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Exploring the Key Risks and Risk Mitigation Measures for Guaranteed Maximum Price and Target Cost Contracts in Construction

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Abstract

This paper aims to identify the key risk factors and propose some risk mitigation measures for Guaranteed Maximum Price (GMP)/Target Cost Contracts (TCC) construction projects, based on a series of in-depth interviews on the perceptions of relevant experienced industrial practitioners in Hong Kong. The interviewees perceived unforeseen ground conditions, nature of variations and the quality of tender documents to be the three most significant risk factors associated with GMP/TCC, while the effective risk mitigation measures include more thorough site investigations, the implementation of partnering approach and the establishment of an adjudication committee and clear tender briefing and tender interview.

Keywords: Guaranteed maximum price, target cost contracting, key risk factors, risk mitigation measures, Hong Kong

Introduction

The Construction Industry Review Committee of the Hong Kong Special Administrative Region (HKSAR) recommended a wider application of target cost contracts to achieve better project performance in terms of time, cost and quality[1]. However, the performance of some Guaranteed Maximum Price (GMP) or Target Cost Contracting (TCC) construction projects in Hong Kong is still far from being satisfactory due to the fact that the employers traditionally apply exculpatory clauses to minimize their own obligations in the contracts. This may not be in the interest of the construction industry in the long run. The short-term benefits of shifting as many risks as possible to contractors may create an atmosphere of hostility that causes a plethora of contractual disputes and, even worse, a reluctance to tender for works in future[2].

1 Construction Industry Review Committee (2001) *Construct for Excellence*. Report of the Construction Industry Review Committee, Hong Kong SAR, 207 pages.
2 Fung, C.Y. (2008) Risk Allocation of Unforeseen Ground Conditions and Underground Utilities in Construction Contracts – Time for a Rethink. Downloaded from website of James R Knowles (Hong Kong) Limited. http://www.jrk.com.hk/pdf/CYF Article 1.pdf, date of access: 2 July 2008.

Systematic risk management allows early detection of risks and encourages the major project stakeholders to identify, analyze, quantify and respond to the risks, as well as to implement risk mitigation policies[3]. The identification of key risk factors and development of risk mitigation measures for those projects procured with the GMP/TCC procurement arrangements are thus important to the contracting parties. The research findings presented in this paper would contribute to the development and application of the GMP/TCC procurement option worldwide and enable key project stakeholders to better understand the potential risks and risk mitigation strategies associated with the GMP/TCC projects in particular.

Definitions of GMP and TCC

GMP can be considered as a lump price for a project for which the employer pays as the maximum price under the contract[4]. It is believed that GMP is not a form of contract[5,6], but a condition which can be applied to any form of contract. Masterman (2002)[7] defined GMP as an agreement which will reward the contractor for any savings made against the GMP and penalize him when this sum is exceeded as a result of his own mismanagement or negligence.

Carty (1995:322)[8] perceived GMP as the arrangement that "the contractor and owner agree that the former will perform an agreed scope of work (defined as clearly as possible) at a price not to exceed an agreed amount, the guaranteed maximum price (GMP) …… If these costs and the predetermined contractor's profit add up to be less than the GMP, the owner and contractor will share the savings based on an agreed formula. If the costs exceed the GMP without any changes to the defined scope, the contractor must solely bear the additional cost."

As cited by McInnis (2001)[9], Scott (1997)[10] described a target cost contract as a risk sharing contract. The National Economic Development Office (1982)[11] regarded that a target cost contract specifies a best estimate of the cost of the works to be undertaken. The initial target cost will be adjusted by agreement between the owner or his

3 Akintoye, A., Beck, M., Hardcastle, C., Chinyio, E. and Asenova, D. (2002) *Framework for Risk Assessment and Management of Private Finance Initiative Projects*. Final Report, EPSRC/DTI, Glasgow Caledonian University, UK.

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

5 Fan, Avan C.W. and Greenwood, David (2004) Guaranteed maximum price for the project? *Surveyors Times, The Hong Kong Institute of Surveyors*, March, 20-21.

6 Same as 4.

7 Masterman, Jack W.E. (2002) *Introduction to Building Procurement Syste*m, 2nd Edition, London New York Spon Press.

8 Carty, G.J. (1995) Construction. *Journal of Construction Engineering and Management, ASCE*, 121(3), 319-28.

9 McInnis, Arthur. (2001) *The New Engineering Contract: A Legal Commentary*. London: Thomas Telford

10 Scott, Robert E. (1987) Risk Distribution and Adjustment in Long-Term Contracts. In The Complex Long-Term Contract Structures and International Arbitration (ed. Fritz Nichlisch). C F Muller Juristischer Verlag, Heidelberg, 1987, 60-63.

11 National Economic Development Office (1982) *Target Cost Contracts – A Worthwhile Alternative.* Civil Engineering Economic Development Committee, National Economic Development Office, London, UK.

nominated representative and the contractor to accommodate the changes to the original design and specifications, during the course of works. Differences between the actual cost at completion and the target cost will be shared between the owner and the contractor. Broome and Perry (2002)[12] believed that a target cost is introduced in this kind of project and any cost saving or overrun against the target cost is divided with pre-agreed portions. Wong (2006)[13] stated that the contractor should be paid the actual cost for the work done during the contract stage in projects applying TCC. When the final construction cost, termed as the final total cost differs from the initial 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 as shown in Figure 1.

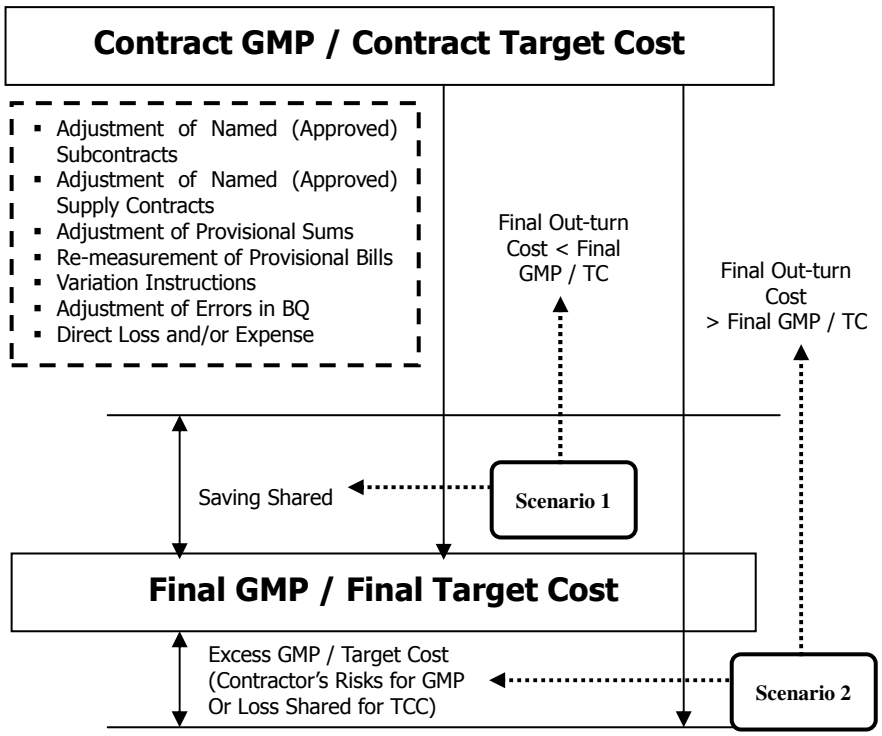

Figure 1. Gain-share/Pain-share mechanism of GMP/TCC scheme[14]

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

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

[14] Adapted from Cheng, Rebecca L.L. (2004) Investigation of the application of guaranteed maximum price in the Hong Kong construction industry. *Unpublished BSc (Hons) Dissertation in Construction Economics and Management*, Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong, 58 pages.

Recent research studies on GMP/TCC

Some previous research studies which have been published in international journals related to GMP and TCC between 2000 and 2009 are summarized in Table 1. Nicolini *et al.* (2000)[15] studied two successful pilot projects with TCC and commented that target costing might support supply chain integration, whilst improving profitability and quality of the construction industry in the United Kingdom. However, Roja and Kell (2008)[16] reported that the final construction cost of 75% of school projects investigated in the northwest of the United States exceeded the GMP, while the same phenomenon was found in about 80% of non-school projects. These findings did not support the notion that GMP was really "guaranteed".

Perry and Barnes (2000)[17] proposed methods of tender evaluation of TCC and suggested that the contractor's share of cost overrun and saving should not be less than 50%. Both Broome and Perry (2002)[18] and Badenfelt (2008)[19] explored how the pain-share/gain-share ratio in TCC should be determined in the British and Swedish perspectives respectively.

Boukendour and Bah (2001)[20] analysed GMP with option pricing theory and considered GMP as a hybrid system of cost reimbursement contract and optional contract hedging the owner from over-budget and provide him possibility of cost savings. Bower *et al.* (2002)[21] examined three projects with different contractual arrangements, including one with TCC, to illustrate the effective use of incentive mechanisms. They concluded that contract incentive structures should provide appropriate incentives to contractors to meet the targets of cost, schedule and quality; correctly allocate risks and allow a suitable level of client's involvement in the projects.

Both Walker *et al.* (2002)[22] and Hauck *et al.* (2004)[23] investigated the case of the Australian National Museum procured with TCC arrangement. Bubshait (2003)[24] conducted a questionnaire survey on incentive/disincentive contracting to the clients

[15] 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, 303-24.

[16] 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.

[17] Perry, J.G. and Barnes, M. (2000) Target cost contracts: an analysis of the interplay between fee, target, share and price. *Engineering, Construction and Architectural Management*, 7(2), 202-8.

[18] Same as 12.

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

[20] Boukendour, S. and Bah, R. (2001) The guaranteed maximum price as call option. *Construction Management and Economics*, 19(6), 563-67.

[21] Bower, D., Ashby, G., Gerald, K. and Smyk, M. (2002) Incentive mechanism for project success. *Journal of Management in Engineering*, ASCE, 18(1), 37-43.

[22] 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*, 7(2), 83-91.

[23] Hauck, A.J., Walker, D.H.T., Hampson K.D. and Peters, R.J. (2004) Project Alliancing at National Museum of Australia – Collaborative Process. *Journal of Construction Engineering and Management*, ASCE, 130(2), 143-52.

[24] Bubshait, A.A. (2003) Incentive/disincentive contracts and its effects on industrial projects. *International Journal of Project Management*, 21(1), 63-70.

and contractors of industrial projects in Saudi Arabia and his findings supported the use of this kind of contract. Tang *et al.* (2008)[25] conducted a similar research on incentive contracts in the Chinese perspective by means of an empirical survey and a case study of the Three Gorges Project.

Wong (2006)[26] introduced a computerized system for cost management in a cable car project in Hong Kong. Chan *et al* (2007b)[27] reported on the findings of 8 structured interviews in respect of the motives behind, perceived benefits, potential difficulties, key risks, critical success factors of launching the GMP/TCC scheme and the suitability of application. Furthermore, Chan *et al.* (2008)[28] also evaluated the effectiveness of partnering for an underground railway extension project with TCC arrangement in Hong Kong via another research study. Kaplanogu and Arditi (2009)[29] explored the practice of pre-project peer reviews in construction companies in the United States, suggesting that this kind of review was critical in reducing the risks of a proposed project.

It is found that the studies mentioned above do not focus on the risk aspects of GMP and TCC, thus this paper fills the gap in this respect. Despite a fair amount of research related to GMP/TCC, studies especially on the risk aspects of GMP/TCC are rather limited. Risk factors, risk allocation and risk mitigation measures for GMP/TCC contracts are particularly lacking in existing literature.

Risk factor is defined as "an event, activity or situation that could lead to the possibility of suffering some loss"[30]. When compared with the conventional design-bid-build delivery method, GMP/TCC stakeholders will expose to a higher level of risk as they typically set an agreed GMP or target cost value in the contract well before the full completion of project design. Meanwhile, previous research revealed that the success of a construction project depends very much on the extent to which the risks involved can be identified, measured, understood, reported, communicated and allocated to the appropriate parties[31]. Thus, it is essential to identify and understand the associated risks as early as possible, so that suitable strategies can be developed and implemented either to retain some particular risks by a certain party or to transfer them to other more capable parties to minimize any likely negative aspect they may have to the project[32].

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

[26] Same as 13.

[27] Chan, D.W.M., Chan, A.P.C., Lam, P.T.I., Lam, E.W.M. and Wong, J.M.W. (2007b) Evaluating Guaranteed Maximum Price and Target Cost Contracting Strategies in Hong Kong Construction Industry. *Journal of Financial Management of Property and Construction*, 12(3), 139-49.

[28] Chan, A.P.C., Chan, D.W.M., Fan, L.C.N., Lam, P.T.I. and Yeung, J.F.Y. (2008) Achieving Partnering Success through an Incentive Agreement: Lessons Learned from an Underground Railway Extension Project in Hong Kong. *Journal of Management in Engineering*, ASCE, 24(7), 128-37.

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

[30] Jha, K.N. and Devaya, M.N. (2008) Modelling the risks faced by Indian construction companies assessing international projects. *Construction Management and Economics*, 26(4), 337-48.

[31] Tam, C.M. (1999) Build-Operate-Transfer model for infrastructure developments in Asia: reasons for successes and failures. *International Journal of Project Management*, 17(6), 377-82.

[32] Wang, S.Q., Dulaimi, M.F. and Aguria, M.Y. (2004) Risk management framework for construction projects in developing countries. *Construction Management and Economics*, 22(3), 237-52.

Table 1. Some recent research studies published in international journals related to GMP/TCC contracts between 2000 and 2009

Authors	Year	Journal	Volume	Pages	Focus
Nicolini *et al.*	2000	BJM	11	303-24	Two case studies of TCC in the United Kingdom
Perry and Barnes	2000	ECAM	7	202-8	Tender evaluation of TCC
Boukendour and Bah	2001	CME	19	563-67	Analysis of GMP with option pricing theory
Bower *et al.*	2002	JME	18	37-43	Comparison of incentive features of 3 case studies
Broome and Perry	2002	IJPM	20	59-66	Determination of sharing ratios of TCC with utility theory
Walker *et al.*	2002	SCMgt	7	83-91	Case study of the Australian National Museum Project procured with TCC arrangement
Bubshait	2003	IJPM	21	63-70	Perceptions of owners and contractors on incentive/disincentive contracting in industrial projects in Saudi Arabia
Hauck *et al.*	2004	JCEM	130	143-52	Case study of the Australian National Museum Project procured with TCC arrangement
Wong	2006	ITcon	11	257-68	Study on a computer system for cost monitoring in cable car project with TCC in Hong Kong
Chan *et al.*	2007b	JFMPC	12	139-47	Report of interviews, motives, benefits, difficulties, risks, success factors and suitability of adopting GMP/TCC in Hong Kong
Roja and Kell	2008	JCEM	134	387-97	Comparison of cost growth performance between construction at risk with GMP and design-bid-build approach in school projects in the United States
Chan *et al.*	2008	JME	24	128-37	Case study of an underground railway extension project in Hong Kong with TCC arrangement
Tang *et al.*	2008	JCEM	134	457-67	Perceptions of stakeholders on incentives in the Chinese construction industry
Badenfelt	2008	ECAM	15	54-65	Sharing ratio in TCC in Sweden
Kaplanogu and Arditi	2009	ECAM	16	175-85	Timing, benefits, effectiveness of pre-project peer review in GMP/lump sum contracts in the US

Notes: BJM: British Journal of Management; CME: Construction Management and Economics; ECAM: Engineering, Construction and Architectural Management; IJPM: International Journal of Project Management; JCEM: Journal of Construction Engineering and Management; JFMPC: Journal of Financial Management of Property and Construction; JME: Journal of Management in Engineering; and SCMgt: Supply Chain Management.

Research Design

Since the GMP/TCC form of procurement is relatively new within the local construction industry, application and experience are confined to a limited number of leading property developers and major construction companies. Table 2 shows projects applying the GMP/TCC concepts in Hong Kong. Invitation letters were sent to the project participants in projects listed in Table 2, followed up by phone calls. A total of seven semi-structured in-depth face-to-face interviews with eight relevant project representatives who played different roles in the four cases were launched from June to July of 2008 to identify the key risk factors, together with risk mitigation measures for GMP/TCC projects in Hong Kong.

Table 2. Selected GMP/TCC cases for the research in Hong Kong[33]

	Project Name	Project Nature	GMP/TCC
1.	Chater House	A prestigious rental commercial development in Central	GMP
2.	1063 King's Road	A rental commercial development in Quarry Bay	GMP
3.	Alexandra House Refurbishments	A prestigious rental commercial development in Central	GMP
4.	Tradeport Hong Kong Logistics Centre	A commercial logistics hub for the Asia region at Chek Lap Kok	GMP
5.	Landmark Redevelopment Phase 6 – York House	A rental commercial redevelopment in Central	GMP
6.	The Orchards	A twin tower residential development in Quarry Bay	GMP
7.	Three Pacific Place	A prestigious rental commercial development in Wanchai	GMP
8.	Public Housing Development at Eastern Harbour Crossing Site Phase 4	A public rental housing development in Yau Tong as a pilot study project	Modified GMP
9.	Tseung Kwan O Railway Extension – the sixth operational railway line with 5 stations	13 civil engineering contracts, 4 building services contracts as well as 17 electrical and mechanical contracts	TCC
10.	Tsim Sha Tsui Metro Station Modification Works (MTRC Contract C4420)	Tsim Sha Tsui Metro Station Modification Works	TCC
11.	Tung Chung Cable Car Project	A sightseeing transportation facility including civil and building works	TCC

[33] Chan, D.W.M., Chan, A.P.C., Lam, P.T.I., Lam, E.W.M. and Wong, J.M.W. (2007a) An Investigation of Guaranteed Maximum Price (GMP) and Target Cost Contracting (TCC) Procurement Strategies in Hong Kong Construction Industry. *Research Monograph*, Department of Building and Real Estate, The Hong Kong Polytechnic University, 152 pages, ISBN 978-962-367-593-2, October 2007.

The details of the interviewees are elicited in Table 3. Copies of relevant materials including the project's scope of work, contract terms and letters of award on GMP/TCC, in-house guidelines or best practice framework for implementing GMP/TCC scheme, case reports, as well as on-line materials, were obtained as secondary source of evidence to support primary opinions and information gleaned during the interviews. As all of the interviewees were senior construction personnel having abundant direct hands-on experience with GMP/TCC projects in Hong Kong, the interview opinions and findings were considered representative and valid for general applications.

Table 3. Details of 8 interviewees for 7 semi-structured interviews

ID	Sector	Stakeholder	Position of Interviewee	Organization
1	Private	Contractor 1	Managing Quantity Surveyor	Major construction contractor
2	Private	Contractor 2	Assistant General Manager	Major construction contractor
3	Private	Client 1	Project Manager	Leading property developer
4	Qusai-government	Client 2	General Manager – Procurement and Contracts	Qusai-government mass railway service provider
5	Private	Client 3	Senior Project Manager	Leading property developer
6	Public	Consultant 1	Architect	Public housing developer
7	Private	Consultant 1	Technical Director	Quantity surveying consultant
8	Private	Consultant 2	Director	Quantity surveying consultant

Notes: Interviewees 6 and 7, who were involved in a public housing project engaging a private quantity surveying consultant, were both interviewed in one single meeting held on 11 June 2008 and their opinions were consolidated as views of "Consultant 1" in this study.

The opinions obtained from the interviews were first audio-recorded and later transcribed into written dialogues. The interview dialogues were later forwarded back to corresponding interviewees for verification via email transmission. A systematic account of information and data obtained from in-depth interviews were archived for subsequent analysis. The interview dialogues were duly analyzed 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 were classified into different groupings according to the nature of contents) to capture any similarities and differences for comparisons. Interview dialogues can be classified and reduced into more relevant and manageable bits of data[34]. This method can be applied to situation under which information and understanding of issues relevant to general aims and specific research project are obtained[35].Content analysis can be regarded as a technique of data analysis which is applicable in construction research[36]. 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 analyzed 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 categorized data which may be subject to statistical analyses. Comparisons may be

[34] Weber, R.P. (1990) *Basic Content Analysis*, 2nd Edition, Sage Publication.
[35]Gillham, B. (2000) *The Research Interview*. Continuum, London, United Kingdom.
[36] Fellows, R. and Liu, A. (2008) *Research Methods for Construction*, *3rd Edition*, Blackwell Science, Oxford, UK.

made and hierarchies of categories can be examined[37]. 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 categorized data against respondents is structured. This technique was applied in investigating critical success factors in construction project briefing[38]. Outcomes derived from the analysis of interviews were cross-referenced to the published literature wherever appropriate and to complement each other for validation.

The following open-ended questions were asked during the interviews in order to convey ideas of the information solicited, and the interviewees were encouraged to express freely on the issues 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. How were these important risk factors allocated amongst various contracting parties in the project?
3. Can you provide some strategies or guidelines to mitigate the risks involved in GMP/TCC projects?

Interview findings and discussions

Table 4 summarizes the key findings of the interview survey on the aforesaid first two research questions pertaining to the perceived key risk factors and actual risk allocation for those GMP/TCC construction projects, as gleaned from the seven interviews.

Table 4. Summary of the interview findings on perceived key risk factors and for GMP/TCC construction projects in Hong Kong

	Contractor 1	Contractor 2	Client 1	Client 2	Client 3	Consultant 1	Consultant 2	Total no. of hits
Contractual Risks								
1. Nature of variations	√	√		√	√		√	**5**
2. Quality and clarity of tender documents	√	√		√	√		√	**5**
3. Change in scope of work		√		√		√		**3**
4. Setting a genuine maximum price or target cost in contract				√				1
Physical Risks								
5. Unforeseen ground conditions	√		√		√	√	√	**5**
6. Inclement weather							√	1
Economic Risks								
7. **Fluctuation of materials price**		√	√			√	√	**4**
8. Market trend in building design							√	1

[37] Same as 36.

[38] 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.

Design Risks									
9.	**Approval from regulatory bodies for alternative cost saving designs**	√	√				√		**3**
10.	Lack of involvement of contractor in issuing variation orders	√							1
Others									
11.	Unfamiliarity with GMP/TCC methodology by project team members			√				√	2
12.	Selection of competent project team					√	√		2
13.	Implication of construction project to surrounding environment			√					1
Total number of key risk factors identified from each interviewee		**5**	**5**	**4**	**4**	**4**	**5**	**7**	

Perceived key risk factors for GMP/TCC contracts

All of the risk factors, each of which was suggested by 3 or more interviewees, are discussed in this section (as highlighted in Table 4). "Nature of variations" was considered as the most common risk factor inherent with GMP/TCC projects in Hong Kong by the five interviewees. That is, whether an architect/engineer instruction should be classified either as GMP/TCC variation which would be liable to adjust the agreed GMP (or target cost value) in contract or as design development change. This echoes the commentary made by Chan *et al*[39,40]and Fan and Greenwood (2004)[41] that nature of variation can be a main source of disputes in GMP/TCC schemes. Two interviewees (Contractor 1 and Consultant 2) expressed that the changes in building services installation and structural building frame erection were usually classified as design development items which would not alter the GMP/TCC contract value. In other words, the additional cost for this kind of change would be at the main contractor's risk and such changes were deemed to have been covered in the fixed lump-sum price of main contractor's direct works.

The second key contractual risk factor as perceived by the respondents was "quality and clarity of tender documents". The contract document comprising the tender documents is a fundamental tool for risk allocation. If there exist errors, omissions or discrepancies within the contract document at the outset of the project, they would give rise to a huge number of intractable disputes or conflicts and unnecessary contract variations during the post-contract stage. One interviewee with contracting background reported that the contractor had to cover the risk of inaccuracy of firm quantities in the Bills of Quantities for his project, for which his company finally incurred a loss. Yew (2008)[42] shared a similar perception that contractors are bound to take all of the risks under GMP/TCC contracts, including errors and omissions in tender documents in Singapore.

[39] Same as 33

[40] Chan, D.W.M., Chan, A.P.C., Lam, P.T.I. and Wong, J.M.W. (2010) Empirical study of the risks and difficulties in implementing guaranteed maximum price and target cost contracts in construction. *Journal of Construction Engineering and Management*, ASCE, 136(5), 495-507.

[41] Same as 5.

[42] Yew, M. (2008) Guaranteed Maximum Price (GMP) Contracts in Singapore. *EC Harris Asia Commentary – January 2008.*

The third significant contractual risk reported by the interviewees is "change in scope of work". Disputes may arise due to the changes in scope of work[43,44]. Three interviewees emphasized that when the standard specifications of the architect and/or client change, the standard of GMP/TCC projects under the umbrella of the client organization will also change accordingly. Since unexpected change in scope of work may generate a considerable number of GMP/TCC variations[45], it would prolong the overall development programme as well as incur significant cost escalations to the project. Besides, the extent of design development changes would also be difficult to define. Improper handling on these issues may provoke adversarial disputes and thus diminish the mutual trust and partnering relationship developed within the project team[46].

As noted from Table 4, five out of the seven interviewees perceived that "unforeseen ground conditions" was a key physical risk factor associated with the GMP/TCC procurement approach. The underground conditions would affect the progress of foundation works and hence the progress of the whole construction project[47]. In addition, this finding is consistent with that reported by Shen (1997) suggesting that unexpected ground conditions were a key risk contributing to project delay in Hong Kong. The main contractor would be liable to liquidated damages if the project could not be completed on or before the date for completion stipulated in the contract due to the difficult ground conditions, provided that the extension of time granted could not cover the delay. The main contractor would also probably bear the cost consequence in many cases.

As for economic risks, according to four interviewees, "fluctuation in materials price" was regarded as one of the key risk factors encountered in adopting GMP/TCC form of procurement, for example, the cost of steel reinforcement bars rose from HK$6.50/kg to HK$10.50/kg, accounting for a 62% increase within a period of one year[48]. It is a common practice of the Hong Kong construction industry to insert the Special Conditions of Contract to delete the fluctuation clause in the General Conditions of Contract in the private sector (i.e. the fluctuation of materials prices is at contractor's risk). One representative from contractor commented that his company suffered a loss due to the sharp increase in materials price in 2008, even though a fluctuation clause was applicable in his project which was a public housing development. It is logical to deduce that the contractors engaged in the private sector building projects who had committed themselves to fixed price contracts also suffered losses of this nature.

"Approval from regulatory bodies for alternative cost saving designs" was considered as a key design risk factor. Three interviewees opined that when the main contractor comes up with an alternative proposal, he has to submit its design proposal to

[43] Tang, S.L. and Lam, R.W.T. (2003) Applying the target cost contract concept to price adjustments for design-and-build contracts. *Hong Kong Engineer*, September, 18-19.
[44] Same as 40.
[45] Same as 5.
[46] Sadler, M.C. (2004) *The Use of Alternative Integrated Procurement Approaches in the Construction Industry.* Unpublished MBA Dissertation in Construction and Real Estate, Department of Construction Management and Engineering, University of Reading, UK, 132 pages.
[47] Same as 2.
[48] Rider Levett Bucknall (2008) *Quarterly Hong Kong Construction Cost Report, June 2008*.

regulatory bodies for verification and approval. If the contractor is not familiar with the practice and operation of those regulatory bodies, this certainly increases the difficulty in obtaining design approval from the relevant unit. The delay of this approval process would affect the overall progress of the project. Moreover, if the proposal is rejected, the time and cost implications would be solely borne by the contractor.

Table 5. Summary of the interview findings on risk mitigation measures for GMP/TCC construction projects in Hong Kong

		Contractor 1	Contractor 2	Client 1	Client 2	Client 3	Consultant 1	Consultant 2	Total no. of hits
Tendering Process									
1.	**Conduct more thorough site investigations**	√	√	√					**3**
2.	**More upfront work of tender documentations**				√			√	**2**
3.	**Tender briefing and tender interview**					√		√	**2**
4.	**Pre-qualification of main contractors**					√	√		**2**
5.	Use of Named Subcontractor rather than nominated subcontractors					√			1
Design Management									
6.	More communication between the architect and main contractor before issuing variation orders	√							1
7.	Application of value engineering			√					1
8.	Design review workshops		√						1
9.	Setting up contingency plans		√						1
10.	Monitoring system set up by main contractor			√					1
Relationship between client and contractor									
11.	**Adoption of partnering approach**		√	√		√		√	**4**
12.	Support from top management to project team	√							1
13.	Adjudication committee to resolve disputes				√				1
Total number of risk mitigation measures suggested by each interviewee		**3**	**4**	**4**	**2**	**4**	**1**	**3**	

Risk mitigation measures for GMP/TCC contracts

Apart from the key risk factors involved in implementing the GMP/TCC contractual arrangement, the interviewees also suggested a plethora of risk mitigation measures to minimize the above-mentioned risks which are consolidated in Table 5. Only those risk mitigation measures which were advocated by at least two interviewees are highlighted for further discussion under this section.

The first risk mitigation measure related to tendering process as proposed by the interviewees was conducting more thorough site investigations during the tender stage. Contractor 1 advocated that more thorough site investigations should be conducted by the main contractor at the tender stage to better understand the soil conditions.

Contractor 2 shared a similar view and expressed that the information about ground conditions in tender documents was only provided in good faith (i.e. the accuracy was not guaranteed). Moreover, Client 1 also recommended undertaking more detailed site investigations would mitigate the risk of "unforeseen ground conditions" inherent with GMP/TCC projects. The cost of launching comprehensive site investigations is minimal to the total project sum[49]. However, clients in general do not allocate adequate resources in performing such investigations. In fact, more in-depth understanding about the underground conditions would help the contractor to price a reasonable allowance for such risk within his tender sum and hence eliminating a source of potential disputes at the post-contract stage.

Placing more emphasis on upfront work in tender documentations was proposed by both Client 2 and Consultant 2. They both concurred that more concerted efforts could be devoted to the upfront work of tender documentations and Consultant 2 suggested using historical statistical data from past reference projects, to ascertain the initial GMP value. A clearly drafted contract can definitely minimize the number of disputes during the post-contract stage. The GMP is neither really guaranteed nor maximum[50]. At the tender stage, it is important for the client/consultants to review draft tender documents to appreciate the specific risks involved and a properly drafted set of tender documents is essential to the project success of GMP/TCC contracts[51].

In addition, "tender briefing and tender interview" was perceived as a risk mitigation measure for GMP/TCC projects by two interviewees. It is believed that the tender briefings could be arranged before inviting tenders to enable interested contractors to gain a basic understanding of the special features and contractual requirements of the project such as the methodology of GMP/TCC contractual arrangement. The tender briefings should be comprehensive, transparent and fair to all of the potential bidders. Tender interviews can enable the tenderers to really understand and recognize the potential risks involved in the project before contract award. This recommendation is consistent with the propositions by Yew (2008)[52] as well as Chan and Yeong (1995)[53].

Besides, pre-qualification of main contractors was an effective means to mitigate risks inherent in projects procured with the GMP/TCC arrangement. The purpose of pre-qualification is to shortlist suitable tenderers who have clear understanding about the scope of work and are capable to undertake the potential risks associated with the construction project. Assessment criteria for pre-qualification exercise include but are not limited to financial stability, current workload, past track record of similar projects and the like[54]. Selection of the right project team appears to be a critical success factor for GMP/TCC projects in Hong Kong[55]. Client needs to constitute a project team who

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[49] Chan, A.P.C. and Yeong, C.M. (1995) A comparison of strategies for reducing variations. *Construction Management and Economics*, 13, 467-73.
[50] Same as 4.
[51] Same as 42.
[52] Same as 42.
[53] Same as 49.
[54] Environment, Transport and Works Bureau (2004) Tender Evaluation of Works Contracts. *Environment, Transport and Works Bureau Technical Circular (Works) No. 8/2004*, Environment, Transport and Works Bureau, HK SAR Government.
[55] Chan, A.P.C., Chan, D.W.M., Fan, L.C.N., Lam, P.T.I. and Yeung, J.F.Y. (2004) A Comparative Study of Project Partnering Practices in Hong Kong. *Summary Report, Construction Industry Institute – Hong Kong, Research Report No.1*, 40 pages, ISBN 988-98153-1-1, September 2004.

is receptive to innovative ideas. The commitment and capability of the contractor are particularly important. The main contractor has to be proactive and willing to communicate with other project participants based on the partnering concepts.

As regards the relationship between client and contractor, four out of the seven interviewees pointed out that the adoption of partnering approach which stresses developing harmonious working relationship, building up mutual trust and achieving common goals[56] could be an effective risk mitigation measure for this kind of project. The GMP/TCC style of procurement in conjunction with the partnering spirit promoted deeper collaboration between the client and the main contractor. Regular partnering review meetings and the adjudication committee operating under the GMP/TCC umbrella established a solid platform to discuss any difficulties encountered and resolve any confrontational issues. This finding is in line with that in the study by Chan *et al.* (2008)[57], advocating that the implementation of partnering concepts together with target cost contracts can improve overall project performance by mitigating unnecessary conflicts and intractable arguments.

Conclusions

The construction industry of Hong Kong has been characterized by the fragmentation of different contracting parties and an adversarial working relationship between clients and contractors for several years[58]. The application of GMP/TCC procurement strategy with a gain-share/pain-share mechanism may be one of the plausible solutions to this problem, provided that the risks inherent in the projects are properly identified, analyzed, allocated and handled. Identification and analysis of the key risk factors and development of risk mitigation measures are critical in the risk management process to achieve an optimum equitable risk sharing mechanism and overall project success. This paper has reported on the key risk factors and risk mitigation measures as perceived by the interviewees, contributing to the development of risk management strategies for GMP/TCC projects in Hong Kong. It is found that a number of key risk factors are related to design variations. Not surprisingly, the risk mitigation measures reported are pertaining to the tendering process and applying partnering concepts to improve the working relationship between client and contractor.

It is widely recognized that risk management is essential to the success of any projects. The research findings derived from this study through an opinion interview survey with key construction stakeholders involved in GMP/TCC projects in Hong Kong are particularly important in further improving risk management in this kind of procurement approach which is increasingly being adopted. The interview results have also formed a strong foundation for further investigation of the GMP/TCC contractual arrangement which is a contemporary topical area of research worldwide. It is believed that this research study can benefit the construction community at large.

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[56] Same as 55.

[57] Chan, D.W.M., Chan, A.P.C., Lam, P.T.I., Chan, J.H.L., Hughes, Will and Ma, Tony (2008). "A Research Framework for Exploring Risk Allocation Mechanisms for Target Cost Contracts in Construction" *Proceedings of the CRIOCM 2008 International Research Symposium on Advancement of Construction Management and Real Estate,* 31 October - 3 November 2008, Beijing, China, pp. 289-296.

[58] Same as 1.

Moreover, a follow-up industry-wide empirical questionnaire survey to solicit various opinions on the importance of various risk factors, appropriateness of risk allocation and evaluation of risk mitigation measures from those project team members with rich experience in GMP/TCC construction projects had also been launched between April and May of 2009 in Hong Kong. The key survey findings will be collated and disseminated to the research community and construction industry through subsequent journal publications and conference presentations.

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