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Key Risk Factors and Risk Mitigation Measures for Target Cost Contracts in Construction – A Comparison Between the West and the East

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Abstract

This paper is an extension of a research article published in the July 2010 issue of the Construction Law Journal in which the findings of seven face-to-face structured interviews, conducted in Hong Kong, on the perceptions of key risk factors and risk mitigation measures for Guaranteed Maximum Price (GMP) contracts and Target Cost Contracts (TCC) were reported. Further to this previous research undertaken in Hong Kong, five similar in-depth structured interviews were conducted in the United Kingdom. The interviewees perceived the change in scope of work, quality and clarity of tender documents, selection of competent subcontractors and unforeseen ground conditions as key risk factors encountered in GMP/TCC construction projects. They also considered a basket of measures including: the adjudication of bids in risk assessment; total reflection on potential risks in tender documents; use of risk registers; and development of a proper risk management process, as being effective in risk mitigation. The UK findings were compared and contrasted with those from Hong Kong. It was found that the key risk factors associated with GMP/TCC contracts between the two jurisdictions are similar by nature in general. However, differences in perceptions on risk mitigation measures are also observed, which may be due to the disparities in the implementation of GMP/TCC methodology between the two regions.

Keywords: Comparative law; Construction contracts; Hong Kong; Risk; Target cost contracts

Introduction

The construction industry has long suffered from limited trust between contracting parties, the misalignment of objectives amongst various project stakeholders and lack of incentives to improve project performance[1,2]. There has been a strong wind of change in procurement approach to rectify the prevailing deteriorating situations. Both Guaranteed Maximum Price (GMP) and Target Cost Contracting (TCC) schemes are alternative integrated procurement strategies attempting to share risks, avoid the occurrence of contractual disputes and offer incentives to provide value-added services[3]. Hands-on experiences drawn from overseas cases indicated that the GMP/TCC style of arrangement can only achieve considerable mutual benefits to contracting parties concerned, provided that the risks inherent with the projects are properly identified, analysed, managed and mitigated[4,5]. TCC has been used on introduced to those construction projects with high levels of risks[6]. The identification of key risk factors appears to be a significant task to contracting parties involved in construction projects, since the project team would be keen to focus on those risk factors that could have significant impact on the project delivery process.

Despite the fact that GMP/TCC schemes have been applied in different parts of the world in recent years, not every project procured with these contractual arrangements is equally successful as expected. Winch[7] reported that two new stadia were completed in London in 2006, both using the GMP procurement strategy. The Wembley National Stadium was completed more than a year late and with major losses for the contractor and his supply chain partners. However, the Emirates Stadium, arguably as complex as Wembley, was completed both on time and within budget. In Australia, Walker *et al.*[8] highlighted a case study of the Australian National Museum procured using TCC where agreement on a risk and reward formula under an open-book accounting regime was adopted. This arrangement tied the individual objectives of the employer and the contractor together and encouraged more co-operative behaviours between project teamwork between project stakeholders. In

[1] Egan, J. (1998), *Rethinking Construction*, Department of the Environment Transport and Regions, London.

[2] Construction Industry Review Committee (2001), Construct for Excellence, *Report of the Construction Industry Review Committee*, Hong Kong SAR, 207 pp.

[3] Chan, D.W.M., Chan, A.P.C., Lam, P.T.I. and Wong, J.W.M. (2010b) Identifying the critical success factors for target cost contracts in the construction industry, *Journal of Facilities Management*, 8(3), 179-201.

[4] Trench, D. (1991). *On Target – A Design and Manage Target Cost Procurement System.* London: Thomas Telford.

[5] Walker, D.H.T., Hampson, K.D. and Peters, R (2000) *Relationship-based Procurement Strategies for the 21st Century*, AusInfo, Canberra, Australia, 112 pp.

[6] Broome, J. and Perry, J. (2002) How practitioners set share fractions in target cost contracts, *International Journal of Project Management*, 20(1), 59-66.

[7] Winch, G.M. (2010) *Managing Construction Projects, 2nd Edition*. United Kingdom: John Wiley and Sons Limited.

[8] Walker, D.H.T., Hampson, K.D. and Peters, R. (2002) Project alliancing vs project partnering: a case study of the Australian National Museum Project, *Supply Chain Management: An International Journal*, 7(2), 83-91.

Asia side, Bayliss *et al*.[9] reported on a successful case study of the Tseung Kwan O Metro Extension (Yau Tong Station) adopting the TCC approach. A study from the United States by Rojas and Kell[10] revealed that the final construction cost of 75% of the public school projects investigated in the northwest of the United States exceeded the GMP value, while the same phenomenon was found in about 80% of non-school projects. These findings did not support the notion that GMP was really a guarantor of construction cost, and formed the rationale to conduct this research study by capturing the lessons learned from previous GMP/TCC contracts.

Concepts of GMP and TCC

Broome and Perry[11] suggested that a target cost is introduced in this kind of project and the risks of cost underrun or overrun against the target is shared between the parties in pre-agreed and specified proportions. Wong[12] stated that the contractor was paid the actual cost for the work done during the construction stage but if the final construction cost, termed as the final total cost differed from the initial contract target cost, the difference would be shared between the employer and the contractor based on a pre-determined gain-share/pain-share ratio stated in the contract. A target cost contract (TCC) is described as a risk sharing contract[13]. Boyd[14] opined that TCC is a contract in which payment is based on the actual costs incurred by the contractor with incentives for efficient performance against pre-agreed time and cost targets.

GMP can be considered as a lump-sum price for a project in which the amount of money which the employer pays is the maximum price under the contract[15]. It has been postulated that GMP is not a form of contract, but a condition which can be applied to any form of contract[16,17]. Masterman[18] defined GMP as an agreement which will reward the contractor for any savings made against the GMP value and penalise him when this sum is exceeded as a result of his own mismanagement or

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[9] Bayliss, R., Cheung, S.O., Suen, H.C.H. and Wong, S.P. (2004) Effective partnering tools in construction: a case study on MTRC TKE Contract 604 in Hong Kong, *International Journal of Project Management*, 22(3), 253-63.

[10] Rojas, E.M. and Kell, I. (2008) Comparative analysis of project delivery systems cost performance in Pacific Northwest public schools. *Journal of Construction Engineering and Management*, *ASCE*, 134(6), 387-97.

[11] Broome, J. and Perry, J. (2002) How practitioners set share fractions in target cost contracts. *International Journal of Project Management,* 20(1), 59-66.

[12] Wong, A.K.D. (2006) The application of a computerised financial control system for the decision support of target cost contracts. *Journal of Information Technology in Construction (ITcon)*, 11 (Special Issue on Decision Support Systems for Infrastructure Management), 257-68.

[13] Scott, B. (2001), *Partnering in Europe Incentive Based Alliancing for Projects*, Thomas Telford, London.

[14] Boyd, J.L. (1985) Target cost contract, *The Journal of the Hong Kong Institution of Engineers*, September, 1985.

[15] Davis Langdon and Seah (2003), Guaranteed Maximum Price Contracts. *Executive Summaries for the Practitioners*, Vol 4. Issue 1: April 2004.

[16] Fan, A.C.W. and Greenwood, D. (2004) Guaranteed maximum price for the project? *Surveyors Times*, The Hong Kong Institute of Surveyors, March, 20-21.

[17] Davis Langdon and Seah (2003), Guaranteed Maximum Price Contracts. *Executive Summaries for the Practitioners*, Vol 4. Issue 1: April 2004.

[18] Masterman, Jack W.E. (2002) *Introduction to Building Procurement System*, *2nd Edition*, London New York Spon Press.

negligence.

Previous research studies on GMP and TCC

Europe

The procurement strategies of GMP/TCC have interested practitioners worldwide over the recent decade. In Europe, Nicolini *et al.*[19] studied two pilot construction projects using TCC in which the costs of some specific items were reduced due to the adoption of innovative solutions and methods, thereby suggesting that target costing may be one way to support supply chain integration, improve profitability and quality within the construction industry in the United Kingdom. This study also found that the relationship amongst project team members was less adversarial in projects with TCC. Bresnen and Marshall[20] conducted six case studies using TCC in the United Kingdom and concluded that incentives can reinforce commitment and build mutual trust between organisations in the long run. However, significant changes and inconsistencies in internal policies and personnel can make any trust developed difficult to sustain. Pryke and Pearson[21] conducted case studies in both France and the United Kingdom, investigating gain-share/pain-share arrangements under a prime contracting procurement approach and the use of GMP in standard form of building contract. This study opined that adoption of GMP can lead to a change in attitude of the contractors when handling variations as the contractors become more proactive in financial control of inappropriate variations under this arrangement.

Al-Subhi Al-Harbi[22] applied utility theory to explain how employers and contractors determine sharing ratios from their points of view with numerical examples. It was suggested that both parties may need to discuss the extent of project variability and identify the basis of their decisions during the negotiation of sharing ratios in TCC. However, Broome and Perry[23] launched a series of interviews with practitioners to investigate the setting of sharing ratios in TCC for construction projects. This study suggested that utility theory may not be sufficient to deal with the interactions between factors governing the choice of sharing profile. Badenfelt[24] interviewed eight clients and eight contractors in the Swedish construction industry, followed by a case study of a large construction project procured with a target cost contract. This study concluded that an appropriate sharing ratio in TCC may be determined based on long-term relationships and perceived relational risks. Another investigation by

[19] Nicolini, D, Tomkins, C, Holti, R and Oldman, A. (2000) Can target costing and whole life costing be applied in the construction industry? Evidence from two case studies, *British Journal of Management*, 11(4), 303-24.

[20] Bresnen, M. and Marshall, N. (2000) Motivation, commitment and the use of incentive partnerships and alliances, *Construction Management and Economics*, 18(5), 587-98.

[21] Pryke, S. and Pearson, S. (2006) Project governance: case studies on financial incentives, *Building Research and Information*, 34(6), pp. 534-45.

[22] Al-Subhi Al-Harbi, K.M. (1998) Sharing fractions in cost-plus-incentive-fee contracts, *International Journal of Project Management*, 16(2), 73-80.

[23] Broome, J. and Perry, J. (2002) How practitioners set share fractions in target cost contracts. *International Journal of Project Management,* 20(1), 59-66.

[24] Badenfelt, U. (2008) The selection of sharing ratios in target cost contracts, *Engineering, Construction and Architectural Management*, 15(1), 54-65.

Badenfelt[25] examined the control mechanisms used in the early phase of target cost contracts with a case study in Sweden, indicating that trust is fragile which must be continuously preserved in TCC, requiring a high level of mutual trust between the client and contractor. This study indicated that on one hand employers try to maintain the level of mutual trust by letting contractors be aware that they are knowledgeable and not easy to mislead. On the other hand, the contractors attempt to communicate that they cherish the existence of a long-term working relationship and a goodwill reputation. A three-year longitudinal study by Badenfelt[26] identified a number of formal control mechanisms (e.g. open-book accounting regime together with project and progress meetings) and informal control mechanisms (e.g. partnering arrangement and project diary) under TCC performed by project participants in the Swedish perspective. The findings showed that informal control mechanisms conducted by employers appear most effective as a means to preserve mutual trust. In addition, it is found that behaviours of contracting parties are affected by previous experience of working together.

United States

Arditi *et al.*[27] launched a survey on incentive/disincentive provisions in highways contracts within the United States. It was suggested that the frequency and magnitude of change orders in incentive/disincentive contracts were larger than those in non-incentive/disincentive contracts. Rojas and Kell[28] analysed the data of 297 completed school projects in Oregon and Washington. The project cost exceeded the GMP value in 75% of the cases. The findings contradict the general perception that GMP is a guarantor of maximum construction cost. They suggested that the cost overrun may be due to scope creep, unforeseen conditions, force majeure, and design errors and omissions. Kaplanogu and Arditi[29] conducted a questionnaire survey on pre-project peer reviews in GMP or lump-sum contracts. This research found that the primary benefit of pre-project peer reviews is to minimise the risk of under-estimating the project cost in bidding for lump-sum or GMP projects.

Australia

Davis and Stevenson[30] conducted ten interviews on the benefits and limitations of procuring projects using GMP in Western Australia. Their findings concluded that price certainty, time saving and the encouragement of better team relationships were

[25] Badenfelt, U. (2007) Trust and control in the early phases of target cost contracts. In: Bord, D. (Ed) *Proceedings of the 23rd Annual ARCOM Conference*, 3-5 September 2007, Belfast, UK, Association of Researchers in Construction Management, 23-32.

[26] Badenfelt, U. (2010) I trust you, I trust you not: a longitudinal study of control mechanisms in incentive contracts, *Construction Management and Economics*, 28(3), 301-10.

[27] Arditi, D., Khisty, C.J. and Yasamis (1997) Incentive/disincentive provisions in highway contracts, *Journal of Construction Engineering and Management, ASCE*, 123(3), 302-7.

[28] Rojas, E.M. and Kell, I. (2008) Comparative analysis of project delivery systems cost performance in Pacific Northwest public schools. *Journal of Construction Engineering and Management*, *ASCE*, 134(6), 387-97.

[29] Kaplanogu, S.B. and Arditi, D. (2009), Pre-project peer review in GMP/lump sum contracts, *Engineering, Construction and Architectural Management*, 16(2), 175-85.

[30] Davis, P.R. and Stevenson, D. (2004) Understanding and Applying Guaranteed Maximum Price Contracts in Western Australia, *Proceedings of the Australian Institute of Project Management 2004 National Conference, Perth, 10-12th October, 2004*. Australian Institute of Project Management, Perth.

considered as the major advantages of GMP by the interviewees. In contrast, a lack of common understanding of the underlying concepts of GMP, a lack of standard form of contract for GMP scheme, a lack of appropriate skills in design management and capital cost being compromised were perceived as the key limitations of GMP. Walker *et al.*[31] launched a case study on the Australian National Museum which applied TCC. It was found that the risk/reward arrangements encouraged a teamwork approach to innovative problem solving with successful project outcomes in terms of both time and quality.

Rose and Manley[32] identified the motivational drivers affecting the effectiveness of financial incentives in a large-scale building project with a less than satisfactory project outcome in Australia. This research recommended that the construction risks could be shared equitably between the client and contractor with flexibility being provided in the contract to handle unforeseen situations and relationship management in order to design a financial incentive mechanism strategy. A recent investigation also by Rose and Manley[33] involving four case studies of large Australian building projects suggested that the benefits of financial incentives could be maximised through equitable contract risk allocation, early contractor involvement in design development, value-driven tender selection, holding relationship workshops and offering future work opportunities.

Asia

Tang *et al.*[34] undertook a research project on the use of incentives in the Chinese Mainland construction industry using a questionnaire survey together with a case study of the Three Gorges Project. It was found that incentives could be developed based on project type, delivery system, project risks and participants' needs and their experiences to enable incentives to improve the efficiency of project delivery process. Bayliss *et al.*[35] reported on a successful case of applying construction partnering under a TCC arrangement and opined that both partnering review workshops and the use of am incentivisation scheme underpinned the success of a railway extension project in Hong Kong. Wong[36] explored the application of a computerised financial control system to a development of a cable car construction project with TCC in Hong Kong. He opined that TCC exercised a vigorous control over tendering,

[31] Walker, D.H.T., Hamspon, K.D and Peters, R. (2002) Project alliancing vs project partnering: a case study of the Australian National Museum Project. *Supply Chain Management: An International Journal*, 7(2), 83-91.

[32] Rose, T. and Manley, K. (2007) *Effective Financial Incentive Mechanisms: An Australian Study*, CIB World Building Congress, Cape Town, South Africa, 14-18 May.

[33] Rose, T and Manley, K. (2010) Client recommendations for financial incentives on construction projects, *Engineering, Construction and Architectural Management*, 17(3), 252-267.

[34] Tang, W., Qiang, M., Young, D. and Lu, Y. (2008) Incentives in the Chinese Construction Industry, *Journal of Construction Engineering and Management, ASCE*, 134(7), 457-67.

[35] Bayliss, R., Cheung, S.O., Suen, H.C.H. and Wong, S.P. (2004) Effective partnering tools in construction: a case study on MTRC TKE contract 604 in Hong Kong, *International Journal of Project Management*, 22(3), 253-63.

[36] Wong, A.K.D. (2006) The application of a computerised financial control system for the decision support of target cost contracts. *Journal of Information Technology in Construction (ITcon)*, 11 (Special Issue on Decision Support Systems for Infrastructure Management), 257-68.

subcontracting, and contract administration during project delivery. Chan *et al*[37] identified critical success factors for target cost contracts in the construction industry of Hong Kong by means of an empirical questionnaire survey. Reasonable share of cost saving and risks, early involvement of contractor in design development, well-defined scope of work, right selection of project team and cultivation of partnering spirit, were perceived as the essential determinants of a successful GMP/TCC project. Senam *et al*[38] evaluated the suitability of applying the GMP approach as an alternative procurement method for public sector projects in Malaysia. It was indicated that industrial practitioners had little experience or awareness of the concepts of GMP but would welcome the introduction of these concepts to the construction industry in Malaysia.

It seems, judging from the literature review of the GMP/TCC practices in Europe, the United States, Australia and Asia, what has not been adequately addressed but may be significant is a detailed analysis of the key risk factors and risk mitigation measures for GMP/TCC projects in the construction industry. Further to the previous research results derived from the structured interviews in Hong Kong[39], the findings obtained from five structured interviews with relevant industrial practitioners based in the United Kingdom are discussed, compared and cross-referenced with other related studies wherever deemed appropriate.

Research design

A total of five structured in-depth interviews with relevant project representatives who played different roles in the five cases were conducted in June 2010 in order to identify the key risk factors and risk mitigation measures for GMP/TCC construction projects in the United Kingdom. Table 1 provides detail of the interviewees.

Copies of relevant materials including projects' scope of work, contract terms and letters of award on GMP/TCC, in-house guidelines or best practice frameworks for implementing GMP/TCC schemes, case reports, as well as on-line materials, were provided by the interviewees and utilised as secondary sources of evidence to support the primary opinions and information obtained during the interviews. All of the interviewees were senior construction personnel having significant direct hands-on experience with GMP/TCC projects in the United Kingdom, as a result, their opinions and findings were considered representative, reliable and valid for general application.

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[37] Chan, D.W.M., Chan, A.P.C., Lam, P.T.I. and Wong, J.M.W. (2010b) Identifying the critical success factors for target cost contracts in the construction industry, *Journal of Facilities Management*, 8(3), 179-201.

[38] Senam, M.R., Ehrhardt, C. and Zaini, R.M. (2010) An Evaluation of Applying Guaranteed Maximum Price (GMP) Procurement Method for Public Construction Projects in Malaysia, In Kobayashi, K., Rashid, K.A., Onshi, M. and Lei, S.: Towards new Paradigm of Partnership for the Increasingly Global Construction Markets, *Proceedings of the 6th International Conference on Multi-National Joint Venture for Construction Works*, 22-23 September, Kyoto.

[39] Chan, D.W.M., Chan, A.P.C., Lam, P.T.I. and Chan, J.H.L. (2010a) Exploring the key risks and risk mitigation measures for guaranteed maximum price and target cost contracts in construction. *Construction Law Journal*, 26(5), 364-78.

Table 1: Personal details of the five interviewees in the United Kingdom

ID	Sector	Stakeholder (GMP or TCC)	Position of Interviewee	Organisation
1	Private	Contractor 1 (GMP)	Legal / Contract Advisor	Major construction contractor
2	Private	Contractor 2 (Cost reimbursement with cap, TCC)	Commercial Advisor	Major service provider of oil and gas industry
3	Public and Private	Consultant 1 (TCC and GMP)	NEC Consultant	NEC consultant
4	Public	Client 1 (TCC)	Senior Technical Officer	Public agency for highways development projects
5	Private	Client 2 (GMP)	Senior Policy and Performance Manager	Public agency for health-care services

The opinions obtained from the interviews were first audio-recorded and subsequently transcribed into written form. Interview transcripts were then returned to the relevant interviewee for verification and approval. A systematic account of information and data obtained from in-depth interviews were then archived for subsequent analysis. The interview dialogues were duly analysed with the concepts of content analysis technique in a matrix table format (i.e. each question posed against answers from each interviewee and the answers classified into different groupings according to the nature of content) to capture any similarities and differences for comparison. Interview dialogue can be classified and reduced into more relevant and manageable bits of data[40]. This method can be applied to situations in which information and understanding of issues relevant to the general aims and specific research project are obtained[41]. Content analysis can be regarded as a technique of data analysis which is applicable in construction research[42]. It is often applied to determine the major facets of a set of data, by simply counting the number of times an activity happens or a topic is depicted.

The steps of conducting content analysis are: (1) to identify the materials to be analysed; and (2) to determine the form of content analysis to be employed which includes qualitative or quantitative methods. The choice depends on the nature of research. The choice of categories depends on the issues to be addressed in the research if they are known. Emphasis is put on determining the meaning of data (i.e. grouping data into categories) in qualitative content analysis. Quantitative content analysis extends the approach of qualitative form to generate numerical values of the categorised data which may be subject to statistical analyses. Comparisons may be made and hierarchies of categories can be examined[43]. The data collected in the interviews are given coded allocation to categories and respondents from whom the data were obtained, so a matrix table of categorised data against respondents can be structured. Yu *et al.*[44] applied the same technique in investigating critical success

[40] Weber, R.P. (1990) *Basic Content Analysis*, *2nd Edition*, Sage Publication.
[41] Gillham, B. (2000) *The Research Interview*. Continuum, London, United Kingdom.
[42] Fellows, R. and Liu, A. (2008) *Research Methods for Construction*, 3rd Ed. Wiley-Blackwell.
[43] Fellows, R. and Liu, A. (2008) *Research Methods for Construction*, 3rd Ed. Wiley-Blackwell.
[44] Yu, A.T.W., Shen, Q.P., Kelly, J. and Hunter, K. (2006) Investigation of critical success factors in construction project briefing by way of content analysis. *Journal of Construction Engineering and Management*, ASCE, 132(11), 1178-86.

factors in construction project briefing. Outcomes derived from the analysis of interviews were cross-referenced to the published literature wherever appropriate and to complement each other for validation. Moreover, the interview findings of the same study between the United Kingdom and Hong Kong are compared and contrasted in order to ascertain similarities and differences.

Since this paper aims to undertake a direct international comparison between the West (United Kingdom) and the East (Hong Kong), the same research methodology (i.e. structured interview) was adopted and the same set of questions were asked during the interviews in both regions. The following two open-ended questions were raised during the interviews in order to convey ideas of the information solicited, and the interviewees were encouraged to express freely on the issues or areas concerned, without being restrained by the pre-determined questions as follows:

1. Can you name some important risk factors associated with those GMP/TCC contracts that you had encountered?
2. Can you provide some strategies or guidelines to mitigate the risks involved in GMP/TCC projects?

Presentation and discussion of interview findings

Table 2 is a summary of the key findings of the interview survey on the aforesaid first research question pertaining to the perceived key risk factors for those GMP/TCC construction projects, as gleaned from the five interviews from the United Kingdom. The description and discussion of the major interview results obtained from Hong Kong were published in another journal article for reference and cross-comparison[45].

Perceived key risk factors for GMP/TCC contracts

All of the risk factors, if suggested by two or more interviewees, are discussed in this section. "Change in scope of work" was perceived to be the most conspicuous risk factor associated with GMP/TCC projects in the United Kingdom by four interviewees out of five. In other words, whether an architect's instruction or engineer's instruction should be classified either as a GMP/TCC variation which would be subject to change the agreed GMP value (or Target Cost value) in contract or as a design development change which would not alter the GMP/TCC contract value, was considered as a key risk factor by the interviewees. Any changes in project scope may engender several potential conflicts, disputes or even claims. Fan and Greenwood[46] opined that nature of variations can be a main source of disputes in GMP/TCC schemes. Lewis[47] shared a similar perception that the employer's requirements and the scope of work should be carefully scrutinised before making a realistic assessment of the tender price in this kind of contracts. This finding is

[45] Chan, D.W.M., Chan, A.P.C., Lam, P.T.I. and Chan, J.H.L. (2010a) Exploring the key risks and risk mitigation measures for guaranteed maximum price and target cost contracts in construction. *Construction Law Journal*, 26(5), 364-78.

[46] Fan, A.C.W. and Greenwood, D. (2004) Guaranteed maximum price for the project? *Surveyors Times*, The Hong Kong Institute of Surveyors, March, 20-21.

[47] Lewis, S. (1999) GMP Contracts: are they worth the risk?, *Construction Law*, 10(3),25-27.

congruent to that derived in Hong Kong by Chan *et al*.[48] that change in scope of work was found to be the most common risk encountered with GMP/TCC construction projects.

The second key contractual risk factor as discerned by the interviewees was "quality and clarity of tender documents". If errors, omissions or discrepancies are present within the contract documents at the outset of the project, they would probably generate a multitude of intractable disputes or conflicts and variations during the post-contract stage. An earlier research study by Cox *et al*.[49] showed that both omissions in tender documents and inconsistencies in tender documents were the most frequently cited reasons for post-contract design changes in construction projects. Rooke *et al*.[50] advocated that errors in measurement in tender document would unnecessarily increase the total out-turn cost of projects, since contractors could take advantage of mistakes in bills of quantities at tender stage by inserting a higher rate for those items which are under-measured, in order to increase the final out-turn cost and hence generating more profits. A more recent study by Olawale and Sun[51] conducted in the United Kingdom also suggested that discrepancies in contract document was amongst the top ten factors inhibiting effective project time and cost control. The same appears to be equally applicable to GMP/TCC form of procurement. When compared with the findings in Hong Kong, "Quality and clarity of tender documents" was considered as the most significant risk factor for GMP/TCC schemes, being suggested by five out of seven interviewees. Seemingly, the findings obtained from both the United Kingdom and Hong Kong are quite similar.

"Selection of competent subcontractors" was regarded as one of the most important risks inherent with GMP/TCC construction projects. It is a common practice in the construction industry for the main contractor to sublet significant proportions of the construction works to various trades of subcontractors. Hinze and Tracey[52] suggested that about 80-90% of the works are undertaken by subcontractors in many construction projects. Sustainable satisfactory performance of subcontractors is essential to the overall success of most construction projects[53]. In GMP/TCC projects, the unsatisfactory performance of subcontractors may have an adverse effect on the total project cost. Such an outcome is undesirable from the point of view of the main contractor and the employer. Therefore, more emphasis should be placed on the selection of subcontractors. Selection criteria may include not only the past track record of time, cost and quality performance, but also capabilities in environmental management, safety management, technical competence, organisational culture and

[48] Chan, D.W.M., Chan, A.P.C., Lam, P.T.I. and Chan, J.H.L. (2010a) Exploring the key risks and risk mitigation measures for guaranteed maximum price and target cost contracts in construction. *Construction Law Journal*, 26(5), 364-78.

[49] Cox, I.D., Morris, J.P., Rogerson, J.H. and Jared, G.E. (1999) A quantitative study of post contract award design changes in construction, *Construction Management and Economics*, 17(4), 427-39.

[50] Rooke, J, Seymour, D. and Fellows, R. (2004) Planning for claims: an ethnography of industry culture, *Construction Management and Economics*, 22(7), 655-662.

[51] Olawale Y.A. and Sun, M. (2010) Cost and time control of construction projects: inhibiting factors and mitigating measures in practice, *Construction Management and Economics*, 28(5), 509-26.

[52] Hinze, J and Tracey, A. (1994) The contractor-subcontractor relationship: The subcontractor's view, *Journal of Construction Engineering and Management, ASCE*, 120(2), 274-287.

[53] Arditi, D. and Chotibhongs, R. (2005) Issues in subcontracting practice, *Journal of Construction Engineering and Management, ASCE*, 131(8), 866-76.

the like[54]. However, the interviewees in Hong Kong did not perceive this risk factor as a major risk. One possible explanation is that the majority of main contractors in Hong Kong usually have their own subsidiary subcontractors through strategic partnering which are under the same auspices umbrella of the main contractors. Such "construction arms" are very familiar with the required level of acceptance of their main contractors and probably work satisfactorily whatever the construction project is including those under GMP/TCC. Moreover, because of the launch in November 2003 of the Voluntary Subcontractor Registration Scheme in Hong Kong, both client organisations and main contactors are required to engage those registered subcontractors for new works (registration requiring a track record of good performance) which has resulted in higher quality of constructed facilities. Thus the Hong Kong's interviewees did not take this risk as an important one.

Apart from contractual risks, another physical risk, "Unforeseen ground conditions" was observed as a key risk factor of GMP/TCC by two interviewees (Consultant 1 and Client 2). Ground conditions especially for foundation works are not controllable and geographic reports usually cannot sufficiently reflect the actual underground conditions[55]. Such variance in site conditions would affect both the designs of foundation and superstructure in a construction development. Williams[56] shared a similar view that ground conditions were a key risk in the construction of Terminal 5 at London's Heathrow Airport, which was procured with TCC. The project team applied a proactive risk management approach to risk elimination, rather than taking remedial measures after the occurrence of risks in this case. This finding is again in line with that derived in Hong Kong that unforeseen ground conditions were also advocated as a key risk factor encountered with GMP/TCC construction projects.

Comparison of key risk factors of GMP/TCC between United Kingdom and Hong Kong

Table 3: Key risk factors encountered with GMP/TCC construction projects between United Kingdom and Hong Kong

United Kingdom (findings from this study)	**Hong Kong** (Chan *et al.*, 2010a)
1. **Change in scope of work**	1. **Change in scope of work**
2. **Quality and clarity of tender documents**	2. **Quality and clarity of tender documents**
3. **Unforeseen ground conditions**	3. **Unforeseen ground conditions**
4. Selection of competent subcontractors	4. Nature of variations
	5. Fluctuation of materials price
	6. Approval from regulatory bodies for alternative cost saving designs

[54] Eom, C.S.J., Yun, S.H. and Paek, J.H. (2008) Subcontractor Evaluation and Management Framework for Strategic Partnering, *Journal of Construction Engineering and Management, ASCE*, 134(11), 842-51.

[55] Tam, V.W.Y., Shen, L.Y., Tam, C.M. and Pang, W.S.P. (2007) Investigating the intentional quality risks in public foundation projects: A Hong Kong study, *Building and Environment*, 42(1), 330-43.

[56] Williams, O.I. (2007) Managing risk – successful project delivery, underground infrastructure for Terminal 5 Heathrow Airport, UK. In Bartak, Hrdina, Romancov and Zlamal (Eds): *Underground Space – the 4th Dimension of Metropolises*, Taylor and Francis Group, London.

Table 2: Summary of the interview findings on perceived key risk factors for GMP/TCC construction projects in the United Kingdom

	Contractor 1	**Contractor 2**	**Consultant 1**	**Client 1**	**Client 2**	**Total no. of hits**
Contractual Risks						
1. Quality and clarity of tender documents	√	√	√			**3**
2. Programming of construction work on-site	√					1
3. Selection of competent subcontractors	√	√				**2**
4. Change in scope of work		√	√	√	√	**4**
5. Setting a genuine maximum price or target cost in contract				√		1
6. Transparency of cost information and data					√	1
Physical Risks						
7. Unforeseen ground conditions			√		√	**2**
Economic Risks						
8. Fluctuation of materials price (e.g. Inflation)				√		1
Design Risks						
9. Inaccurate design at tender stage			√			1
Other Risks						
10. Contractor's efficiency in site management			√			1
11. Environmental issues such as heritage preservation, adverse ground conditions and flooding				√		1
12. Client's competence to drive the projects forward					√	1
13. Professionals' own technical competence					√	1
Total number of key risk factors identified from each interviewee	**3**	**3**	**5**	**4**	**5**	**20**

One of the objectives of this paper is to draw an international comparison of interview findings between the United Kingdom and Hong Kong. As observed in Table 3, three key risk factors were common between the two jurisdictions. GMP/TCC schemes are by nature the contractual arrangements which will cap the total out-turn cost of a project paid by the employer, provided that there is no change in the value of GMP or Target Cost. The crux of whether a contractor is to make a profit or not is really dependent on whether the value of contract GMP or Target Cost can be adjusted during the post-contract stage. It thus becomes logical and reasonable that both contracting parties can define the circumstances under which the value of GMP or Target Cost can be adjusted which is identifiable as a significant risk factor inherent with GMP/TCC procurement strategies.

As regards the differences in findings, as discussed in the previous section, most of the main contractors in Hong Kong usually have their own subsidiary subcontractors, providing a "one-stop" service for construction together with possible engagement of "registered" subcontractors, so the selection of competent subcontractors may not be a critical risk to them. The timing of conducting the interviews between the United Kingdom and Hong Kong may give some bearing on the differences in perception on the risk factor "Fluctuation of materials price". The interviews in Hong Kong were conducted in June 2008, while those in the United Kingdom were undertaken in June 2010. In 2008, there was a considerable increase in materials price such as copper

wires and steel reinforcement bars[57]. However, the price trend in 2010 was relatively steady when compared with that in 2008. This may explain why the British interviewees did not consider price fluctuation of materials as a key risk factor in their projects.

Risk mitigation measures for GMP/TCC contracts

In addition to the key risk factors involved in implementing a GMP/TCC contract, a plethora of risk mitigation measures were suggested to minimise the above-mentioned risks. These are consolidated in Table 4. Similar to the previous section on key risk factors, only those risk mitigation measures which were advocated by at least two interviewees are highlighted for further discussion under this section.

"Adjudication of bids with senior management to assess the acceptability of various risks in tendering for a GMP/TCC project" was suggested by two interviewees who were both representatives of contractors (Contractors 1 and 2). Pricing is a science as well as an art. Laryea and Hughes[58] (2008) pointed out that the pricing of a contractor is affected by the amount of risk they assume. However, a bidding contractor with a realistic contingency value in the tender cannot remain competitive. This is one of the reasons why the senior management of contractors has to adjudicate bids. As reported in Laryea and Hughes's study[59], during the adjudication of bids, senior management would make adjustments to the tender price, depending on the proposed scope of work, the balance between current and forthcoming workload and the like by experience and intuition. It is logical that such adjudication of bids is practised in the tendering exercise of GMP/TCC projects which usually carry high risks[60].

The second risk mitigation measure as suggested by three interviewees was "Total reflection on the potential risks inherent with the project in tender documents". Contractor 1, Contractor 2 and Consultant 1 concurred that more concerted efforts could be devoted to the upfront work in preparing tender documentation. Vague definitions of scope change within the contracts would probably cause disputes with a tendency that both the employer and contractor pulling in opposite directions to maximise their own financial benefits[61]. The GMP value is neither really guaranteed nor maximum[62,63]. At tender stage, it is recommended that there should be a clear distinction between a design change and a design development item in tender

[57] Chan, D.W.M., Chan, A.P.C., Lam, P.T.I. and Chan, J.H.L. (2010a) Exploring the key risks and risk mitigation measures for guaranteed maximum price and target cost contracts in construction. *Construction Law Journal*, 26(5), 364-78.

[58] Laryea, S. and Hughes, W. (2008) How contractors price risk in bids: theory and practice, *Construction Management and Economics*, 26(9), 911-24.

[59] Laryea, S. and Hughes, W. (2008) How contractors price risk in bids: theory and practice, *Construction Management and Economics*, 26(9), 911-24.

[60] Wong, A.K.D. (2006) The application of a computerised financial control system for the decision support of target cost contracts. *Journal of Information Technology in Construction (ITcon)*, 11 (Special Issue on Decision Support Systems for Infrastructure Management), 257-68.

[61] Fan, A.C.W. and Greenwood, D. (2004) Guaranteed maximum price for the project? *Surveyors Times*, The Hong Kong Institute of Surveyors, March, 20-21.

[62] Haley, G. and Shaw, G. (2002) Is "guaranteed maximum price" the way to go? *Hong Kong Engineer*, January, 2002.

[63] Davis Langdon and Seah (2003), Guaranteed Maximum Price Contracts. *Executive Summaries for the Practitioners*, 4(1), April 2004.

documents to avoid potential disputes in future[64], and to appreciate and understand the specific risks involved before tender submission. This recommendation is also consistent with the findings from Hong Kong[65].

In addition, "Use of risk registers" is perceived as an effective risk mitigation measure by three interviewees. It is common to use a risk register as a baseline document for the process of risk management in GMP/TCC projects as contained within the New Engineering Contract Version 3 (NEC3) and NEC2 and commonly applied to such kind of projects. Client 1 responded that the risk register was sometimes left idle and cannot be effectively used in risk management in some cases. The risk register should be kept under review regularly throughout the whole project delivery process for effective risk management.

Another risk mitigation measure "Development of a proper risk management process" suggested by two interviewees (Consultant 2 and Client 1) is also related to risk management. Risk management constitutes an important part of decision making of a construction company[66]. The risk management process is composed of risk identification, risk assessment, risk allocation and risk response[67]. Rahman and Kumaraswamy[68] suggested joint risk management to be one of the keys for mitigating risks in projects with a collaborative working arrangement. Obviously, a proper risk management process (e.g. regular risk management meetings, risk management workshops and early warning mechanisms (such as established in NEC3, etc) could reduce the impact of risks inherent with GMP/TCC projects which usually involve different kinds of risks.

Comparison of key risk mitigation measures for GMP/TCC between United Kingdom and Hong Kong

Table 5: Key risk mitigation measures encountered with GMP/TCC construction projects between United Kingdom and Hong Kong)

United Kingdom (findings from this study)	**Hong Kong** (Chan *et al.*, 2010a)
1. Adjudication of bids with senior management to assess the acceptability of various risks in tendering for a GMP/TCC project	1. Tender briefing and tender interview
2. Total reflection on the potential risks inherent with the project in tender documents	2. More upfront work of tender documentations
3. Use of risk registers	3. Pre-qualification of main contractors
4. Development of a proper risk management process	4. Adoption of partnering approach
	5. More thorough site investigations by contractors during tender stage

[64] Olawale Y.A. and Sun, M. (2010) Cost and time control of construction projects: inhibiting factors and mitigating measures in practice, *Construction Management and Economics*, 28(5), 509-26.

[65] Chan, D.W.M., Chan, A.P.C., Lam, P.T.I. and Chan, J.H.L. (2010a) Exploring the key risks and risk mitigation measures for guaranteed maximum price and target cost contracts in construction. *Construction Law Journal*, 26(5), 364-78.

[66] Kartam, N.A. and Kartam, S.A. (2001) Risk and its management in the Kuwaiti construction industry: a contractor's perspective, *International Journal of Project Management*, 19(6), 325-335.

[67] Flanagan R. and Norman, G. (1993). *Risk Management and Construction***.** Oxford-Blackwell Scientific Publications.

[68] Rahman, M.M. and Kumaraswamy, M.M. (2004) Potential for Implementing Relational Contracting for Joint Risk Management, *Journal of Management in Engineering, ASCE*, 20(4), 178-89.

Table 4: Summary of the interview findings on risk mitigation measures for GMP/TCC construction projects in the United Kingdom

	Contractor 1	**Contractor 2**	**Consultant 1**	**Client 1**	**Client 2**	**Total no. of hits**
Cost Estimating						
1. Generation of an accurate cost plan at the pre-contract stage	√					1
Tendering Process						
2. More lead-in time for tender preparation at tender stage	√					1
3. Early involvement of the contractor to tap in their expertise in both design and construction	√					1
4. Two-stage tendering method in contractor selection	√					1
5. Identification of the potential risks at tender stage by launching risk identification workshops		√				1
6. Adjudication of bids with senior management to assess the acceptability of various risks in tendering for a GMP/TCC project	√	√				**2**
7. Total reflection on the potential risks inherent with the project in tender documents	√	√	√			**3**
Risk Management						
8. Involvement of different key project stakeholders in risk management workshops at the post-contract stage		√				1
9. Use of risk registers		√	√	√		**3**
10. Focus on the most significant risks after identifying different risks involved				√		1
11. Development of a proper risk management process			√		√	**2**
12. Equitable allocation of the residual risks			√			1
Performance Measurement						
13. Establishment of library of project information and data					√	1
14. Effective performance management process					√	1
Mutual Trust						
15. Mutual trust and transparent communications					√	1
Total number of risk mitigation measures proposed by each interviewee	**6**	**5**	**4**	**2**	**4**	**21**

The risk mitigation measures as suggested by the UK interviewees and their Hong Kong counterparts are tabulated in Table 5. There exhibit some similarities in the finding that "Adjudication of bids with senior management to assess the acceptability of various risks in tendering for a GMP/TCC project", and "Total reflection on the potential risks inherent with the project in tender documents" from the UK and "Tender briefing and tender interview", "More upfront work of tender documentations", and "More thorough site investigations by contractors during tender stage" from Hong Kong are all closely related to the tendering process. The findings are logical and reasonable as the majority of key risk factors can be classified as contractual risks. It is not surprising, therefore, that interviewees in both jurisdictions suggested some effective risk mitigation measures primarily focusing on tendering process.

However, the UK interviewees seemed to focus more on the process of risk management than those in Hong Kong. This may stem from the difference in the use of NEC contracts between the two regions investigated. NEC has been in use in the

United Kingdom since the 1990s, while NEC was first used on a pilot project of open nullah improvement works commissioned by the Drainage Services Department of the Hong Kong SAR Government in August 2009[69]. Some useful risk management processes are already built into the NEC contract, for example, a risk register forms an essential part of tender documents let using NEC3. On the other hand, the Chinese traditionally rely more on "relationship" in doing business[70]. The interviewees in Hong Kong may value the implementation of a partnering approach which stresses the harmonious working relationship, mutual trust and teamwork between employer and contractor as an effective tool in risk mitigation for this kind of GMP/TCC construction projects.

Conclusions

The construction industry is often fraught with the fragmentation and traditional adversarial working relationship between the employer and contractor worldwide[71,72]. The acknowledgement of the importance of motivation and its impact on overall project success has led to a wider application of cost incentive contracts such as GMP and TCC forms of contract, which have been considered as an effective procurement approach for construction projects with high risks and confrontational working culture[73].

Hands-on experiences derived from the United Kingdom and Australian cases have indicated that the TCC style of procurement could bring considerable mutual benefits to all of the parties involved, provided that the risk factors are properly identified, analysed, shared and managed[74]. This article has reported on the findings of key risk factors and risk mitigation measures for GMP/TCC construction projects through a series of structured interviews in the United Kingdom. It was found that a number of key risk factors as perceived by the interviewees are pertaining to contractual risks (e.g. change in scope of work, quality and clarity of tender documents, etc). By nature, both GMP and TCC are special kinds of contractual arrangement which can serve to align the individual objectives of employers and contractors. The principles underpinning GMP/TCC projects are quite different from the traditional design-bid-build procurement approach. It is not surprising that the primary risk factors are concerned more with the clarity of tender documents and contract provisions. On the other hand, essential risk mitigation measures advocated relate to both tendering process and risk management with the purpose of mitigating the possible contractual risks.

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69 Cheung, I. (2008) New Engineering Contract (NEC). *EC Harris Asia Commentary*, July, 2008.

70 Ang, Y.K. and Ofori, G. (2001) Chinese culture and successful implementation of partnering in Singapore's construction industry, *Construction Management and Economics*, 19(6), 619-32.

71 Egan, J. (1998), *Rethinking Construction*, Department of the Environment Transport and Regions, London.

72 Construction Industry Review Committee (2001), Construct for Excellence, *Report of the Construction Industry Review Committee*, Hong Kong SAR, 207 pp.

73 Wong, A.K.D. (2006) The application of a computerised financial control system for the decision support of target cost contracts. *Journal of Information Technology in Construction (ITcon)*, 11 (Special Issue on Decision Support Systems for Infrastructure Management), 257-68.

74 Trench, D. (1991). *On Target – A Design and Manage Target Cost Procurement System.* London: Thomas Telford.

Another objective of this paper was to conduct an international comparison of the interview findings between the United Kingdom and Hong Kong. It is observed that the key risk factors associated with GMP/TCC construction projects between these two jurisdictions are similar in general. Perhaps, the rule of the game in GMP/TCC schemes is about whether the value of GMP or Target Cost can be adjusted or not, which in turn affects the profitability of the contractors. It is not illogical that both the employer and contractor were concerned about changes in scope of work and the clarity of tender documents in such kind of contracts. Similar to the contractual risks, both the UK and Hong Kong interviewees identified a number of effective risk mitigation measures mainly focusing on the tendering process. The minor differences in the findings may be explained by different construction practices (e.g. western culture versus eastern culture) and different pace of using the NEC contract between the two regions.

It is widely accepted that risk management is crucial to project success in the construction industry. The research findings derived from this study via structured opinion interviews with key project stakeholders (i.e. employers, contractors and consultants) in both the United Kingdom and Hong Kong are particularly useful in improving the risk management of GMP/TCC schemes which have been increasingly popular in the construction market. The interview results have also developed a solid basis for further investigation of the GMP/TCC procurement strategies which emerge to be a hot global topical area of research in recent years. Another profound contribution of this paper is to fill the knowledge gap in an international comparison of key risk factors and essential risk mitigation measures for GMP/TCC construction projects between the West (United Kingdom) and the East (Hong Kong), something not conducted before. It is therefore believed that this paper is highly beneficial to the construction industry at large, not least, as a pilot study for reference.

Further research was undertaken in the United Kingdom between April and May of 2010, via empirical questionnaire, with responses from key project stakeholders with extensive hands-on experience in GMP/TCC construction projects. The research collected data as to the criticality of different risk factors, preference of risk allocation and the assessment of risk mitigation measures. The major survey results will be consolidated and disseminated to the construction community via subsequent publications in both academic journals and conference proceedings.

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