Incentives in the Chinese Construction Industry

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Abstract: Incentives have been increasingly applied to align the objectives of participants in the delivery of construction projects. However, little research has been undertaken to systematically study the use of such incentives. This paper reports the findings of an empirical survey of the Chinese construction industry on: the need to apply incentives; frequency of the usage of incentives; how the incentive schemes are decided; and their effectiveness in application. The incentive schemes of the Three Gorges Project is also studied, from which an incentive matrix is presented that has measures tied not only to the final results but also extended to the whole construction process to facilitate providing early warnings, obtain continuous improvement, and ultimately achieve satisfactory project results for participants. It is recommended that future studies be encouraged to develop incentives according to project features such as project type, delivery system, project risk, and participants' needs and their experience, enabling incentives to be applied broadly by participants to improve the efficiency of project delivery.

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Research Background on Incentives

Many studies pointed out that it is necessary to adopt cooperative strategies to improve performance by reducing confrontation in the construction industry, among which partnering has been introduced to deliver projects effectively since the late 1980s (Kadefors 2004; Scott 2001; NAO 2001; Grajek et al. 2000; ACA 1999; Carr et al. 1999; Gransberg et al. 1999; Egan 1998; Pietroforte 1997; Pocock et al. 1997; Li and Green 1996; Crowley and Karim 1995; Hanly and Valence 1993; Weston and Gibson 1993; Cowan 1992; CII 1991; Contracts Working Party 1991). Recently, further advancements to partnering, termed alliancing, have also been successfully utilized in the construction industry. Such arrangements are underpinned by an incentive scheme, whereby the rewards of the contractor and, indeed, the owner are linked directly to actual performance during the execution phase of the project (Scott 2001). Alliancing links the ethos of partnering as a contractual requirement and uses clearly defined risk/reward allocation to manage the process, in which the cooperative philosophy is tied into the contract through using of incentives that provides a powerful motivation to achieve project goals (Tang et al. 2006; Walker and Hampson 2003; Gallagher 2002).

The main reason for introducing incentives to the partnering process is that project benefits should be equitably shared among participants. The lowest responsible, responsive bidder selection process places extreme pressure on the bidders to provide a marginally adequate bid to cover the work, which may result in a situation where contractors feel compelled to find profit in variations and claims (NAO 2001; Carr et al. 1999). This is consistent with the traditional risk management strategy adopted by clients—to transfer as much of the risk as possible to others (ACA 1999). The problems above originate from the structure of the traditional delivery systems, i.e., misalignment between the clients and the contractors and dealing with increased risk (Scott 2001; Car et al. 1999). Although the partnering processes can facilitate an environment of trust in which parties might recognize that they share a lot of objectives, the priorities of each party may still be different (Tang et al. 2006). If parties rely only on a partnering charter without using clear benchmarks with hard incentives to promote good performance, no amount of good intention is going to stop disputes as and when the project runs into trouble (Hosie 2001). Incentives afford contractors a genuine opportunity to work together with clients to achieve good results by giving contractors a direct financial stake in the efficient execution of a project (Scott 2001; Halman and Braks 1999), and may create a more proactive, cooperative relationship between the contracting parties (Bower et al. 2002; Bresnen and Marshall 2000). Incentives enable all parities to make a reasonable return and to bear appropriate risks (Tang et al. 2007, 2004b), and help to build a flexible system that apportions the risks depending on

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the circumstances of each party and their ability to bear that risk (Tenders and contracts for buildings 1999).

Commonly incentives involve a risk-reward or gain share/pain share formula which specifies the division of gains or losses that were based on an agreed target cost (Walker and Hampson 2003; Gallagher 2002; Olds 2002; Clegg 2001; Ross 2001; Scott 2001; Hoisie 2001; Voordijk 2000; Bresnen and Marshall 2000; Association of Consultant Architects 2000; Barlow 2000; ACA 1999; Bennett and Jayes 1998; Shwer 1997). In addition, incentives on quality, schedule, safety, early completion, value engineering, sharing added value, and combined multiple incentives are also common (Gangwar and Goodrum 2005; Walker and Hampson 2003; ECI 2003; Bubshait 2003; Bower et al. 2002; Association of Consultant Architects 2000; Arditi and Yasamis 1998; Warne 1994). Critical for project success is the use of incentives as a method for promoting a culture within which technical and process innovation can flourish (Barlow 2000). Financial gain or loss should be decided according to the achievement of the targets stated in the key performance indicators (Association of Consultant Architects 2000), and use of incentives should take into account the constraints and risks of a project as well as the strengths and weaknesses of the project participants (Broome and Perry 2002; Kemp and Stephen 1999; Al-Harbi 1998).

Despite the strategies addressed by the above studies, the treatment of risks within incentives and their interaction with the choice of share profiles needs to be further investigated (Broome and Perry 2002). The effectiveness of incentives does diminish with time, which must be continuously reinvented (Gangwar and Goodrum 2005). The unwanted effects from target cost incentive may include: difficulty in agreeing on the target, exaggeration of cost savings, understatement of cost over-runs, limited flexibility for change, conflict in the interpretation of functional requirement versus variations, losing motivation once the cost exceeds the target, and too complicated checking cost procedure (Bower et al. 2002; Tenders and Contracts 1999; ACA 1999; Kemp and Stephen 1999). Incentives also increase the total risk for contractors and may jeopardize their financial life (Kemp and Stephen 1999). Practitioners should know well how to deal with these issues when using incentives (Bubshait 2003). However, there has been very little discussion or systematic analysis of the motivational principles and assumptions underlying the use of incentives (Bresnen and Marshall 2000). The above studies on use of incentives were typically undertaken by way of case studies, most of which were reported based on the projects in the oil and gas industry (Scott 2001; Gallagher 2002), and studies should be done to enable other types of projects to obtain the benefits from incentives, which should be appropriately designed and introduced into these projects (Tang et al. 2006). Fisher and Green (2001), Li et al. (2002), and Lazar (1997) also claimed that the empirical evidence contained in previous studies is thin. Thus, there is a clear need to systematically investigate the application and effectiveness of using incentives, by which to explore incentive schemes that are appropriate to the construction industry for improving the efficiency of project delivery.

This paper reports the findings of an empirical study of the Chinese construction industry into the need to apply incentives, frequency of the usage of incentives, how the incentive schemes should decided, and their effectiveness in application. The Three Gorges Project, one of the largest projects in China, has been adopted as an example to further illustrate the key points from the survey due to incentives being applied extensively in the project.

Empirical Research Method

Selection of China as a Study Area

The practical limitation of resources has constrained the survey component of this study to the construction industry in China. Chen (1998) indicated that China has created the largest construction market in the world, which may provide adequate data for this study. In terms of contractual background, recent Chinese business practices seem to incorporate significant elements of neoclassical contracting in general, and the Chinese culture comprises certain core values such as trust and relationship that influence business operations, supporting the notion that risk is better undertaken if true rewards are seen to be rewarded, and incentives are seen to motivate participants to perform better (Jin and Ling 2005; Tang et al. 2004a; Chen and Partington 2003; Rahman and Kumaraswamy 2002). Hence, the Chinese construction industry is a suitable study area to conduct this empirical research on use of incentives.

Six areas (Hubei, Beijing, Shanghai, Jiangsu, Heilongjiang, and Guangxi) were carefully chosen for sources of data. The areas are scattered over the Central, North, East, Southeast, Northeast, and Southwest regions of China. In 2001, the overall construction production value of the six areas was United States $55 billion, accounting for 29.4% of the whole construction industry in China (National Statistical Bureau of China 2002). It was decided to use the principal stakeholders of the Chinese construction industry as respondents, including clients, contractors, designers, superintendents, and management organizations. Clients are also referred to as owners. Superintendents have dual roles: to act as the agent for the client in conveying the client's instructions to the contractor, and as a certifier for the purpose of issuing certificates and making decisions as to reasonable measures of value of work, quantities, or time. Management organizations are in charge of the management of projects in the name of government to ensure the projects are complied with regulations and public interest. The chosen respondents, who had experience in the delivery of significant projects, were drawn from the oil and gas, energy, transportation, industrial and commercial building, and public infrastructure industries. It was decided that all types of project delivery strategies could be included to reflect the overall picture of the industry as much as possible.

Questionnaire

A questionnaire was chosen as the principal survey method. Most questions were asked by using a five-point Likert scale, and other multichoice questions were applied, which permit different statistical techniques to be used to analyze the collected data. Postal surveys avoid the legwork problem, but another problem is to an obtain adequate level of response (Thomas 1996). Akintoye and Macleod (1997) argued that postal surveys can be biased if the return rate is lower than 30–40%. To avoid these limitations of a postal survey, the questionnaire survey was conducted through fieldwork, with the projects and respondents being chosen and contacted in advance. A questionnaire was completed face to face by each respondent. An interview with the respondent after the questionnaire was completed has also been done, which helps to test and interpret the results from the questionnaire survey.

Respondents to the questionnaire represent different roles in the construction industry, mainly including management organizations, clients, contractors, designers, and superintendents. The total number of respondents is 115, and the distribution of

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Table 1. Perceptions on Risk Allocation between Clients and Contractors

Question	Client	Contractor	Superintendent	Designer	Management organization	All
1. What do you think about the allocation of obligations/risks in the current delivery system?	3.26	2	2.68	2.95	3.13	2.66

samples is as follows: 18 (Hubei), 38 (Beijing), ten (Shanghai), 19 (Jiangsu), ten (Heilongjiang), and 20 (Guangxi). Ninety percent of the respondents held senior positions in their organizations, such as director, general manager, or project manager, and the others also had been involved in the industry for many years. The fieldwork approach used in this survey enabled all questionnaires sent to be collected after interviews were held with participants. Thus, in this case, the response rate reached 100%. The data of each questionnaire are carefully validated, and overall, 99 questionnaires were used to conduct quantitative analysis.

Data Collection on Use of Incentives in Three Gorges Project

Three weeks of fieldwork were conducted at the Three Gorges Project (TGP) construction site to learn the use of incentives in the project. In addition to the questionnaires and interviews, data were also collected through direct observation and a detailed review of the published project documents.

Data Analysis Techniques

The data collected from questionnaire were analyzed using the Statistical Package for Social Science (SPSS 1997). The selected techniques that are appropriate to this study include: estimation of the sample population mean, rank cases, one-way analysis of variance (ANOVA), Spearman rank correlation, and chi-square test. The data from the TGP were analyzed using the balanced scorecard technique.

Of these statistical techniques the ANOVA, Spearman rank correlation, and chi-square test were adopted for inferential analysis with the results being tested by their significant level. The hurdle of significance in this study follows the usual level for statistical significance of 0.05, with 0.01 level being highly significant.

Survey Results and Analysis

First, respondents were asked their perceptions of the contract and delivery system used in the industry. As contracts deal with risks and specifically allocate these to clients and contractors, respondents were asked their perceptions of the allocation of risks according to a scale of 1–5, where 1=contractors taking all risks; 2=contractors taking more risks; 3=contractors and clients taking even risks; 4=clients taking more risks; and 5=clients taking all risks. The results are shown in Table 1. (The values in the column marked "All" in this and later tables are weighted averages of all responses.)

One-way analysis of variance (ANOVA) was performed to test the perceptions of clients, contractors, superintendents, designers, and management organizations. The one-way ANOVA is used to test the hypothesis that several means are equal (SPSS 1997). The computed F ratio was 9.09 at the significance level of 0.000, suggesting that there is a significant difference on perceptions of risk allocation among the groups. Clients and management organizations tended to believe that clients take more risks, whereas contractors, superintendents, and designers perceived that contractors take more. Notably, the rating of contractors was as low as 2, suggesting that contractors strongly believed they bear much more risk than clients. The overall score is 2.66, which indicates that, according to the general perception of the respondents, contractors take 58% of project risks compared to 42% taken by clients, which is calculated as follows: $(2.66-1)/(5-1)*100\%=42\%$. [For example, if the rating is 3, which means contractors and clients taking even risks, the calculated result should be: $(3-1)/(5-1)*100\%=50\%$]. Nevertheless, clients are still subject to considerable risks.

To investigate the need of incentives, respondents were asked to give a response to the statement "the current contract has specified the risks and obligations of the parties, but lacks incentives to promote better performance" on a scale of 1–5, where 1=strongly disagree; and 5=strongly agree. The results are shown in Table 2.

The computed F ratio by using ANOVA was 1.06 at the significance level of 0.38 higher than 0.05, suggesting that there is a consensus regarding statement 2. The overall score for the statement is 3.67, indicating that most respondents believe there is a lack of incentives to promote better performance. It is recognized by all parties that contracts need to be complemented by incentives to create motivation for better performance.

To investigate the perceptions of applying incentives, respondents were asked to give a response to the statement "incentives make the project risk allocation fairer, because incentives can be seen as the sharing of rewards from good performance," ranging

Table 2. Perceptions on Contract and Delivery System

Statement	Client	Contractor	Superintendent	Designer	Management organization	All
2. The current contract has specified the risks and obligations of the parties, but lacks incentives to promote better performance	3.37	3.7	3.58	4.05	3.5	3.67

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Table 3. Perceptions on Use of Incentives

Statement	Client	Contractor	Superintendent	Designer	Management organization	All
3. Incentives make the project risk allocation fairer, because incentives can be seen as the sharing of rewards from good performance	3.79	3.96	4.11	4.1	3.71	3.98

from 1=strongly disagree to 5=strongly agree. The results are shown in Table 3.

The computed *F* ratio by using ANOVA was 0.50 at the significance level of 0.734 higher than 0.05, suggesting that there is a consensus on statement 3. The overall score for statement 3 is 3.98, and all groups believe that incentives make risk allocation fairer between parties.

As it is of great importance that incentives for all participants tie the performance to the project objectives (Bower et al. 2002), the significance of cost, quality, and schedule/time objectives was investigated. Respondents were asked to give a response to the question "what is the relevant significance of the objectives of cost, quality, and schedule/time of your project?" where 1=not important, and 5=most important. The results are shown in Table 4.

The quality objective was found to be the most important, ahead of the schedule/time objective and the cost objective. The low rating of the cost objective provides a solid base for parties to reach incentive agreements.

Clients ranked the quality objective the highest (score=4.47), followed by the schedule/time objective (score=4.11), and cost objective (score=3.58). This shows that what concerns clients most is the quality of the completed work. Whether a project can be completed in time is of second priority for them, with the cost objective only of third consideration. The views of superintendents and management organizations were similar to those of the clients.

Contractors also gave the quality objective first priority; however, their score for this objective (4.14) was the lowest among all the groups. There were disparities in the ranking of the cost and schedule/time objectives between the contractors and the above three groups. They ranked the cost objective second with a score of 3.86 and the schedule/time objective third with a score of 3.72. This indicates that contractors pay more attention to the balance of quality and cost than do clients. When clients and contractors are dealing with project objectives, these differences should be considered. Designers had the same priorities as the contractors on significance of project objectives, showing that designers consider that whether a project is cost effective is a more important issue than for clients, superintendents, and management organizations.

Respondents were also asked to identify the incentives actually being applied in their projects. They were required to respond on a scale ranging from 1 to 5, where 1=not applied, and 5=always applied. The results are shown in Table 5.

In this table the top entry in each cell is the average rating of a group, and the lower entry is the rank according to the rating. Since the quality objective is the most significant (see Table 4), it

Table 4. Significance of Cost, Quality, and Schedule Objectives

Objectives	Client	Contractor	Superintendent	Designer	Management organization	All	Rank
Quality	4.47	4.14	4.5	4.18	4.43	4.31	1
Schedule/time	4.11	3.72	3.85	3.47	4	3.78	2
Cost	3.58	3.86	3.55	3.53	3.57	3.66	3

Table 5. Application of Incentives

Incentive for items	Client (rank)	Contractor (rank)	Superinintendent (rank)	Designer (rank)	Management organization (rank)	All (rank)
Quality product and service	3.84 (3)	3.86 (1)	4.05 (2)	3.58 (1)	3.57 (2.5)	3.85 (1)
Schedule meets milestone	4.05 (1)	3.76 (2.5)	4.16 (1)	3.32 (2)	3.14 (6)	3.78 (2)
Earlier completion	3.89 (2)	3.62 (4)	4 (3)	3.21 (3)	3.29 (5)	3.63 (3)
Good safety record	3.58 (4)	3.76 (2.5)	3.68 (4)	2.79 (4)	3.57 (2.5)	3.5 (4)
Cost saving	3.53 (5)	3 (6)	3.37 (5)	2.74 (5)	3.43 (4)	3.2 (5)
Within an established budget	3.47 (6)	3.07 (5)	3.05 (6)	2.63 (6)	4 (1)	3.16 (6)

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Table 6. Correlations among Participants on Application of Incentives

	Client	Contractor	Superinintendent	Designer	Management organization
Client	1.000	—	—	—	—
	—	—	—	—	—
Contractor	0.580	1.000	—	—	—
	0.228	—	—	—	—
Superintendent	0.934[a]	0.754	1.000	—	—
	0.005	0.084	—	—	—
Designer	0.829[b]	0.841[a]	0.934[b]	1.000	—
	0.042	0.0036	0.005	—	—
Management organization	−0.812[b]	−0.044	−0.667	−0.464	1.000
	0.050	0.943	0.148	0.354	—

[a]Correlation is significant at the 0.01 level (2-tailed).

[b]Correlation is significant at the 0.05 level (2-tailed).

is not surprising that overall the quality incentive is the most frequently used, with time, earlier completion, safety, and cost incentives following. Although the consensus among all the other groups is that the clients chose quality incentives as the first priority, clients actually more frequently use incentives regarding time and schedules, with "schedule meets milestone" ranked first (score=4.05) and "earlier completion" ranked second (score =3.89). The "quality project and service" incentive is only their third most frequently used method (score=3.84), followed by "good safety record" (score=3.58), "cost saving" (3.53) and "within an established budget" (3.47). "Within an established budget" is the least frequently used incentive by clients, probably because an established budget is normally confidential to other groups. However, if the cost of the project is under budget, it is relatively easy for clients to reward the contractors. Superintendents have similar rankings as clients. This is understandable, as the superintendents and clients can be seen as the same organization regarding payments. (The superintendents normally are in charge of implementing these incentives.)

To test whether there was consensus among the various participants on the rankings of the use of incentives, the Spearman rank correlation coefficient r_s was computed, using the SPSS package. The results are shown in Table 6.

In this table the top entry in each cell is the Spearman correlation coefficient, and the lower entry is the significance level. The computed coefficients among clients, superintendents, and designers are positively correlated at a significance level lower than 0.05, suggesting the rankings of the three groups are strongly correlated. This is not surprising because both superintendents and designers are the consultants of clients, and their jobs are largely conducted to achieve the objectives of the client. The computed r_s between clients and contractors is 0.58 at the significance level of 0.228 higher than 0.05, showing that clients and contractors have their own incentive strategies according to their different priorities. Notably, the coefficient between clients and management organizations is negative, with $r_s=-0.812$ at the significance level of 0.05, suggesting that clients and management organizations have a significant difference on the use of incentives, e.g., the incentive of within an established budget is ranked sixth, while this incentive is ranked first by management organizations. This reflects the difference regarding the use of project budget. Management organizations govern projects in the name of government with the project budget being firmly fixed, and if the final cost of a project is within an established budget, the management organizations can have room for payout incentives. Comparatively, clients are more flexible than management organizations on allocating the project resources.

To understand the project stage at which incentives are introduced to a project, respondents were required to give a response to the question: At what stage do the incentive provisions appear? The results are shown in Fig. 1.

The proportion of incentive provisions included at the planning and design stage is 10.1%. The proportion of incentive provisions included at the tending documents is 22%, which are prepared by clients or consultants, and another 22% of incentive provisions are decided by both clients/consultants and contractors through negotiation at the awarding contract stage. The remaining 45.5% of incentive provisions are decided at the construction stage, which has the largest proportion. The chi-square test tabulates a variable into categories and computes a chi-square statistic based on the differences between observed and expected frequencies to test whether all categories contains the same proportion of values or each category contains a user-specified proportion of values (SPSS 1997). The calculations for the chi-square statistic are: chi square=25.97, with significance level at 0.01, showing that different stages have a significant influence on the choice of incentives.

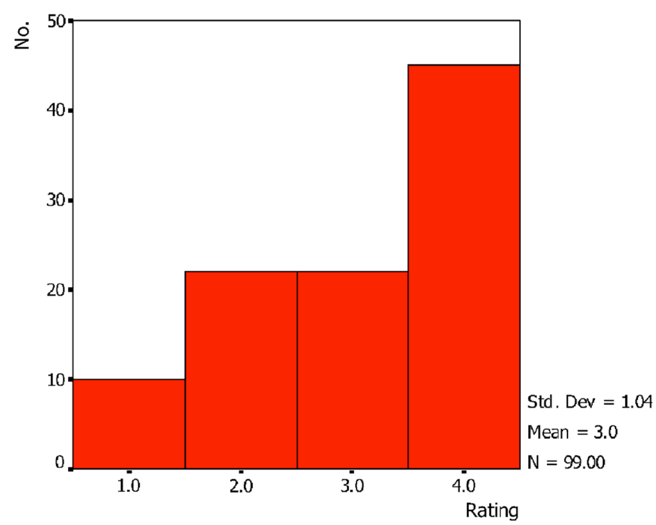

Fig. 1. Stage at which incentive provisions are introduced into project

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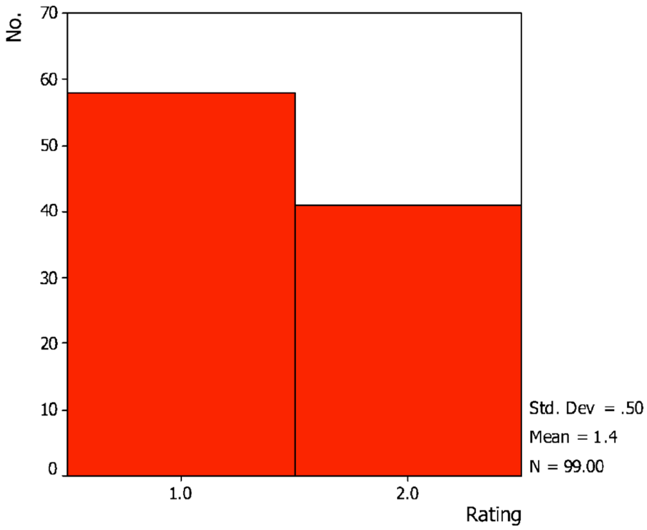

Fig. 2. Parties who decide incentive schemes

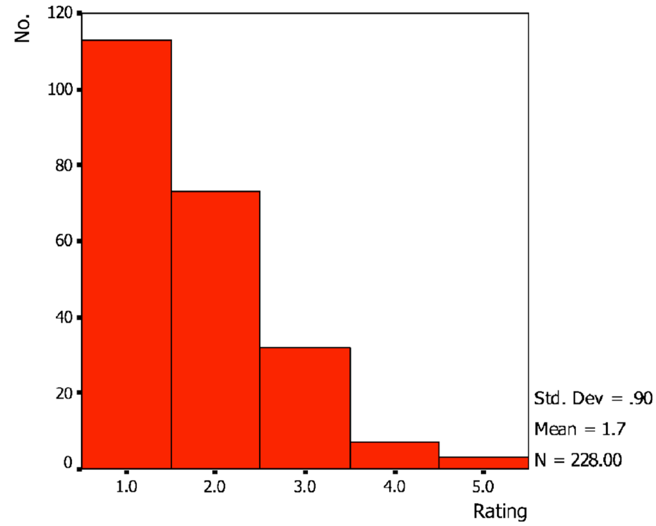

Fig. 4. Ranges of incentive amounts compared to total project costs

To investigate the role of the parties in deciding the incentive schemes, respondents were required to respond to the question: who decides the incentive scheme? The results are shown in Fig. 2.

The majority of incentive schemes (58.6%) are decided by clients and consultants, and the remaining 41.4% of incentive plans are based on negotiation among parties, suggesting that the use of incentives in a project is largely decided by the choices of clients. However, the results of the chi-square test (the chi square is 2.919 at a significance level higher than 0.05) show that although clients and consultants have a stronger influence on deciding incentive schemes, contractors also have a considerable influence on incentives by negotiating with clients and consultants.

To understand how the amounts of incentives are decided, respondents are required to give a response to the question: how do you decide the amount of incentive? The results are shown in Fig. 3.

Majority incentive amounts (56.6%) depend on the necessity of clients, which is consistent with incentives largely decided by the choices of clients (see Fig. 2), and 27.3% of incentive amounts are decided depending on the risk allocation of each party, followed by 16.2% of incentive amounts being decided according to traditional trends. The chi square is 25.88 at the significant level of 0.01, showing that clients' needs have a significant influence on the incentive amounts.

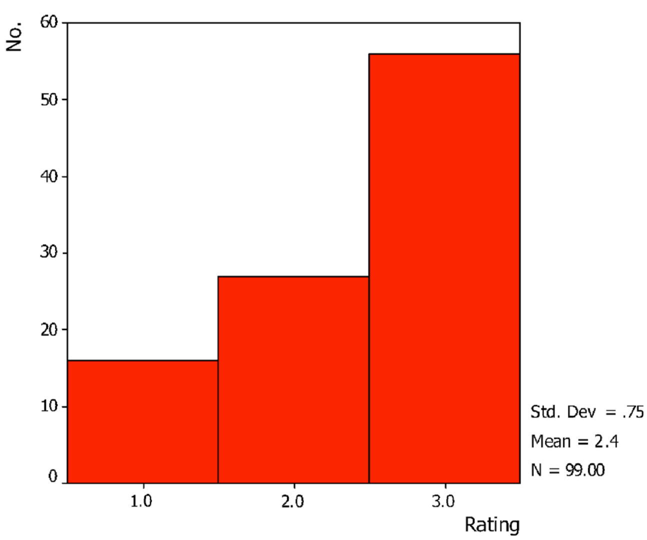

Fig. 3. Factors that influence amounts of incentives

To understand how much is spent on incentives, respondents were asked a question "what are the ranges of the incentives compared to the total project costs during the past 5 years?" To avoid bias, each respondent was required to list not more than five projects. The ranges of incentive amounts of 228 projects were rated from 1 to 5, with the results shown in Fig. 4.

These results indicate the ranges of incentive amounts of 228 projects. Nearly half of the project (49.6%) are under 0.5% compared to the total project costs, showing that these projects spend very limited resources on incentive schemes, and 32% of projects are ranged from 0.5 to 2%, followed by 18.4% of projects being in the range of over 2% of the total project cost.

To investigate the effectiveness of applying these incentives, respondents were asked to give a response to the statement "use of incentives is an effective method for better project performance," ranging from 1=strongly disagree to 5=strongly agree. Table 7 lists their perceptions.

The computed F ratio by using ANOVA was 0.45 at the significance level of 0.77 higher than 0.05, suggesting that there is a consensus on statement 4. The overall score is 4.17, and all groups believe that the use of incentives can really provide motivation for participants to perform better.

The survey above has revealed the general status of the incentives applied in the Chinese construction industry, and the Three Gorges Project is now presented to further illustrate the effective use of incentives below.

Example of Using Incentives: Three Gorges Project

Three Gorges Project Incentive Schemes

The TGP is the largest hydropower project in China, which comprises dams, power plants, and navigation facilities. The total investment is estimated to be United States $24.6 billion. The

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Table 7. Perceptions on Effectiveness of Applying Incentives

Statement	Client	Contractor	Superintendent	Designer	Management organization	All
4. Use of incentives is an effective method for better project performance	4	4.28	4.21	4.14	4	4.17

Table 8. General Incentive Scheme of the TGP

Number	Incentives	Measures	Weight (%)
1	Quality	Preconstruction issues	5
		Construction procedures	30
		Postconstruction examining and testing	10
2	Schedule	Schedule progress	24
3	OH & S and environment	Safety measures, safety records, and construction site management	15
4	Information management	Management of required information under TGPMS	10
5	Coordination	Effectiveness of coordination dealing with project issues among participants	6

construction period was scheduled from 1993 to 2009. The main functions of the project are flood control, electricity generation, and navigation.

Construction of the TGP commenced in 1993. After years of practice and exploration, the importance of using incentives was recognized gradually, and formal incentive schemes were developed and applied to assist in reaching project objectives. Multiple incentive schemes were adopted in the TGP, which reflected the client's priorities. The general combined incentive schemes in TGP typically included five incentives: quality, schedule, occupational health and safety (OH & S), and environment, information management, and coordination, which had various measures to allow an appropriate reward/risk to be decided (see Table 8). The weights of the incentives were decided on the basis of the importance of the theme that a particular incentive deals with as perceived by the project participants.

The quality incentives have the heaviest weight of 45%, showing that quality was considered as most important (this is consistent with what was established in Tables 4 and 5). Quality incentives included three subclass incentives: preconstruction issues, construction procedures, and postconstruction examining and testing. The schedule incentive had the second heaviest weight of 24%, and the OH & S and environment incentive had a weight of 15%, which are also in line with the survey results in Tables 4 and 5. As the TGP is such a complex construction project with multidisciplinary components, there is a need to effectively share and manage the large amount of information derived from the construction activities. Thus, the information management incentive and coordination incentive has also been set with the weights of 10 and 6%, respectively.

Besides the combined incentive schemes, a value engineering incentive was also put in place to promote innovation, which aimed at project cost saving. The cost saving deduction of relevant costs from a value engineering proposal presented by a contractor was to be shared by the client and the contractor in the proportion of 50:50.

Appraisal of TGP Incentive Schemes Using Balanced Scorecard

Measurement of project performance is the key issue when setting up incentive schemes. To achieve this, adoption of an appropriate measurement system is critical. Swamy (2002) summarized the evolution of performance measurement, and identified balanced scorecard (BSC) as an important measurement technique since the 1990s. Because it was found that the principles underpinning the measures included in the incentive schemes of the TGP were consistent with the BSC technique, BSC has been adopted to appraise the incentive schemes of the TGP.

Traditionally, performance measurement in construction is mainly applied in the measurement of the finished works. However, there are weaknesses associated with this approach (Cox and Townsend 1998):

1. The process is entirely retrospective: the tendency is to review performance on completion. By then, it may be too late to take any corrective action;
2. Measures tend to be the same for all projects, regardless of the project aims and objectives. There is little consideration of appropriateness; and
3. The focus is on meeting accepted standards. This does not support an ethos of continuous improvement.

Kaplan and Norton (1996) introduced the concept of the BSC which has much broader measurements than traditional approaches. The BSC is a performance management system which incorporates four main measurement categories (perspectives): financial, customer, internal process, and learning, each with a wide range of potential submeasures (Kagioglou et al. 2001), which attempts to integrate all the interests of key participants on a scorecard (Mohamed 2003). BSC can be adapted to assist managing business functions, organizational units, and individual projects (Martinsons et al. 1999), and can be applied as a methodical approach to reveal problems and identify areas needing improvement (Stewart 2001). Most importantly, BSC keeps an organization looking forward toward future growth, with the potential advantages being far greater than what traditional measure-

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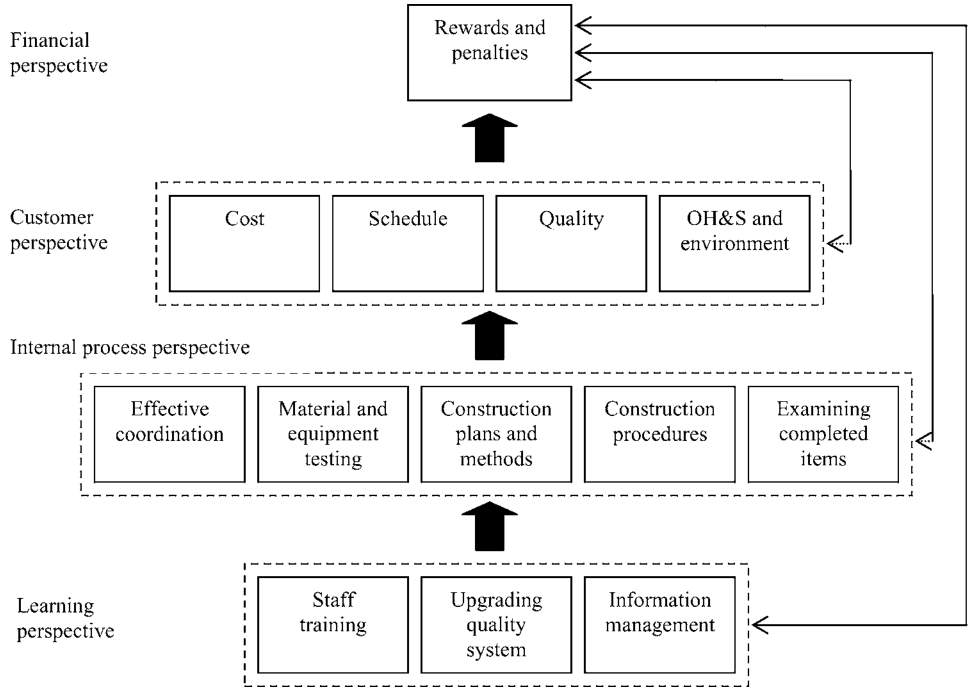

Fig. 5. Balanced scorecard of TGP incentive schemes

ment methods can achieve (Leauby and Wentzel 2002).

Although the TGP incentive schemes were directly developed from practice during past years, they actually reflect the four perspectives contained in BSC. Thus, BSC is an appropriate technique to appraise the TGP incentive schemes. Such an appraisal can bring deeper theoretical understanding of the TGP incentive schemes. According to BSC, the TGP incentive schemes can be translated into the scorecard as shown in Fig. 5.

As shown in Fig. 5, the TGP incentive schemes extended the performance measurement from results to earlier steps of the construction processes. The direct objective of the incentive schemes is the customer perspective, which is to meet the requirements of the ultimate customer (the client) regarding quality, schedule, cost, OH & S, and environment. The measures of customer perspective belong to lagging indicators, which reflect the final results. The use of internal process measures ensures that the final results are achieved. Internal process measures are used to effectively track in-progress activities, and thus provide an early-warning system for identifying necessary midcourse corrections (Crane et al. 1999). The internal process measures include effective coordination, material testing, construction plan and methods, construction procedures, and examination of completed items. The learning perspective is more basic than the internal process perspective, which supports the internal process by upgrading the quality system, staff training, and information management. From a financial perspective, the rewards/risks in the TGP incentive schemes are not only tied with measures regarding customer perspective, but also linked to measures from the perspectives of internal process and learning. The rationale for this strategy is sharing of the saved project contingencies by taking measures during the construction process to prevent the occurrence of project risks.

By far, the achievement of the quality, schedule, and cost objectives in the TGP is satisfactory (Lu 2005), indicating the incentive schemes were effective in the TGP, which also suggests the incentives may have the potential to be effective in other projects.

Derivation of Incentive Matrix

As the incentive schemes in the TGP can effectively facilitate improving project performance, it is desirable to develop the incentive schemes into a concise matrix, which may facilitate other projects to develop similar incentive schemes. Based on the overall incentive schemes in the TGP, an incentive matrix can be expressed as Eq. (1)

$$\begin{aligned}\text{reward/risk result (RRR)} &= \Sigma I(i) + R_{\mathrm{VE}}\\ &= \Sigma(C * x\,\% * W(i) * \alpha(i) - R_i)\\ &\quad + (C_{\mathrm{save}} - C_{\mathrm{VE}}) * \beta \end{aligned} \tag{1}$$

In Eq. (1), reward/risk result (RRR) is obtained from $\Sigma I(i)$ and R_{VE}. $\Sigma I(i)$ reflects the general combined incentive schemes of the TGP. R_{VE} reflects the reward from value engineering, which is derived from the value engineering incentive scheme of the TGP. The details of Eq. (1) are presented below, where $I(i)$=particular incentive; C=cost of the work; x=percentage rate of the cost of the work (in this case, x=2); $W(i)$=weight of an incentive; $\alpha(i)$=performance evaluation Index (decided according to incentives measures); $R(i)$=risk allocated from nonconformance; R_{VE}=reward from value engineering; C_{save}=cost reduction of value engineering proposal; C_{EV}=cost incurred for presenting the value engineering proposal; and β=rate of sharing the net saving (here β=0.5).

When Eq. (1) is applied to other projects, the parameters x, i, w, α, and β can be decided according to the priorities of clients, project features, and other key issues regarding the projects.

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The benefits of using Eq. (1) can be seen by comparing it with other types of incentive schemes. Arditi and Yasamis (1998) pointed out that the classical application of incentives is in the form of target cost incentives with the reward/risk result given by

$$\mathrm{RRR} = \gamma(\mathrm{TC} - \mathrm{AC}) \tag{2}$$

where γ=rate of gain share/pain share; TC=agreed target cost; and AC=actual cost.

A difficulty in using Eq. (2) is in agreeing on the target cost. The contractor would like a higher target cost, and the client favors a lower target cost (ACA 1999). Besides, Eq. (2) cannot help participants understand the effects of the incentives before the project is actually completed. Because of these, Eq. (2) is normally applied in high risk projects, mostly off-shore oil and gas projects (Scott 2001 and Gallagher 2002). Comparatively, Eq. (1) has a potential to be applied broader in different project types. Eq. (1) has further advantages: it can be used to facilitate measurements to provide early warning of risks, and provide strong motivation for participants in the whole project delivery process.

Conclusions

The intent of this study has been achieved through a systematic Chinese industry survey on the use of incentives. The major findings of this study include the following:

1. The delivery systems currently being applied in China retain features of the traditional systems. However, the limitations of these systems are being recognized, and it is agreed by all parties that the current contract has specified the risks and obligations of the parties, but lacks incentives to promote better performance. All the parties also support the idea that incentives make the project risk allocation fairer, because incentives can be seen as the sharing of rewards from good performance;
2. Generally, the quality objective was found to be the most important, ahead of the schedule/time objective and the cost objective, with contractors having ranked cost objective ahead of schedule/time objective. The frequencies of using incentives are consistent with the priority of objectives, and the quality incentive is the most frequently used, with schedule, earlier completion, safety, and cost incentives following;
3. It is found that the incentive provisions are mainly decided at the construction and bidding stages, following the planning and design stage;
4. The majority of incentives are decided by clients and their consultants with considerable incentives being decided through negotiation among parities. Most of the incentives are decided depending on the necessity of clients, followed by incentives depending on the risk allocation on each party and according to traditional trends. These show that clients have a stronger influence on deciding incentive schemes than contractors;
5. Among a variety types of surveyed projects, nearly half of the projects spend very limited resources on incentives, with incentive amounts of other projects ranging over 0.5% of the total project cost;
6. There is a consensus among all parties that use of incentives is effective in providing motivation for participants to perform better;
7. The general combined schemes in TGP typically included five incentives: quality, occupational health and safety (OH & S) and environment, schedule, information management, and coordination. The various measures included in the incentives can be viewed on perspectives of financial, customer, internal, and learning. The outcomes of the project indicate these incentives are effective; and
8. Eq. (1), which is derived from the TGP incentive schemes and has incorporated measures extending from results to process, has the potential to be applied broader than Eq. (2) adopted by many target cost contracts.

Future Research Directions

The results of this study suggest some potential strategies for future application in the construction industry. Future studies on incentives should be conducted to enhance the developments and applications on these strategies, which include the following:

1. As use of incentives makes risk allocation fairer, and is an effective method for better project performance, incentives should be encouraged in the construction industry to improve the efficiency of project delivery;
2. Future research direction on incentive schemes should follow the strategies as shown in Eq. (1) that has measures that are tied not only to final results but also extended to the whole construction process, which facilitate providing early warnings, obtaining continuous improvement, and ultimately achieving satisfied project results;
3. This study shows that clients are seen to be driving the process on deciding incentives. Future studies should be conducted for clients to make sure that their needs are clearly tied with incentives, which should reflect the principle of equity in dealing with the different priorities between clients and contractors;
4. This study indicates that different types of projects can apply incentives more or less. Future studies should be conducted to develop incentives according to project features, such as project type, delivery system, project risk, and participants' needs and their experience, which enables incentives to be applied broadly by participants in the construction industry; and
5. The conclusions of this study were obtained from an empirical study conducted in the Chinese construction industry, and Eq. (1) presented in this study is based only on the TGP incentive schemes. Further study investigations would be required to test these in industries elsewhere in the world.

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