

## **Identifying the critical success factors for target cost contracts in the construction industry**

Daniel W.M. Chan<sup>1\*</sup>; Albert P.C. Chan<sup>2</sup>; Patrick T.I. Lam<sup>3</sup>;  
and James M.W. Wong<sup>4</sup>

<sup>1</sup> *Associate Professor, Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China (email: [bsdchan@inet.polyu.edu.hk](mailto:bsdchan@inet.polyu.edu.hk))*

<sup>2</sup> *Professor and Associate Head, Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China (email: [bsachan@inet.polyu.edu.hk](mailto:bsachan@inet.polyu.edu.hk))*

<sup>3</sup> *Associate Professor, Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China (email: [bsplam@inet.polyu.edu.hk](mailto:bsplam@inet.polyu.edu.hk))*

<sup>4</sup> *Postdoctoral Fellow, Department of Civil Engineering, The University of Hong Kong, Pokfulam Road, Hong Kong, China (email: [jmwwong@hkucc.hku.hk](mailto:jmwwong@hkucc.hku.hk))*

**\* Corresponding author: Daniel W.M. Chan**

## **Abstract**

**Purpose** – This paper aims to present a succinct review of guaranteed maximum price (GMP) and target cost contracting (TCC) concepts and features in general, and to identify the critical success factors for procuring GMP/TCC contracts from the Hong Kong perspective in particular.

**Design/methodology/approach** – By means of an empirical questionnaire survey geared towards industrial practitioners with direct hands-on GMP/TCC experience, the opinions of various contracting parties including clients, consultants and contractors were solicited, analysed and compared in relation to GMP/TCC success factors.

**Findings** – Experienced practitioners shared the unanimous perception that: (1) reasonable share of cost saving and fair risk allocation; (2) partnering spirit from all contracting parties; (3) right selection of project team; (4) well-defined scope of work in client's project brief; and (5) early involvement of contractor in design development, are the most essential ingredients for the successful implementation of GMP/TCC scheme.

**Research limitations/implications** – Although the research study is based in Hong Kong with a limited sample size, the survey findings and hands-on experience of the relevant industrial practitioners may be cross-referenced to other similar investigations in other parts of the world for international comparisons.

**Originality/value** – The research study has provided some useful insights into assisting key project stakeholders in determining important successful ingredients when launching GMP/TCC scheme. Such an identification of critical success factors would be valuable in formulating effective practical strategies to improve overall project performance, create win-win opportunities for contracting parties and mitigate the occurrence of construction disputes/claims. It also attempts to seek more research evidence to capture the levels of success and lessons learned from previous GMP/TCC construction projects for generating best practice recommendations for future implementation.

**Keywords:** Guaranteed maximum price, Target cost contracting, Procurement strategies, Critical success factors, Hong Kong

**Paper type:** Research paper

## **Introduction**

The construction industry has long suffered from several deficiencies, such as inequitable risk allocation, limited trust and misalignment of objectives amongst contracting parties, together with a lack of incentives to improve project performance, leading to project delays, cost overruns, difficulty in resolving claims and a win-lose climate (Moore *et al.*, 1992; Chan *et al.*, 2004). As rightly pointed out by the Construction Industry Review Committee of the Hong Kong Special Administrative Region, strong alarms have also been raised because of the conventional practice of awarding contracts to the lowest bidders, which has resulted in low profit margins (Construction Industry Review Committee, 2001). These besetting problems have instigated the need for a new procurement approach in order to rectify the deteriorating situations.

Both the guaranteed maximum price (GMP) and target cost contracting (TCC) schemes are such project procurement strategies which attempt to mitigate risks, avoid dispute/claim occurrence, integrate the diverse interests of a complex construction project and offer incentives to provide value-added services. Triumphant overseas cases indicated that the GMP/TCC arrangement can only accrue considerable mutual benefits to all of the contracting parties involved, provided that they are properly structured, implemented and managed (Trench, 1991; Walker *et al.*, 2000).

GMP/TCC has received considerable attention in the United States, United Kingdom and Australia over recent years. For example, the New Engineering Contract which includes various target cost contract options has been adopted in the engineering and construction sectors throughout the United Kingdom and overseas for many years (Broome and Perry, 1995). Nicolini *et al.* (2000) explored whether TCC can be applied within the United Kingdom construction industry via case evidence from two new pilot building projects. Nicolini *et al.* (2001) further found that both of the two pilot demonstration projects obtained a cost reduction of 8-14%, faster programme by 5-20% and rework down by 90-95% when compared with a similar project under the traditional contracting approach, with no reportable accidents recorded during construction.

Harris (2002) claimed that while the New Wembley National Stadium located in London, England procured under a GMP form of contract was finally open in March 2007, it cost more than £757 million (over original estimated budget of £200 million back in 1996), and opened almost two years behind schedule with its troubles widely reported, e.g. two high profile court cases between the main contractor and steel contractor. But the National Museum of Australia Project had achieved outstanding project outcomes under the design-and-build alliancing arrangement with a target cost contracting approach (Walker *et al.*, 2002). So it is worthwhile examining the underlying reasons for the favourable or unfavourable project performance when a GMP/TCC contract is adopted.

The GMP arrangement based on a target cost concept has been gaining popularity in Hong Kong amongst other alternative integrated procurement strategies since the completion of the first project introducing GMP in August of 1999. Being a high-rise private commercial development of “1063 King’s Road” located in Quarry Bay, the project was completed on schedule and the final out-turn cost is 11%-38% less than similar buildings using the traditional procurement system (Ho, 2000). However, not all of these GMP/TCC projects have been equally successful even though GMP/TCC has been practiced in the United States, United Kingdom and Australia for several years. Besides, very limited research evidence especially in the Hong Kong context has demonstrated the levels of success and lessons learned from those previous GMP/TCC projects, despite multitudinous literature about the practices of GMP/TCC in overseas countries (e.g. Trench, 1991; Gilbreath, 1992; Kerzner, 1995; Ferreira and Rogerson, 1999; Blumkin and Schwartz, 2003).

This paper therefore aims to identify and analyse the critical success factors for implementing GMP/TCC construction projects by evaluating empirically the opinions of local project participants on which ingredients make GMP/TCC a success. The underlying philosophy and features of GMP/TCC, research methodology, together with the analysis and discussion of survey results are presented and explained. The success factors behind using GMP/TCC are worthy of in-depth investigation in order to achieve future construction excellence.

### **What are GMP and TCC?**

GMP/TCC is an incentive-based procurement strategy which will award the contractor for any savings made against the guaranteed price or target cost and will penalise him when this

sum is exceeded as a result of his own mismanagement or negligence according to a pre-agreed share ratio (Masterman, 2002). The contractor usually includes a sum for future design development in the form of GMP/TCC allowance and for any unforeseeable risks associated with the project (Gander and Hemsley, 1997).

### ***Target cost contracting (TCC)***

The National Economic Development Office (United Kingdom) – Civil Engineering (1982) defined TCC as:

*“Target cost contracts specify a best estimate of the cost of the work to be carried out. During the course of the work, the initial target cost will be adjusted by agreement between the client or his nominated representative and the contractor to allow for any changes to the original specification. Any savings or overruns between target cost and actual cost at completion are shared between the parties to the contract.”*

Trench (1991) shared the same view that under a target cost contract, the actual cost of completing the work is evaluated and compared with an estimate or target cost of the work and the differences within a cost band are shared between the employer and the contractor. It is a unique arrangement that shifts from the fixed price approach to a target cost approach based on joint determination and agreement between the contractor and the client on the allocation of shared risks.

### ***Guaranteed maximum pricing (GMP)***

Boukendour and Bah (2001), on the other hand, considered the GMP as a hybrid arrangement consisting of a cost reimbursement contract and a call option for a fixed price contract. The contractor guarantees that the project will be completed within the contract period in full accordance with the drawings and specifications and the cost to the owner will not exceed the initial GMP agreed at main contract award.

Kerzner (1995) regarded GMP to be:

*“..... the contractor is paid a fixed fee for his profit and reimbursed for the actual cost of engineering, materials, construction labour, but only up to the ceiling figure established as the ‘maximum guaranteed’. Savings below the maximum guaranteed are shared between*

*owner and contractor, whereas the contractor assumes the responsibility for any overrun beyond the guaranteed maximum price.”*

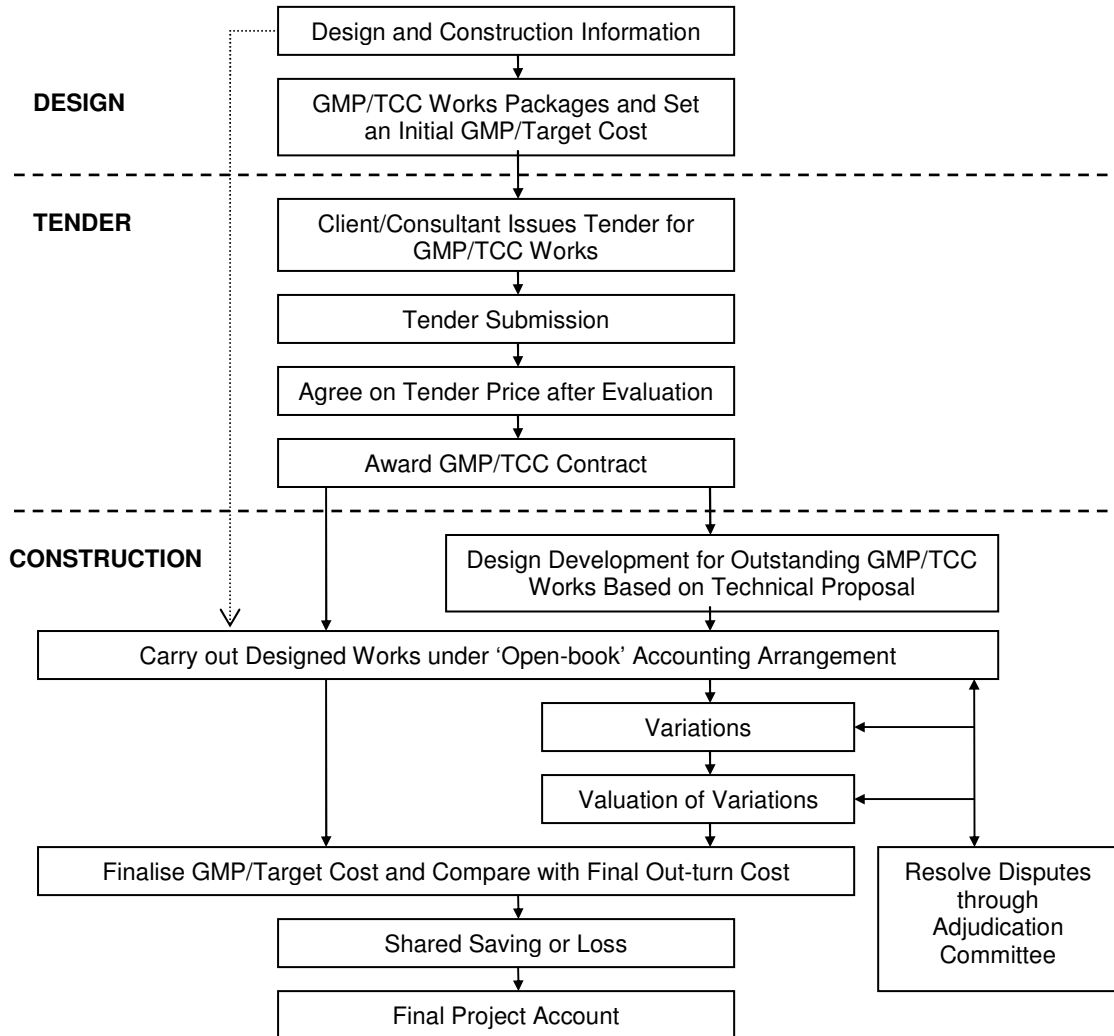
Hence, GMP can be considered as one of the forms of TCC with the sharing arrangement limited solely to the gain (Perry and Thompson, 1982). Hence, under the operational mechanisms of GMP and TCC, an agreed ceiling price and a gain-share/pain-share arrangement are developed in the construction contract under this agreement (Clough and Sears, 1994).

### **Key features of GMP/TCC**

#### ***Tendering method***

Figure 1 shows a typical procurement route of the GMP/TCC approach. If a GMP/TCC project is procured on a negotiated contract basis, the preferred contractor has already been sought through a long-term corporate business relationship. However, in the case of selective tendering basis, tenderers will be invited to pre-qualify in the normal manner by submitting a preliminary proposal detailing corporate strength, relevant work experience, past track record, expertise in alternative procurement methods, technical competence, financial stability, organisational structures and personnel, partnering commitment, etc. Subsequently, the proposals are reviewed by the client in collaboration with his team of consultants. After rigorous evaluation, a group of pre-qualified contractors will be shortlisted and invited to submit a tender (Hong Kong Housing Authority, 2006).

After tender evaluation, shortlisted tenderers are then requested during the second stage to submit more detailed proposals based on: (1) bills of quantities; (2) a more completed set of design drawings (e.g. 80%); and (3) performance specifications for works packages. Under the negotiated tendering approach, the requirement does not detract from the objectives of obtaining a competitive tender, as the majority of the subcontract packages are ultimately tendered on an ‘open-book’ competitive tender basis. This information exchange, however, requires a high level of mutual trust amongst the project team members, especially the main contractor. The quantum of the subcontract packages competitively tendered may range from 60 to 80% of the total contract value.



**Figure 1.** Typical contract procurement route of GMP/TCC scheme  
 [Adapted from Hong Kong Housing Authority (2006)]

With regard to the information required for GMP/TCC contracts, both the guaranteed maximum price and target cost are estimated based on preliminary design documentation provided by client and his team of consultants. Tender documents for GMP contracts usually comprise: (1) cost for main contractor’s direct works (e.g. substructure works, reinforced concrete superstructure works, finishing works, etc); (2) domestic subcontractor’s works packages (e.g. electrical and mechanical installation, MVAC installation, plumbing and drainage, fire services installation, lift installation, etc); (3) provisional quantities; (4) provisional sums; and (5) design development allowance (Hong Kong Housing Authority, 2006). ‘Provisional Quantities’ means works quantified at the time of contracting based on a specification which is reasonably defined but where the design has not progressed to

ascertain a defined quantum of works. 'Provisional Sums' means sums provided for work or expenditure which cannot be entirely foreseen, defined, quantified or detailed at the time the tender documents are issued (items without Bills of Quantities). The information provided in the tender documents is not sufficient for construction and completion of the works. The contractor thus allows in his tender pricing for design development. Further design information will be provided by the client and his team of consultants after the target cost is agreed and issued to the main contractor under Architect's Instructions.

Generally, tender documents for domestic subcontractor's works packages will be prepared by the main contractor in conjunction with the team of consultants. The tender documents will be issued to pre-qualified or preferred subcontractors to control the range and quality of work. The main contractor must identify any GMP variations (i.e. subject to a re-calculation of the GMP) within the subcontract tender documents prior to the issue of tenders (Fan and Greenwood, 2004). Upon issue of the subcontract tender documents to the tenderers, the main contractor is deemed to have accepted that the scope of work described by the tender document for that particular subcontractor's works package is within the allowances included for design development (i.e. not subject to a re-calculation of the GMP).

Tenders will then be analysed by the main contractor together with his team of consultants and the team will jointly make recommendations to the client for award on a competitive 'open-book' arrangement, and subcontractors can be assured of a fair assessment of their tendered sum (Hong Kong Housing Authority, 2006). The main contractor will enter into a domestic subcontract with the successful subcontractor. This process eliminates the requirement to adopt nominated subcontracts and their inherent liabilities. The main contractor also assures that the subcontractors will not assign or sublet their works without the approval of the client. Any procurement savings generated in the tendering of the domestic subcontractors' works will be incorporated into the final out-turn costs, and will form the basis for calculation of shared savings at completion of the project.

### ***Pricing mechanism***

A GMP/TCC contract, like other standard cost-based contracts, requires that details of the contractor's tender pricing for any GMP/TCC subcontract works packages be made fully available to the client but usually through an 'open-book' accounting arrangement. The



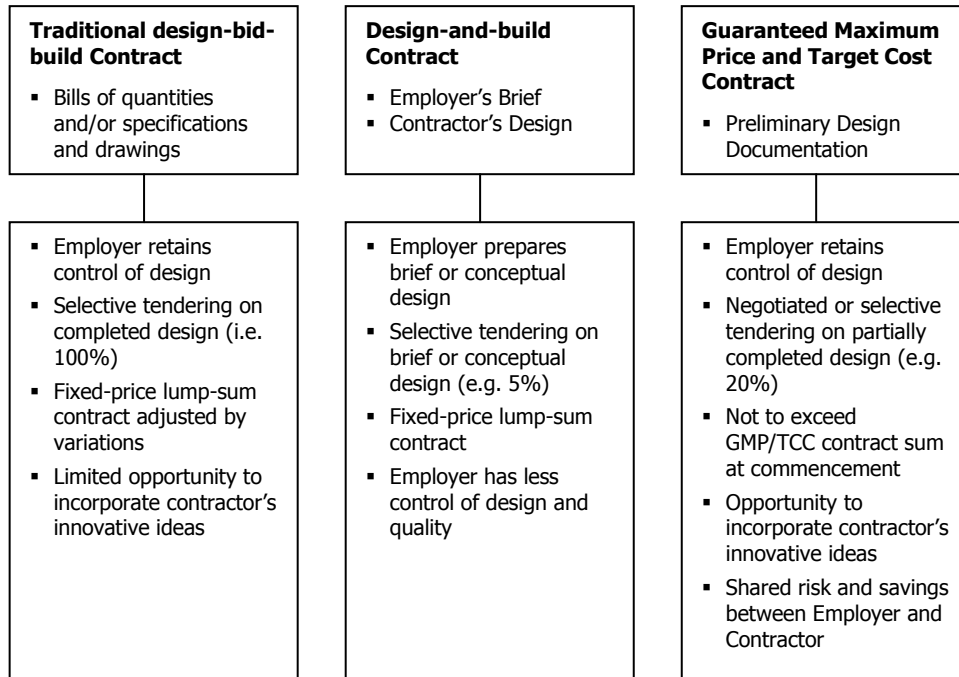
contractor's accounts must be open to scrutiny by the client, and the client must satisfy himself that the contractor's supporting staff on-site will include a strong administrative team and an accountant experienced in this procedure. The client pays these costs to the main contractor subject to satisfactory checks of constructed facilities. The use of open-book accounting regime enables better accountability and quantification of the costs of risk (National Economic Development Office, 1982).

The GMP/TCC procurement approach is also characterised by the agreement that the works will be completed within the contract period and the cost to the client will not exceed the target cost, as warranted by the contractor (Gander and Hemsley, 1997). In adopting the GMP approach, Cantirino and Fodor (2003) stated that in case the actual cost is greater than the negotiated guaranteed maximum price, the client will merely be liable up to the guaranteed maximum amount and the excess costs would be solely paid by the contractor. The price ceiling is set for the project and the financial risk borne by the client is moderated significantly (Boukendour and Bah, 2001).

As emphasised, the gain-share/pain-share mechanism is another unique feature of the target cost contracting strategy introduced to the construction contract (Trench, 1991). If there are any savings or losses resulting from a difference between the actual cost and the target cost, there is a sharing function to split the 'gain/pain' between the client and the contractor. This mechanism thus creates a strong incentive for the contractor to save project cost by incorporating contractor's expertise and innovations in both design and construction methods.

### ***Contractor's inputs in design and construction***

GMP/TCC is regarded as a crossover of traditional design-bid-build and design-and-build contracts (Fan and Greenwood, 2004). Figure 2 compares the characteristics amongst the three procurement approaches. GMP/TCC can bring in expertise in building designs and innovations in construction methods or materials from the contractor (Masterman, 2002). Whereas both GMP/TCC and design-and-build contracts are structured for better utilisation of contractor's expertise, GMP/TCC allows opportunity for clients to exercise greater control over the process of design development and project cost whilst at the same time integrating contractor's expertise and innovations under a defined framework.



**Figure 2.** Comparison amongst alternative procurement methods  
 [Adapted from Hong Kong Housing Authority (2006)]

***Project variations (architect's instructions)***

In a typical GMP/TCC construction project, two types of variations are often pre-defined under the conditions of contract: (1) design development changes (i.e. non GMP/TCC variations); and (2) GMP/TCC variations (Gander and Hemsley, 1997). The design development changes do not trigger a re-calculation of the GMP or target cost because they are deemed to be included in the fixed lump sum of main contractor's direct works finalised at contract award. However, GMP/TCC variations can allow for the re-calculation of the GMP or target cost and they will be valued in accordance with the measured works and schedule of rates. Generally, GMP/TCC variations arise only due to: (1) changes in scope of work such as change in floor area or volume; (2) change in function of an area; (3) change in quality of an area; (4) adjustment of provisional quantities or provisional sums; (5) corrected quantity errors by consultants; and (6) unexpected additional fees or charges imposed by statutory authorities (Fan and Greenwood, 2004). Extras should therefore be related to scope changes requested by the client. The net cost adjustment of such GMP/TCC variations will be added to (for 'addition' work) or subtracted from (for 'omission' work) the contract GMP or target cost.

The contractor should notify the architect in writing, advising the value and extension of time (if any) if the contractor wishes to make a claim arising out of a GMP/TCC variation; or he disagrees with the architect's decision as to whether or not the architect's instruction is a GMP/TCC variation. If the architect and the contractor disagree on the definition of a GMP/TCC variation, the architect will convene a meeting of the Adjudication Committee to determine the nature and extent of the variation, and to facilitate the resolution of any unresolved issues, which involves representatives from client, architect, quantity surveyor and main contractor (Hong Kong Housing Authority, 2006). The intent is to settle any issues at source with a view to enhancing project efficiency and accountability.

## **Research methodology**

### ***Research framework***

Walker (1997) provided a useful general model of a research process for basic and applied research in the field of construction. The specific methodology of this research study undertaken in Hong Kong follows the concept of Walker (1997)'s model, which is based on an extensive literature review, in-depth face-to-face interview and an empirical questionnaire survey. The general model is perceived to be applicable and useful to this study in identifying and analysing the critical success factors for target cost contracts in construction. The research tools were applied in collecting appropriate and sufficient information and data of projects using GMP/TCC based contracts in Hong Kong. The scope of the study was restricted to those construction projects which were completed recently under the GMP/TCC approach in Hong Kong. Contacts were made with the key participants of the target projects for data collection.

### ***Survey questionnaire***

The research study started with an extensive review of relevant contemporary materials from textbooks, journal articles, conference papers, research reports, dissertation reports, professional journals, seminar notes and internet information to capture background knowledge about GMP/TCC concepts and applications. The objective of the literature review was to develop an overall research framework for the research study and to prepare an appropriate template for the questionnaire survey. All of the reported factors for GMP/TCC

success were considered to develop a list of items for empirical testing. The identified success factors were scrutinised and verified through a series of face-to-face interviews with a number of selected industrial practitioners possessing eminent experience in GMP/TCC, including senior management representatives and site management staff of client, consultant and main contractor organisations in Hong Kong (Chan *et al.*, 2007a). In all, ten individuals at the managerial level were interviewed between January and April of 2006 (Table 1). The interviews were found useful in acquiring a deep understanding of GMP/TCC practices in Hong Kong, as well as in facilitating the development and refinement of the empirical research questionnaire. The draft of the empirical survey questionnaire was also reviewed by the interviewees during interviews. Since no adverse comments were received from them, the draft questionnaire was taken as the final empirical questionnaire for investigation. A total of ten critical success factors for GMP/TCC (Table 2) primarily sought from the contemporary literature and previous face-to-face interviews constitute the basis of the empirical survey questionnaire.

**Table 1.** Details of 10 interviewees participating in 7 interview meetings for GMP/TCC procurement strategy in Hong Kong

ID	Sector	Type of Stakeholder	Position of Interviewee	Type of Organisation
1	Private	Client 1	Executive Director (Projects and Quantity Surveying)	Leading private property developer
2	Private	Client 1	Head of Quantity Surveying	Leading private property developer
3	Private	Consultant 1	Director	Quantity surveying consultant firm
4	Private	Client 2	Project Manager	Leading private property developer
5	Private	Client 3	Project Manager	Leading private property developer
6	Private	Contractor 1	Head of Planning and Pre-construction Engineering	Major construction company
7	Private	Contractor 1	Construction Manager (Estimating and Subletting)	Major construction company
8	Quasi-government	Client 4	Contracts Administration Manager – Operations	Quasi-government railway service provider
9	Quasi-government	Client 5	Chief Executive Officer	Subsidiary of a quasi-government railway service provider
10	Public	Client 6	Senior Architect	Public sector housing developer

Notes: (1) Interviewees with ID (1-3) joined together for the same interview meeting on 8 February 2006 and Interviewees with ID (6-7) on 24 January 2006.  
 (2) Names of the interviewees are not shown for the sake of privacy.

**Table 2.** Ten critical success factors for GMP/TCC identified from literature and face-to-face interviews

---

1. Standard form of contract for GMP/TCC projects.
  2. Well-defined scope of work in client's project brief.
  3. Familiarity with and experience of GMP/TCC methodology amongst client, consultants, main contractor and subcontractors.
  4. A right selection of project team.
  5. Reasonable share of cost saving and fair risk allocation.
  6. Partnering spirit from all contracting parties.
  7. Early involvement of the contractor in design development.
  8. Establishment of adjudication committee and meeting.
  9. Proactive main contractor throughout the GMP/TCC process.
  10. Open-book accounting regime as provided by the main contractor in support of his tender pricing.
- 

An industry-wide empirical questionnaire survey was launched between May and June of 2007 in Hong Kong to solicit the perceptions of different key project stakeholders towards the critical success factors of adopting the GMP/TCC approach. Respondents were requested to rate each of the identified success factors according to a five-point Likert scale delineating different levels of agreement (1 = strongly disagree; 3 = neutral and 5 = strongly agree) with reference to a particular GMP/TCC project they had been involved in. Respondents were also invited to suggest and rate any other unmentioned success factors based on their personal discretion and actual experience but no new factors were received from them.

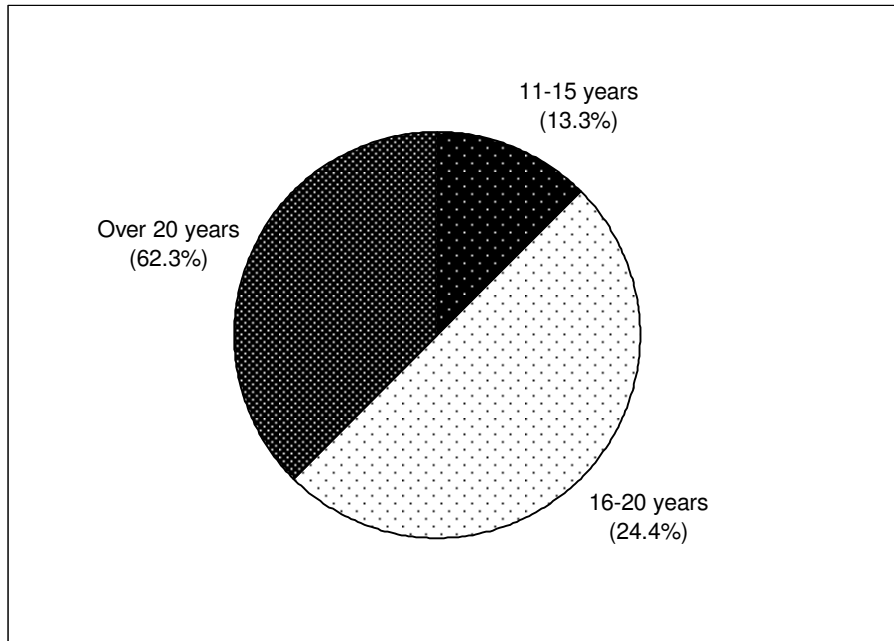
Local industrial practitioners who have derived extensive hands-on experience with GMP/TCC in Hong Kong were the target respondents of the questionnaire survey. In this research, data were gleaned through direct distribution of empty questionnaire from the senior staff of corresponding client organisations to the representatives of project consultants, main contractors and subcontractors, together with the full support of the Association for Project Management, Hong Kong Branch (APM-HK) and the Construction Industry Institute, Hong Kong (CII-HK). A total of 139 self-administered empty survey forms were dispatched to individual industrial practitioners by means of postal mail and electronic mail. Follow-up telephone calls and electronic communications were made where possible to elicit more detailed responses and/or provide further clarifications for any ambiguous items on the survey form.

Finally, a total of 41 valid completed survey questionnaires were received, producing 21.5% of the response rate. Given that GMP/TCC is a relatively new contractual arrangement being adopted in Hong Kong, this level of response was perceived as acceptable and sufficient for further statistical analysis. Table 3 gives the breakdown of the 41 returned questionnaires obtained from different key industry stakeholders: client organisations (15 respondents), consultant firms comprising various disciplines of architectural, engineering and quantity surveying (12 respondents) and main contractors (14 respondents). Thus, it is believed that each of the three groups was adequately represented in the survey.

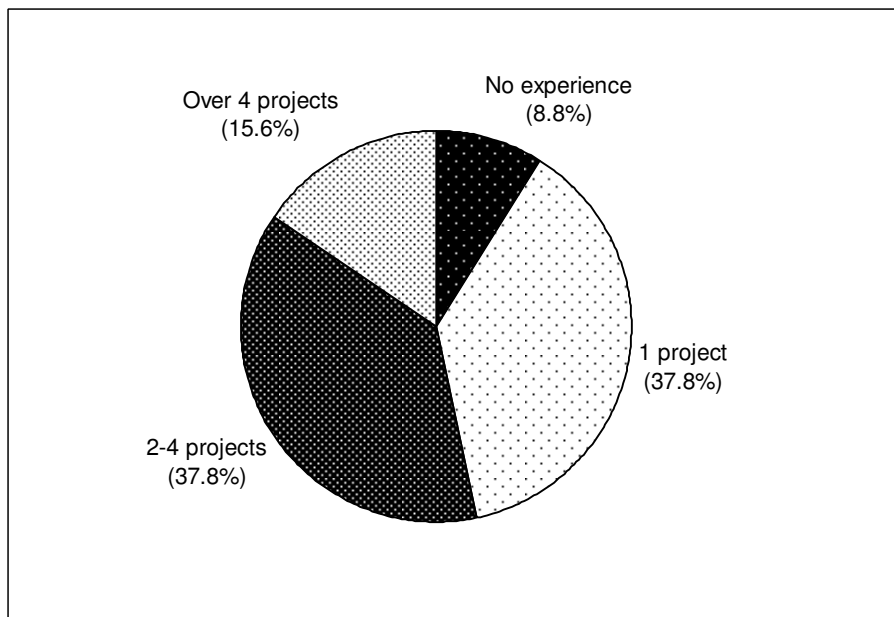
**Table 3.** Organisation type of the survey respondents (N = 41)

<b>Type of organisation</b>	<b>Frequency</b>	<b>Percentage</b>
Client organisation	15	36.6%
Consultant firm (architectural, engineering and quantity surveying)	12	29.3%
Main contractor	14	34.1%
Total	41	100%

Most of the survey respondents held a senior position in their organisations with abundant experience in the construction sector. All of the respondents have already acquired over 10 years of working experience in the construction industry with over 62% of them having more than 20 years (Figure 3). Regarding the direct experience with GMP/TCC projects, over 90% of the respondents possessed direct hands-on experience in one or more GMP/TCC projects (Figure 4). Hence, all of the respondents were well-experienced professionals in the construction practice who should be able to provide reliable information and genuine opinions to the research.



**Figure 3.** Length of working experience of the survey respondents in construction (N = 41)



**Figure 4.** Hands-on experience of the survey respondents in participating GMP/TCC projects (N = 41)

### Methods of data analysis

#### *Mean score ranking technique*

Quantitative data gleaned from the questionnaire survey were analysed by applying non-parametric statistical techniques. Descriptive statistics and mean score (Chan *et al.*, 2003) were generated to evaluate the relative importance of the critical success factors for GMP/TCC using the Statistical Package for Social Sciences (SPSS). Respondents were further divided into three different categories of survey groups based on their roles involved in a project (i.e. whether client group, contractor group or consultant group) with a view to conducting more meaningful cross-comparisons on the success factors for GMP/TCC under investigation. The five-point Likert scale mentioned above was applied to determine the mean score for each success factor, which was then used to give their relative rankings in descending order of importance. These rankings made it possible to cross-compare the relative importance of the success factors across different groups of respondents.

#### ***Cronbach's alpha reliability test***

The Cronbach's alpha reliability (the scale of coefficient) measures were used to verify the internal consistency amongst the responses under the adopted Likert scale of measurement regarding the success factors for GMP/TCC (Sanotos, 1999; Norusis, 2002). The Cronbach's alpha coefficients range from 0 to 1 in value and may be used to describe the reliability of factors extracted from dichotomous and/or multi-point formatted questionnaires or scales (Sanotos, 1999). If the items making up the score are all identical and perfectly correlated, then  $\alpha = 1$ . If the items are all independent, then  $\alpha = 0$ . Thus, the higher the score, the more reliable the generated scale will be. Yip and Poon (2009) recommended acceptable alpha values of at least 0.5 for general attitude or perception assessment similar to this study. The Cronbach's alpha tests were employed to test the reliability of the scales of the success factors for implementing the GMP/TCC practices in the questionnaire survey.

#### ***Kendall's concordance test***

The Kendall's coefficient of concordance ( $W$ ) was applied to measure the agreement of different respondents on their rankings of success factors based on mean values within a particular survey group (Siegel and Castellan, 1988). This statistical analysis aims to ascertain whether the respondents within an individual group respond in a consistent manner or not. Values of  $W$  can range from 0 to 1, with 0 indicating perfect disagreement and 1



giving perfect agreement (Daniel, 1978). If the Kendall's coefficient of concordance ( $W$ ) is statistically significant at a pre-defined significance level of say 5% (0.05), then a reasonable degree of consensus amongst the respondents within the group on the rankings of the success factors is indicated. In other words, a high or significant value of  $W$  reflects that different parties are essentially applying the same standard in ranking the success factors.

According to Siegel and Castellan (1988),  $W$  is only suitable when the number of attributes is less than or equal to 7. If the number of attributes is greater than 7, chi-square is used as a near approximation instead. If the actual calculated chi-square value equals or exceeds the critical value derived from the table for a certain level of significance and a particular value of degrees of freedom, then the null hypothesis that the respondents' sets of rankings are unrelated (independent) to each other within a survey group can be rejected.

### ***Spearman's rank correlation test***

The level of agreement between any two survey groups on their rankings of the success factors for GMP/TCC scheme was measured by the Spearman's rank correlation coefficient ( $r_s$ ). The coefficient ( $r_s$ ) ranges between  $-1$  and  $+1$ . A value of  $+1$  indicates a perfect positive linear correlation whereas negative values indicate negative linear correlation meaning that low ranking on one is associated with high ranking on the other. If the correlation is close to 0, then it implies that no linear relationship is present between the two groups on the variable (Albright *et al.*, 2006). If  $r_s$  was statistically significant at a pre-determined significance level of say 5% (0.05) (i.e. the actual calculated p-value  $<$  the allowable value of 0.05), then the null hypothesis that no significant correlation between the two groups on the rankings can be rejected. Therefore, there is adequate evidence to conclude that there is no significant disagreement between the two groups on the ranking exercise.

### ***One-way ANOVA test***

One-way analysis of variance (ANOVA) test for multiple samples were also carried out to detect any differences between the respondent groups on the mean values of their responses for a specific success factor for GMP/TCC. If the test result was significant at the 0.05 level, then the null hypothesis that no significant differences in the mean values between the respondent groups can be rejected. Thus, there is sufficient evidence to conclude that there

are significant differences in the mean values between the respondent groups (Norusis, 2002).

### **Presentation and analysis of survey findings**

The analysis results derived from the empirical questionnaire survey were cross-referenced to the reported literature and to complement each other for validation wherever appropriate.

#### ***Overall ranking of the success factors for GMP/TCC***

The Cronbach's alpha coefficient for the ten rated identified success factors for GMP/TCC is 0.681 ( $F$  statistics = 11.360,  $p$  = 0.000) implying that the scale used for measuring these parameters is reliable at the 5% significance level. Table 4 compares the mean scores and standard deviations of those critical success factors of applying the GMP/TCC approach as perceived by the survey respondents. Both Item 5 'Reasonable share of cost saving and fair risk allocation' (Mean = 4.54; SD = 0.552) and Item 6 'Partnering spirit from all contracting parties' (Mean = 4.54; SD = 0.596) were equally discerned as the two most critical success factors for GMP/TCC projects.

The GMP/TCC provision would involve the contractor in increased financial risk as the excess costs over the target cost due to uncertainties during the design development will be solely borne by him (Stukhart, 1984). Hence, Sadler (2004) highlighted that construction projects procured by target cost contracting rely heavily on fairness and mutual trust. With the feature of unclear scope of work at tender stage under the GMP/TCC methodology, Mills and Harris (1995) found that setting reasonable target cost and share of cost saving/loss between client and contractor are essential to the operation of GMP/TCC scheme. Sadler (2004) recommended that clients should evaluate the combination of fee and share not only to allocate the risks on a fair basis, but also to ensure that the incentive is of sufficient impetus to motivate the contractor. Perry and Barnes (2000) put forth a strong case for avoiding setting the contractor's share at less than 50%. Tang and Lam (2003) suggested various percentages of shares between client and contractor depending on the extent of cost saving achieved for GMP construction projects in Hong Kong as indicated in Table 5.

On the other hand, a clear and fair allocation of risks between client and contractor is vital to the success of a GMP/TCC project as well (Mills and Harris, 1995). The onerous or

inequitable risk apportionment can be conducive to intractable disputes and costly claims. Thus, clients should allow an allowance for design development and risks clearly and rationally within the tender (Sadler, 2004). Fan and Greenwood (2004) advocated that contractors should be well prepared to recognise the risks they have taken on board, beware of undescribed work during the process of ‘design development’, and ensure that their subcontractors’ bids reasonably reflect the risks that they will be shouldering. Decisions should also be made about the nature of contracting process, the employer’s requirements and what is actually encompassed within the scope of work in order to make a realistic assessment of the bid price (Lewis, 1999).

**Table 4.** Critical success factors for GMP/TCC projects in Hong Kong (all respondents)

<b>Critical success factors for GMP/TCC</b>	<b>N</b>	<b>Mean</b>	<b>Standard deviation (SD)</b>
1. Standard form of contract for GMP/TCC projects.	39	3.44	1.071
2. Well-defined scope of work in client’s project brief.	41	4.39	0.771
3. Familiarity with and experience of GMP/TCC methodology amongst client, consultants, main contractor and subcontractors.	41	4.17	0.667
4. A right selection of project team.	41	4.46	0.745
5. Reasonable share of cost saving and fair risk allocation.	41	4.54	0.552
6. Partnering spirit from all contracting parties.	41	4.54	0.596
7. Early involvement of the contractor in design development.	40	4.30	0.648
8. Establishment of adjudication committee and meeting.	41	3.83	0.803
9. Proactive main contractor throughout the GMP/TCC process.	41	4.37	0.662
10. Open-book accounting regime as provided by the main contractor in support of his tender pricing.	40	4.05	0.783

*Note: Items were rated on a 5-point Likert scale with 1= strongly disagree; 3 = neutral and 5 = strongly agree.*

**Table 5.** Shared saving percentage apportionment for GMP construction projects in Hong Kong [Adapted from Tang and Lam (2003)]

<b>Scenario</b>	<b>Client's share</b>	<b>Contractor's share</b>
Final out-turn cost > Final GMP	0%	100%
Final out-turn cost ≤ Final GMP		
(a) Saving < 5%	67%	33%
(b) Saving = 5%-10%	50%	50%
(c) Saving > 10%	33%	67%

The survey results are consistent with the proposition made by Tay *et al.* (2000) that partnering spirit or close working relationship amongst all contracting parties is one of the most essential factors to drive the success of a target cost project. Previous interviewed industrial practitioners also held a consistent perception that partnering spirit should be developed hand-in-hand with GMP/TCC to make the project a success (Chan *et al.*, 2007a). Partnering can greatly expedite communication flows, enhance mutual trust, help resolve disputes and improve working relationship amongst project team members (Chan *et al.*, 2004). Openness of information exchange increases confidence and should lead to active collaboration through the closer alignment of motivation. This partnership philosophy and open-minded attitude towards other parties' opinions become particularly indispensable for GMP/TCC contracts because unclear scope of work is often involved at the initial stage of a project and at the same time the project team may not be familiar with the procurement methodology.

In order to cultivate partnering spirit within the project team, the transparency of the project accounting and an appropriate arrangement of adjudication process are very crucial. The contractor's tender pricing should be open for scrutiny by the client and his team of consultants with proper auditing system. The National Economic Development Office (1982) also emphasised that the adoption of 'open-book accounting' can achieve better accountability and decent working relationship. Furthermore, the adjudication process is imperative to ensure that any disputes can be promptly resolved at site level and maintain the harmonious working relationship by an independent party. One of the previous interviewees further suggested that the adjudication procedures should be adequately followed to minimise the potential for disputes (Chan *et al.*, 2007a). The Adjudication Committee therefore plays an important role in avoiding intractable disputes but its success would be highly dependent

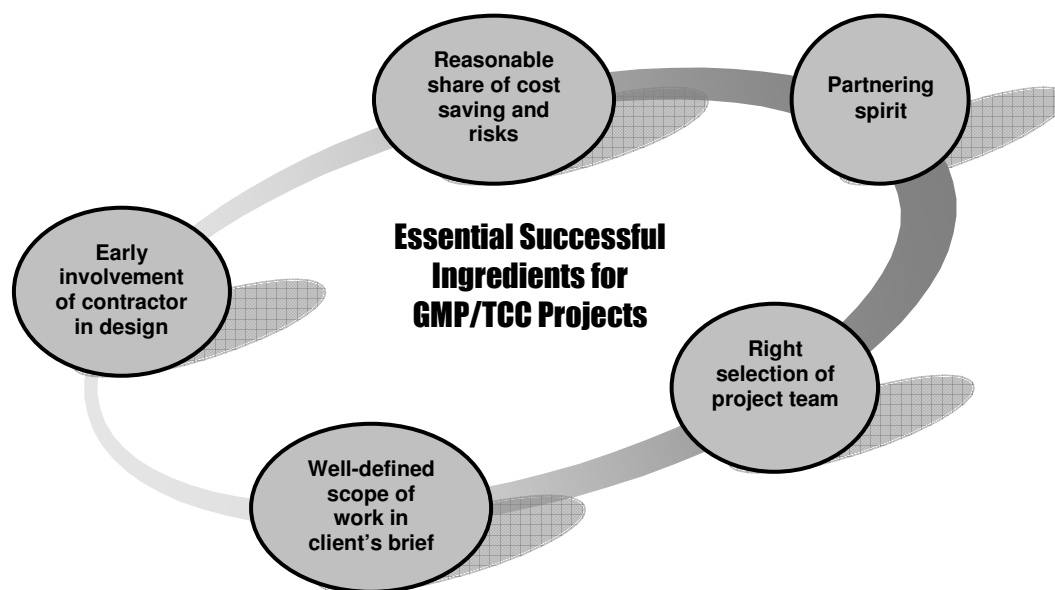
on mutual trust and partnering commitment between the client's team and contractor's team (Sadler, 2004).

In addition, Item 4 'A right selection of project team' (Mean = 4.46; SD = 0.745) and Item 9 'Proactive main contractor throughout the GMP/TCC process' (Mean = 4.37; SD = 0.662) were also highly rated as another two significant determinants of GMP/TCC success. Gander and Hemsley (1997) supported the recruitment of an experienced project team is crucial to the success of a GMP/TCC project, as inexperienced or claim-conscious GMP/TCC contractors may generate a lack of clarity regarding their roles and responsibilities. Hence, the success of GMP/TCC depends largely on contractor's initiative and expertise to propose alternatives for best value products, mutual trust, as well as the receptiveness and competence of both the project team and the contractor for innovation (Gander and Hemsley, 1997). Selecting the right partners with requisite commitment and competence on mutual trust, effective communication and productive conflict resolution is therefore an essential ingredient for underpinning the success of the GMP/TCC approach (Chan *et al.*, 2002).

It is also worth noting that Item 2 'Well-defined scope of work in client's project brief' (Mean = 4.39; SD = 0.771) and Item 7 'Early involvement of the contractor in design development' (Mean = 4.30; SD = 0.648) are favourably scored to be success factors for GMP/TCC projects. The uncertain scope of work during the design development has been proved as the major inherent shortcoming of the GMP/TCC scheme. As disputes often arise between the client and the contractor over whether client's changes are design development or scope change, the scope of contractor's work has to be clearly defined under the client's project brief (Tang, 2005). With design development being a continuously evolving process in GMP/TCC contracts, interpretation of changes whether they arise out of design development or they are classified as GMP/TCC variations could lead to potential disputes if not readily resolved (Gander and Hemsley, 1997). Thus, it is important to define the scope of work as detailed and accurate as possible at the initial stage of a GMP/TCC project and to keep scope changes or necessary variations to a minimum.

On the other hand, Sadler (2004) opined that tapping in the expertise of the contractor during the early design stage is beneficial to target cost-type contracts. If a proactive contractor is involved more at the pre-construction stage, advanced works and programme planning particularly in materials procurement and the buildability of project design will be

remarkably enhanced. Their early participation and influences on the design development process, construction methods and materials selection are vital to GMP/TCC success in terms of time, cost and quality (Hong Kong Housing Authority, 2006). This early involvement allows both client and contractor to determine the appropriate ownership of risks and encourages reaching an equitable allocation of risks associated with a GMP/TCC project (Sadler, 2004). Opinions sought from those industrial practitioners based on the questionnaire survey related to those key factors driving the success of GMP/TCC projects are summarised in Figure 5.



**Figure 5.** Significant factors contributing to GMP/TCC success

#### *Agreement of respondents within each survey group*

The critical success factors for GMP/TCC were also assessed from different perspectives of the client group, contractor group and consultant group. As all of the key active players in adopting GMP/TCC had been included in the questionnaire survey, it was considered that the opinions and findings could substantially represent the GMP/TCC project pool in Hong Kong over the past decade of 1998-2007. Although the number of respondents drawn from each of the three respondent groups was relatively small, the research findings were still considered valid and representative given the scarce number of construction projects procured with the GMP/TCC approach in Hong Kong (about 20 as cited by Chan *et al.*, 2007b).

The rankings derived from each of the respondent groups were transformed into a matrix as the imported data for the calculations of the Kendall's coefficients of concordance ( $W$ ) as shown in Table 6. The Kendall's coefficient of concordance ( $W$ ) for the rankings of success factors was 0.232, 0.276, 0.350 and 0.195 for 'all respondent group', 'client group', 'contractor group' and 'consultant group' respectively. The computed  $W$ 's were all significant with  $p = 0.05$ .

As the number of attributes considered were above seven, as mentioned previously the chi-square value would be referred to rather than the  $W$  value. According to the degree of freedom ( $10 - 1 = 9$ ) and the allowable level of significance [5% as adopted by Chan *et al.*, (2003)], the critical value of chi-square from table was found to be 16.92. For all of the four groups ('all respondent group', 'client group', 'contractor group' and 'consultant group'), the actual computed chi-square values (85.61, 37.26, 44.10 and 21.06 respectively) were all above the critical value of chi-square of 16.92. This result indicates the null hypothesis that 'There is no significant agreement amongst different respondents on the rankings within a particular group' has to be rejected. Therefore, there is sufficient evidence to conclude that there is significant degree of agreement amongst the respondents within each group on the rankings of the success factors for GMP/TCC.

#### ***Agreement of respondents between survey groups***

Since the internal consistency of the rankings within all respondent group and within each of the three respondent groups was now established, the next stage of analysis was to test whether there is any similar substantial agreement on the rankings amongst the respondents across the three various groups. Table 7 provides the test results of Spearman's rank correlation coefficients ( $r_s$ ) and the corresponding significance levels. The null hypotheses that no significant correlation between clients-contractors, clients-consultants and contractors-consultants on the rankings of GMP/TCC success factors can be rejected. Hence, there is adequate evidence to conclude that there is no significant disagreement between any two groups in terms of the ranking exercise. This reflects the apparent unanimous consensus on the perceptions of the success factors for GMP/TCC amongst the three respondent groups. For example, there was considerable agreement across all of the three parties that Item 5 'Reasonable share of cost saving and fair risk allocation' (ranked as either 1st or 2nd), and Item 6 'Partnering spirit from all contracting parties' (ranked as either 2nd or 3rd), which are

the two most significant determinants of success for GMP/TCC projects. The results are in line with the findings reported by Tang and Lam (2003) and Tay *et al.* (2000). The same observations were detected as well for Items 3, 8 and 1.

**Table 6.** Ranking and Kendall's coefficient of concordance for the critical success factors for GMP/TCC

ID	Critical success factors for GMP/TCC	All respondent group		Client group		Contractor group		Consultant group	
		Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
5	Reasonable share of cost saving and fair risk allocation.	4.59	1	4.54	2	4.77	1	4.45	1
6	Partnering spirit from all contracting parties.	4.51	2	4.54	2	4.62	3	4.36	3
4	A right selection of project team.	4.46	3	4.46	4	4.46	5	4.45	1
2	Well-defined scope of work in client's project brief.	4.43	4	4.23	6	4.77	1	4.27	4
9	Proactive main contractor throughout the GMP/TCC process.	4.41	5	4.62	1	4.31	6	4.27	4
7	Early involvement of the contractor in design development.	4.35	6	4.38	5	4.62	3	4.00	8
3	Familiarity with and experience of GMP/TCC methodology amongst client, consultants, main contractor and subcontractors.	4.16	7	4.08	7	4.31	6	4.09	7
10	Open-book accounting regime as provided by the main contractor in support of his tender pricing.	4.08	8	3.92	8	4.15	8	4.18	6
8	Establishment of adjudication committee and meeting.	3.78	9	3.54	9	3.92	9	3.91	9
1	Standard form of contract for GMP/TCC projects.	3.41	10	3.23	10	3.62	9	3.36	10
Number (n)		41		15		14		12	
Kendall's coefficient of concordance (W)		0.232		0.276		0.350		0.195	
Actual calculated chi-square value		85.61		37.26		44.10		21.06	
Critical value of chi-square from table		16.92		16.92		16.92		16.92	
Degree of freedom (df)		9		9		9		9	
Asymptotic level of significance		0.000		0.000		0.000		0.023	
H <sub>0</sub> = Respondents' sets of rankings are unrelated (independent) to each other within each group									
Reject H <sub>0</sub> if the actual chi-square value is larger than the critical value of chi-square from table									



**Table 7.** Spearman’s rank correlation test between groups of survey respondents on the critical success factors for GMP/TCC

Comparison of rankings between groups of survey respondents	$r_s$	Significance level	Conclusion
Client ranking vs Contractor ranking	0.652	0.014	Reject $H_0$ at 5% significance level
Client ranking vs Consultant ranking	0.786	0.007	Reject $H_0$ at 5% significance level
Contractor ranking vs Consultant ranking	0.668	0.028	Reject $H_0$ at 5% significance level

$H_0$  = No significant correlation on the rankings between two groups

$H_a$  = Significant correlation on the rankings between two groups

Reject  $H_0$  if the actual significance level (p-value) is less than the allowable value of 5%

For specific determinants of success for GMP/TCC, it was interesting to realise from the one-way ANOVA test for multiple samples that there are significant differences amongst the three groups of respondents concerning their perceptions on Item 7 ‘Early involvement of the contractor in design development’ (sig. = 0.022). Independent 2-sample t-test further reflected that the contractor group rated significantly higher (Mean = 4.62; Rank = 3) on this factor than the consultant group (Mean = 4.00; Rank = 8) conducive to a noticeable difference with a significance level of 0.007 as sought by Chan *et al.* (2007b). This indicates that the consultants agree less on early participation of the contractor in project design to be an essential contributor to GMP/TCC success whereas the contractors concur more on their integration of expertise and innovative ideas into both design and construction for enhancing the buildability of project (Masterman, 2002; Hong Kong Housing Authority, 2006). These conspicuous differing perceptions may be attributed to the fact that under the traditional industry practice, the design work would be entirely undertaken by an independent team of design consultants due to their inherent expertise and professional training rather than the contractor himself except for design-and-build form of procurement. It seems that this arrangement under GMP/TCC contracts would diminish the role and importance of the design consultant team and thus the consultant group rated this factor comparatively lower than the contractor group.

## Conclusions

The construction industry is characterised by fragmentation and traditional adversarial working relationship. The traditional form of design-bid-build procurement approach used within the Hong Kong construction industry was perceived as being poorly suited to the open

and transparent working relationship. The acknowledgement of the important role of motivation and its influence on project success has thereby led to the increased use of incentive schemes, which has been globally recommended as an effective procurement means of realising high-risk construction projects and improving confrontational working culture (Wong, 2006). GMP/TCC aims to develop a co-operative teamwork spirit based on a decent partnering working relationship.

This research study, through an extensive review of contemporary literature and an industry-wide empirical questionnaire survey, has accomplished a comprehensive analysis of the significant successful ingredients for administering GMP/TCC contracts based on previous GMP/TCC construction projects in Hong Kong. Five essential successful ingredients for implementing GMP/TCC scheme identified from this study include: (1) reasonable share of cost saving with fair allocation of risks; (2) cultivation of partnering spirit; (3) right selection of project team; (4) well-defined scope of work in client's project brief; and (5) early involvement of contractor in design development. A set of corresponding effective practical strategies for the successful implementation of GMP/TCC contracts based on these critical success factors sought may be generated to alleviate the root causes of adverse project performance and ineffective communication, as well as to mitigate construction conflicts and disputes.

Hence, a series of in-depth case studies of various GMP/TCC projects should be launched in future to verify the applicability and reliability of those critical success factors identified and to substantiate the conclusions derived from this preliminary study based on the limited samples. The research findings are also particularly useful in providing sufficient groundwork for client bodies and contracting organisations to develop a set of best practice guidelines for launching GMP/TCC scheme for future target cost-based construction projects, both locally and overseas. Even though the critical success factors for procuring GMP/TCC contracts are identified based in Hong Kong, the same research methodology may be applied in other parts of the world such as the United States, United Kingdom and Australia to glean opinions of relevant key project stakeholders for international comparisons with respect to their similarities and differences.

Limitations of the research study include the conclusions drawn are indicative rather than conclusive, as merely 41 completed survey questionnaires were received and analysed owing

to a limited number of GMP/TCC construction projects in Hong Kong. The number of case studies is also limited but the survey findings would be valuable as a pilot study for future investigations in this area. Moreover, the research was confined to the GMP/TCC practices within the Hong Kong construction industry. Due to limited resources, the comparison of project performance between the local GMP/TCC projects with overseas projects and other procurement strategies other than traditional fixed-price contracts were excluded from this study.

The project delivery method of GMP/TCC is still at an infant stage of development in Hong Kong, and the pace of introducing their concepts and applications in construction is gaining drastic momentum. For those who succeed in committing to GMP/TCC philosophy, the rewards are significant and tangible. A wider adoption of the GMP/TCC arrangements should be recommended across a broad spectrum of the whole construction industry, in order to reap sustainable benefits for construction excellence. Another on-going research project focusing on determining, allocating and mitigating the key risk factors, together with assessing different risk sharing mechanisms for GMP/TCC projects is being launched in Hong Kong, and the major research outcomes will be disseminated via future publications (e.g. Chan *et al.*, 2010).

### **Acknowledgements**

The authors wish to extend their sincere thanks to all of those industrial practitioners who have kindly responded and contributed their valuable opinions and necessary project information in completing the empirical survey questionnaires adopted in this research study. The authors would also like to acknowledge with gratitude the financial support from The Hong Kong Polytechnic University to this research endeavour (HK PolyU Faculty Internal Competitive Research Grants Allocation 2004/05 with Project Account Code: BRE-A-PG36). The work described in this paper was further supported by a grant from the Research Grants Council (RGC) of the Hong Kong Special Administrative Region, China (RGC Project No. PolyU 5107/07E).

This paper forms part of a RGC funded research project entitled “Evaluating the Key Risk Factors and Risk Sharing Mechanisms for Target Cost Contracting (TCC) Schemes in Construction” with several objectives sharing common background of study and research

methodology. Moreover, the constructive comments and valuable suggestions from both the editor and the anonymous reviewers have improved the overall quality of this paper suitable for publication.

## References

- Albright, S.C., Winston, W.L. and Zappe, C. (2006), *Data Analysis and Decision Making with Microsoft® Excel*, 3rd Edition, Pacific Grove, California: Thomson/South-Western.
- Avery, D. (2006), "How collaborative commercial strategies give certainty to the delivery of major railway infrastructure projects", *Proceedings of the PMICOS 2006 Annual Conference*, 23-26 April 2006, Orlando, Florida, USA.
- Blumkin, M. and Schwartz A. (2003), "To GMP or not to GMP? That is the question facing many project owners", *The Real Estate Finance Journal*, Summer 2003.
- Boukendour, S. and Bah, R. (2001), "The guaranteed maximum price contract as call option", *Construction Management and Economics*, Vol. 19 No. 6, pp. 563-567.
- Broome, J.C. and Perry, J.G. (1995), "Experiences of the use of the New Engineering Contract", *Engineering, Construction and Architectural Management*, Vol. 2 No. 4, pp. 271-285.
- Cantirino, J. and Fodor, S. (2003), "Construction delivery systems in the United States", *Journal of Corporate Real Estate*, Vol. 5 No. 2, pp. 169-177.
- Chan, A.P.C. (1998), "Perception on variations – a tale of three cities", *The Australian Institute of Quantity Surveyors Refereed Journal*, Vol. 2 No. 1, pp. 42-54.
- Chan, A.P.C., Chan, D.W.M. and Ho, K.S.K. (2002), *An Analysis of Project Partnering in Hong Kong*, Research Monograph, Department of Building and Real Estate, The Hong Kong Polytechnic University, 96 pages, ISBN 962-367-363-9, October 2002.
- Chan, A.P.C., Chan, D.W.M. and Ho, K.S.K. (2003), "Partnering in construction: critical study of problems for implementation", *Journal of Management in Engineering*, ASCE, Vol. 19 No. 3, pp. 126-135.
- 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.

- Chan, D.W.M., Chan, A.P.C., Lam, P.T.I., Lam, E.W.M. and Wong, J.M.W. (2007a), "Evaluating guaranteed maximum price and target cost contracting strategies in Hong Kong construction industry", *Journal of Financial Management of Property and Construction*, Vol. 12 No. 3, pp. 139-149.
- Chan, D.W.M., Chan, A.P.C., Lam, P.T.I., Lam, E.W.M. and Wong, J.M.W. (2007b), *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.
- Chan, D.W.M., Chan, A.P.C., Lam, P.T.I. and Chan, J.H.L. (2010), "Exploring the key risks and risk mitigation measures for guaranteed maximum price and target cost contracts in construction", *Construction Law Journal*, Vol. 26 No. 5, pp. 364-378.
- Construction Industry Review Committee (2001), *Construct for Excellence*, Report of the Construction Industry Review Committee, Hong Kong Special Administrative Region, 207 pages.
- Clough, R.H. and Sears, G.A. (1994), *Construction Contracting*, 6th Edition, New York, Wiley-Interscience Publication.
- Daniel, W.W. (1978), *Applied Nonparametric Statistics*, Houghton Mifflin, Boston.
- Fan, A.C.W. and Greenwood, D. (2004), "Guaranteed maximum price for the project?", *Surveyors Times*, The Hong Kong Institute of Surveyors, March, pp. 20-21.
- Ferreira, R.M.L. and Rogerson, J.H. (1999), "The quality management role of the owner in different types of construction contract for process plant", *Total Quality Management*, Vol. 10 No. 3, pp. 401-411.
- Gander, A. and Hemsley, A. (1997), "Guaranteed maximum price contracts", *CSM*, January, pp. 38-39.
- Gilbreath, G.R. (1992), *Managing Construction Contracts – Operational Controls for Commercial Risk*, 2nd Edition, John Wiley & Sons Inc.
- Harris, N. (2002), "The cost of Wembley has shot up by around £550 million. So who's netting the extra cash?", 26 September 2002, available at: <http://www.independent.co.uk/sport/general/the-cost-of-wembley-has-shot-up-by-acircpound550m-so-whos-netting-the-extra-cash-643745.html> (accessed on 18 October 2008).

- Hong Kong Housing Authority (2006), *Internal Guidelines for Guaranteed Maximum Price Contract Procurement Based on Private Sector Model*, The Hong Kong Housing Authority, Hong Kong SAR Government, 19 pages.
- Ho, T.O.S. (2000), "Enhancing construction technology through strategic partnering – a contractor's perspective", *Proceedings of Quality Housing Partnering Symposium 2000*, 19-20 October 2000, The Hong Kong Housing Authority, Hong Kong.
- Kerzner, H. (1995), *Project Management – A Systems Approach to Planning, Scheduling and Controlling*, 5th Edition, New York: Van Nostrand.
- Lewis, S. (1999), "GMP contracts: are they worth the risk?", *Construction Law*, Vol. 10 No. 3, pp. 25-27.
- Masterman, J.W.E. (2002), *Introduction to Building Procurement System*, 2nd Edition, London New York Spon Press.
- Mills, R.S. and Harris, E.C. (1995), "Guaranteed maximum price contracts", *Construction Law*, 573/95, pp. 28-31.
- Moore, C., Mosley, D. and Slagle, M. (1992), "Partnering guidelines for win-win project management", *Project Management Journal*, Vol. 22 No. 1, pp. 18-21.
- National Economic Development Office (1982), *Target Cost Contracts – A Worthwhile Alternative*, Civil Engineering Economic Development Committee, National Economic Development Office, UK: London.
- Nicolini, D, Tomkin, C., Holti, R., Oldman, A. and Smalley, M. (2000), "Can target costing and whole life costing be applied in the construction industry? Evidence from two case studies", *British Journal of Management*, Vol. 11, pp. 303-324.
- Nicolini, D, Holti, R. and Smalley, M. (2001), "Integrating project activities: the theory and practice of managing the supply chain through clusters", *Construction Management and Economics*, Vol. 19, pp. 37-47.
- Norusis, M.J. (2002), *SPSS 11.0 Guide to Data Analysis*, Upper Saddle River, New Jersey: Prentice-Hall.
- 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*, Vol. 7 No. 2, pp. 202-208.
- Perry, J.G. and Thompson P.A. (1982), *Target and Cost-reimbursable Construction Contracts*, CIRIA Report R85, London: CIRIA.
- 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.
- Sanotos, J.R.A. (1999), "Cronbach's alpha: a tool for assessing the reliability of scales", *Journal of Extension*, Vol. 37 No. 2, pp. 1-5.
- Siegel, S. and Castellan Jr, N.J. (1988), *Nonparametric Statistics for Behavioral Sciences*, 2nd Edition, McGraw-Hill, New York.
- Stuckhart, G. (1984), "Contractual incentives", *Journal of Construction Engineering and Management*, ASCE, Vol. 110 No. 1, pp. 34-42.
- 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, pp. 18-19.
- Tang, W.Y. (2005), *An Evaluation of the Success and Limitations 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, 41 pages.
- Trench, D. (1991), *On Target – A Design and Manage Target Cost Procurement System*, London Thomas Telford.
- Tay, P., McCauley, G. and Bell, B. (2000), "Meeting client's needs with GMP", *The Building Economist*, June, pp. 4-5.
- Walker, D.H.T. (1997), "Choosing an appropriate research methodology", *Construction Management and Economics*, Vol. 15 No. 2, pp. 149-159.
- Walker, D.H.T., Hampson, K.D. and Peters, R. (2000), *Relationship-based Procurement Strategies for the 21st Century*, AusInfo, Canberra, Australia, ISBN 064243079-9, 112 pages.
- 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*, Vol. 7 No. 2, pp. 83-91.
- Wong, A.K.D. (2006), "The application of a computerized financial control system for the decision support of target cost contracts", *Journal of Information Technology in Construction (ITcon)*, Vol. 11 (Special Issue on Decision Support Systems for Infrastructure Management), pp. 257-268.
- Yip, R.C.P. and Poon, C.S. (2009), "Cultural shift towards sustainability in the construction industry of Hong Kong", *Journal of Environmental Management*, ASCE, Vol. 90 No. 11, pp. 3616-3628.