25-46.

Odeyinka, H., Larkin, K., Weatherup, R., Cunningham, G., McKane, M. & Bogle, G. (2012). "Modelling risk impacts on the variability between contract sum and final account", *COBRA 2010*, 2-3 September, Dauphine Universite, Paris, pp. 8-23.

Olatunji, O.A. (2008). "A comparative analysis of tender sums and final costs of public construction and supply projects in Nigeria". *Journal of Financial Management of Property and Construction, 13* (1), 60-79.

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