

Analysis of Cost Estimation and Payment Systems for Consultant Contracts in the US, Japan, China and the UK

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Abstract—Determining reasonable fees is the main objective of designing the cost estimation and payment systems for consultant contracts. However, project clients utilize different cost estimation and payment systems because of their varying views on the reasonableness of consultant fees. This study reviews the cost estimation and payment systems of consultant contracts for five countries, including the US (Washington State Department of Transportation), Japan (Ministry of Land, Infrastructure, Transport and Tourism), China (Engineering Design Charging Standard) and UK (Her Majesty's Treasury). Specifically, this work investigates the budgeting process, contractor selection method, contractual price negotiation process, cost review, and cost-control concept of the systems used in these countries. The main finding indicates that that project client's view on whether the fee is high will affect the way he controls it. In the US, the fee is commonly considered to be high. As a result, stringent auditing system (low flexibility given to the consultant) is then applied. In the UK, the fee is viewed to be low by comparing it to the total life-cycle project cost. Thus, a system that has high flexibility in budgeting and cost reviewing is given to the consultant. In terms of the flexibility allowed for the consultant, the systems applied in Japan and China fall between those of the US and UK. Both the US and UK systems are helpful in determining a reasonable fee. However, in the US system, rigid auditing standards must be established and additional cost-audit manpower is required. In the UK system, sufficient historical cost data should be needed to evaluate the reasonableness of the consultant's proposed fee.

Keywords—Consultant Services, Cost Estimation and Payment System, Payment Flexibility, Cost-control Concept

I. INTRODUCTION

TO obtain high quality technical service, a technical service provider (consultant) must be compensated with a fair service fee; it is a charge concept acceptable to most proprietors [11, 13]. However, many studies indicate a significant disparity between the service fee determined by proprietors and the cost deemed reasonable by consultants [8, 17, 9]. Researchers in the past usually recommended addressing this cost difference issue by adjusting the service fee rate (e.g., Carr, and Beyor[4], Bubshait, et al. [2]). However, the rate is affected by a consultant's qualifications, service quality and service scope. A proprietor usually will not agree to an increased service fee rate if charge conditions remain unchanged.

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To solve the abovementioned difference between the two sides on costs, this study examines, from the viewpoint of a proprietor, the charge systems adopted in the US (Washington State Department of Transportation, WSDOT), Japan (Ministry of Land, Infrastructure, Transport and Tourism), China (Engineering Design Charging Standard) and the UK (Her Majesty's Treasury) and their respective implementation procedures in terms of budgeting, consultant selection, contract negotiation, contract management and contract audit. Moreover, this study analyzes the hypotheses of proprietors (charge conditions) as implied in the charge systems and investigates the execution features of each type of system based on the flexibility given by proprietors for contractors in charging.

II. US

The Department of Transportation of the State of Washington has adopted a charge system that comes in four types of agreements: Cost Plus a Fixed Fee, Hourly Rate, Task Order Hourly Rate, and Lump Sum. Their respective criteria of applicability are listed in Table I. Among these systems, Cost Plus a Fixed Fee is the most adopted charge system [28].

A. Budgeting

For a project charged by fixed service fee (such as lump sum), a proprietor usually arrives at an estimated service fee by referring to the construction/engineering basic consultant service fee table adopted by the Office of Financial Management (OFM) of the State of Washington and based on the type of project and complexity of the building. The said table is updated roughly once per three years [19].

TABLE I
AGREEMENT TYPES OF WSDOT

Agreement types	Appropriate conditions
Cost Plus a Fixed Fee	This method of compensation is used when the extent of work and the labor and other expenses required for project completion cannot be fully and accurately estimated for each separate work element in advance.
Hourly Rate	This agreement is appropriate if the scope of work can't be clearly defined.
Task Order Hourly Rate	On-Call Hourly Rate Master Agreements (provisional or negotiated) are established for work that has not yet been defined.
Lump Sum	This method of compensation is appropriate if the scope of work (quantity and type) can be clearly defined.

In addition, the rate table also indicates the standardized deliverables required from a consultant at each stage of a project (including design, bidding and construction). Therefore, when deliverables change, the primary proprietor institute

should also change the service rate accordingly. However, the said rate is only a reference for an institute's budgeting, not the actual contract price for technical service project.

For a project charged by non-fixed service fee (such as cost plus a fixed fee), the State Government estimates the total service fee by referring to the statistical data of past projects, and meticulously estimates direct salary, management expense and other direct expenses and revenue.

B. Consultant Selection

For construction and engineering technical service projects, the Department of Transportation adopts three approaches: competitive selection, sole source selection and on-call. Regardless of which selection is chosen, the service fee will not be an element for selection;

The process proceeds to price negotiation only after the best technical service provider has been determined.

1. Competitive Selection: A Short List is produced according to the credential documents submitted by the technical service providers. Candidates are invited to deliver presentations, and the candidate scoring the highest on presentation wins the bid.
2. Sole Source Selection: a technical service project with total amount under US\$ 20,000 requires no open bidding; instead, the Area Consultant Liaison, (ACL) directly negotiates with qualified suppliers. Technical service projects with total amount over US\$20,000 require open bidding, and the ACL negotiates with suppliers by email or telephone.
3. On-call technical service: The DOT announces its needs for on-call technical service projects in November every year (after assessing the requests from its subordinate agencies during September and October) along with the upper budget limits for all types of projects. All liaisons and proprietor agencies may invite technical service providers to submit their credentials and proposals (up to 5 pages) or deliver their presentations, and make their selections of providers accordingly.

C. Contract Negotiation

Having selected a technical service provider for a project totaling more than US\$250,000 or to which an audit is requested by the DOT's contract management section, the Audit Office of the DOT first conducts a pre-award audit by visiting the bid-winning technical service provider (particularly the one that undertakes a DOT project for the first time), and focuses on the technical service provider's actual costs (such as payroll and administration), company accounting books, accounting principles and the project manager's knowledge regarding the DOT's regulations. The audit result is then used as reference for the service fee negotiation [27].

Price negotiations are described below:

1. Lump Sum and Cost Plus a Fixed Fee: By referencing the pre-award audit, the DOT negotiates with the technical service provider concerning the tasks to be executed, payroll for the personnel involved in the project, administration expenses, other direct expenses, profit and total amount.
2. Hourly Rate: By referencing the technical service provider's overhand rate, acceptable hourly rate and reimbursable costs

announced by the ACL or the DOT's Audit Office, the procuring entity and the technical service provider negotiate on the total amount and profit of the agreement. Once an agreement is reached, changes may not be made to the hourly rate.

3. Task Order Hourly Rate: Based on the task order document that the DOT issued to a contractor, the contractor's project manager assists the procurement section to derive the parameters for determining the amount of a contract, including: duration, work scope, personnel and working hours; the total amount paid on all of the tasks cannot exceed the total amount of the agreement. In addition, the calculation of the parameters may take into consideration the actual execution situation and change of task order.

D. Contract Management

DOT verifies expense claims by the following methods:

1. Cost Plus a Fixed Fee: After the kick-off of a contract, the proprietor is responsible for counting the workers present, while the DOT's Audit Office personnel with accountant qualification is responsible for verifying and writing-off the expenses.
2. Lump Sum: For a contract adopting the lump sum system, the DOT does not examine a contractor's receipts in practice; instead, the administrative section will determine the project progress achieved by a technical service provider and pay according to the percentage of accomplishment.
3. Hourly Rate and Task Order Hourly Rate: A technical service provider's service fee is determined by multiplying the actual working hours by the agreed hourly rate.

E. Contract Audit

The DOT adopts two audits: interim audit and final audit. An interim audit primarily focuses on service projects of durations longer than 2 years, and is conducted when the project is near 1/2 of its duration, to verify the variation ratio of administrative expenses, personnel expense claims without receipts, inaccuracy in time sheet, and the expenses that a technical service provider should return. A final audit focuses on service projects whose total amounts exceed US\$100,000, and is conducted at any given time within 3 years after the completion. The DOT may examine a technical service provider's (possibly including subcontractors') accuracy and compliance in financial reports and receipts, and evaluate the technical service provider's performance.

F. Cost Estimation and Payment Perspective

Feldmann, et al., [6] propose that it is commonly perceived among the American proprietors that technical service fee accounts for a considerable portion of the total construction cost (the technical service fee for a new construction project of US\$ 2 million accounts for about 6 to 12% of the total construction cost). Therefore, proprietors establish stringent accounting and auditing systems for the dual purposes of saving costs and ensuring high quality service.

The concept of cost control adopted by the DOT is: The service fee is paid according to the incurred cost of a contractor that has the best qualifications and quality. Therefore, the

payment system focuses on the consistency between service fee and service delivered (including service quality and service scope). With stringent pre-award, interim and final audits, a proprietor is able to understand the cost incurred to a contractor and establish a relatively more accurate budgeting system (such as construction cost portfolio).

In addition, despite the DOT adopting different budgeting systems for fixed and non-fixed service fees, both systems include the concepts of basic service and added service, or payment according to a contractor's service scope.

III. JAPAN

According to Gazette No. 1 [14], 15[15] and 68 [16] of 2009 announced by the Ministry of Land, Infrastructure, Transport and Tourism, Japan (MLITT), only two payment systems are adopted by Japan: the actual cost method and the cost estimating method. Both systems are used during the budgeting period, while the respective contract pricings adopt the lump sum payment method.

A. Budgeting

1. The actual cost method

The actual cost method focuses on services not included in the standard service scope [15]; the technical service fee is budgeted on an item-by-item fashion. The calculation for the cost estimating method is as follows:

Technical service fee = direct payroll + other direct expenses +
admin. + special fee + common fee +
tax

The common fee is usually 20% of the sum of direct payroll, other direct expenses and admin., while the tax is usually 5% of the total service fee [12].

2. The cost estimating method

The Japanese have standard estimate parameters and formulas for standard construction and civil engineering services. The parameters and formulas may differ, but their calculation logic and procedures are similar.

The estimate formula and standardized person-day for a construction project are determined [12] according to the survey that the MLITT has conducted from February 18th to March 16, 2008 on 1,577 architect offices (among which 666 replied) and 2,622 technical service projects (among which 328 were provided by architect offices). The cost estimating method adopts calculation as follows:

Technical service fee = 2* direct payroll + special fee +
common fee + tax

During the budgeting period, the Japanese arrive at an estimated person-days required for the technical service by a comprehensive industry survey on construction purpose, type, service scope (design or construction) and construction acreage. In addition, the Japanese standardized person-day pay is updated annually to realize a smaller difference between the estimated and actual person-day pay.

B. Consultant Selection

In Japan, a list of qualified contractors is established for selecting a technical service provider (the list is produced by Japan Construction Information Center, or JACIC, under the authorization of the MLITT). A call for tenders, similar to the short list method, is offered by first mailing a letter of invitation to the qualified contractors, who in turn respond with an expression of interest. An objective technical standard is used to select several qualified technical service providers, who are further invited to present their Full Technical Proposals. Finally, these proposals are evaluated to determine the bid winner.

C. Contract Negotiation

The Japanese adopt lump sum pricing for contracts; therefore, they will refer to the budget, total amount of negotiated service fee, payment term, payment schedule and payment amounts at different periods when negotiating contracts [12]

D. Contract Management

As the Japanese adopt the lump sum payment system, they usually pay according to the agreed result of a specified period. For examples: 10% of total service fee is paid upon signing a contract, 25% is paid upon the completion of design chart, 25% is paid upon the completion of the main structure, and 40% is paid upon the completion of construction.

E. Contract Audit

As the Japanese adopt the lump sum payment system, they do not have a receipt audit system. Instead, they have a contract performance evaluation system established for technical service providers. After the completion of a technical service project, the proprietor evaluates the satisfaction level for a technical service project and the technical service provider must submit its contract performance record and satisfaction level evaluation data to the Japan Construction Information Center (authorized agency of the MLITT), to provide future reference for the specific contractor's qualifications.

F. Cost Estimation and Payment Perspective

The technical service fee accounts for about 8- 15% of total construction cost in Japan [12]; the proprietors commonly regard the technical service fee as a proportionally high expense that should be tightly controlled. However, the Japanese practice differs from that of the USA and Taiwan. Through an industry survey, the Japanese establish a standardized formula for calculating the service fee, and the formula is the basis for negotiating with contractors.

Under the conditions of a somewhat fixed service fee system, the Japanese adopt a cost control concept: the better the qualifications and service quality a contractor has, the higher the value for the proprietor. Therefore, only the qualification, service quality and performance on past contracts are considered when selecting a contractor. Other than that, while the Japanese do not examine a contractor's execution cost, an industry survey gives them more accurate parameters and formulas to calculate the service fee. However, the frequency of formula updating is critical; a long interval may results in an impractical fee calculation that fails to reflect reality (the

formula announced in 1979 was not updated until 2009). In addition, the MLITT has clearly stipulated standardized and non-standardized service items for the planning, design and construction stages, as well as fee parameters and formulas that correspond to each service item. Therefore, the pricing concept adopted by the Japanese also includes calculating the service fee according to the service items.

IV. CHINA

The Chinese adopt Government Guidance Price and Market Price systems when calculating the prices for contracting technical services. Under the Government Guidance Price, similar to the lump sum system, the competent or concerned government agency in charge of pricing stipulates the amount (not a percentage) and the permitted floating degree of the technical service fee. Under Market Price, a system that adopts the lump sum concept, the service fee is determined through negotiation between a proprietor and a contractor [24]. The two systems have different criteria for design projects and construction projects:

1. For a design service project with an estimated amount (including construction expenses, procurement of equipment and joint test operation fee) under RMB 5 million, Market Price is adopted; above RMB 5 million, Government Guidance Price is adopted.
2. For a construction service project for which statutory supervision is required, Government Guidance Price is adopted, while Market Price is adopted for other construction or non-construction stage services (such as assisting a tender offer) [23].

A. Budgeting

Design and supervision services may be similar in terms of budgeting method, but their respective amount limits differ under Government Guidance Price:

1. For a design service project, despite the engineering inspection design charging standard stipulating that a project with an amount less than RMB 5 million shall adopt Market Price system, the construction design charging base price table under the Government Guidance Price system provides a charging standard for construction project with an amount higher than RMB 2 million (charging amount). Therefore, the calculation program and budgeting under the Government Guidance Price are applicable to a project with an amount ranging from RMB 2 million to 5 million. For a construction project with an amount less than RMB 2 million, the budgeting for the service fee may refer to similar projects in the past.
2. For a supervision service project with an amount over RMB 5 million, the budgeting for the service fee adopts the Government Guidance Price; for under RMB 5 million, budgeting for the service fee refers to the similar projects in the past.

The budgeting procedures for design and supervision service under the Government Guidance Price are described below:

1. Design service under the Government Guidance Price

The calculation formulas for design service projects under the Government Guidance Price are provided below; the calculation parameters are listed in Table II.

- (1) Basic Design fee = Basic fee \times type parameter \times complexity parameter \times additional parameter
- (2) Preliminary design fee = basic design fee + other design fee
- (3) Total design fee = Preliminary design fee \times (1 \pm adjustment parameter)

Basic Design fee means the service fee charged by a contractor for providing basic design and detailed design drawings, as well as participation in the final acceptance inspection. Other design fee means the service fee included in the basic design service. The design fee that is not for a standard construction is determined by multiplying the estimated amount of a construction by a standard rate. The design fee for working drawing or as-built drawing is determined by multiplying the basic design fee by a standard rate.

2. Supervision service under Government Guidance Price

The calculation formula for a supervision service under the Government Guidance Price is described below; all calculation parameters are listed in Table III.

- (1) Construction supervision service fee = Construction supervision service charge base \times Type parameter \times Complexity parameter \times elevation parameter
- (2) Construction supervision service charge = Construction supervision service basic fee \times (1 \pm Adjustment parameter).

The construction supervision service charge base means the expenses required for a technical service provider to perform statutory inspection, design, construction and maintenance, but the billable amount varies according to construction type. The supervision fee for railroad, waterway, highway, water, electricity and dam is calculated according to the construction cost (exclusive of equipment procurement expense and joint operation test expense). The supervision fee for other constructions is determined according to the estimated construction cost (inclusive of construction expense, equipment procurement expense and joint operation test expense).

In addition, the supervision service fee not for the construction stage (such as advising for better technique, assisting the establishment of a supervision method and budgeting) is estimated by the proprietor according to the estimated working days and the Construction Project Supervision and Related Service Personnel's Labor per Day Standard

TABLE II
CALCULATION PARAMETERS FOR DESIGN SERVICE UNDER THE GOVERNMENT GUIDANCE PRICE

Calculation parameter	Description
Basic fee	Billable basic fee included in charged amount (payable) is determined by interpolation method. Basic fee table includes 18 tiers; the minimum is RMB 2 million, the maximum is RMB 20 billion. The service fee for service project with more than RMB 20 billion of construction cost shall be 1.6%.
Type parameter	The adjustment parameters for construction type and workload are determined by the parameter type table for the construction design charge. The parameter type table for the construction design charge includes 7 major types, such as mining, petrochemicals and urban development. Each type has a different adjustment parameter, which increases as construction difficulty increases. In urban development, for example, the adjustment parameter for postal projects is 0.8; construction, municipal administration or telecommunication project, it is 1.0; and for gardening projects, it is 1.1.
Complexity parameter	The complexity adjustment parameter is determined by the construction complexity table. Complexity also includes 7 major types of construction, each of which includes Class I, II and III difficulties (the higher the number, the higher the difficulty). Class I adjustment parameter is 0.85; Class II, 1.0; and Class III, 1.15. A construction with undefined complexity may refer to the complexity parameter of a similar project, and shall be determined through negotiation between the proprietor and technical service provider.
Additional parameter	Influence factors not considered in professional and complexity parameters are to be adjusted with an additional parameter. Each type of construction has a different adjustment parameter. For an ancient relic construction project, the adjustment parameter is 1.3 to 1.6; for interior design, 1.5. When there are two or more additional parameters, one parameter may not be multiplied by another parameter. These parameters are to be summed, minus the number of parameters, and plus a constant value of 1 to determine the additional parameter.
Other design fee	Fees not included in basic design service, such as design, working drawing or as-built drawing for a non-standard construction, has a general rate (0.10 – 0.13), somewhat complex rate (0.13 – 0.16) and complex rate (0.16-0.20).
Adjustment parameter	An adjustment parameter for the consideration of regional difference is to be determined by negotiation between the proprietor and technical service provider. A regular construction may not exceed $\pm 20\%$, but the one that adopts new technology, new working method, new equipment or new material may enjoy an upper limit of 25%.

TABLE III
CALCULATION PARAMETER FOR SUPERVISION SERVICE UNDER THE GOVERNMENT GUIDANCE PRICE

Calculation parameter	Description
Construction supervision service charge base	The billable basic fee included in the charged amount (payable) is determined by the interpolation method. The basic fee table includes 16 tiers, with minimum RMB 5 million and maximum RMB 10 billion. The service fee for a project over RMB 10 billion is 1.039%.
Type parameter	The service fee for a project under RMB 5 million is to be determined by negotiation between the proprietor and contractor. The adjustment parameters for construction type and workload are to be determined by the construction supervision service type parameter table. The construction supervision service charge type parameter table, the same as the construction design charge type parameter table, has 7 major types of construction. The adjustment parameter increases as construction difficulty increases. In urban development, for example, the adjustment parameter for postal projects is 0.8; construction, municipal administration or telecommunication projects, it is 1.0; and for gardening projects, it is 1.0.
Complexity parameter	The adjustment parameter for construction difficulty is determined by the construction complexity table, which is the same as for the construction service project.
Elevation parameter	It is determined according to the latitude of the construction site. For an elevation below 2001m, the parameter is 1; for 2001 – 3000m, 1.1; for 3001 – 3500m, 1.2; for 3501 – 4000m, 1.3; for 4001m and higher, the parameter is to be determined by negotiation between the proprietor and contractor.
Adjustment parameter	The adjustment parameter for the consideration of regional difference is to be determined by negotiation between the proprietor and technical service provider. The adjustment parameter may not exceed $\pm 20\%$.

B. Consultant Selection

Consultant selection systems may vary according to construction type, province/city, and technical service project type. Below is a description of a selection model for a construction project.

1. Design service

For a construction design service project, the Chinese provide a Regulations Governing Construction Design Tender Offer [1] as a universal standard. According to the Regulations [1], a construction project's tender offer may be an open bid or bid by invitation. Other than the service projects that have too few potential bidders, too stringent examination or too high bidding cost for an open bid, execution duration limit and statutory restriction, all regular service projects are open bids. For a project eliciting many major construction company bids, a qualification pre-award review may be implemented.

A qualification pre-award review is to be conducted by the proprietor's professional personnel (and requires 3 or more candidates to succeed in the pre-award review). After the review, the proprietor assembles a bid review committee (mainly consists of construction experts) that comprises an odd number, 5 or more members, who will conduct a general evaluation of the papers submitted by the candidates (without service fee included in the evaluation) and award the contract by open vote, sorting or composite percentile method.

2. Supervision service

Each province and city provides its respective supervision service bidder's evaluation standard. Fujian Province's Regulations Governing House Construction and Urban Infrastructure Project Tender Offer [21] are used as an example for describing supervision service bidding and evaluation.

Fujian provincial construction's supervision project also includes open (bid announcements) and invitational (bid

invitation letters) bids but no criteria are provided for applicability. Additionally, a supervision service bid regardless of construction type, includes prescribed qualifications for bidder, supervision personnel and past contract performance.

For evaluation, a supervision service that charges less than RMB 1 million and Class II or lower construction projects, the random sampling method is adopted; for the same service that charges RMB 1 million or more and Class I projects, the general evaluation method is adopted. Regardless of evaluation method adopted, the procuring entity must assemble an evaluation committee.

C. Contract Negotiation

Market Price has a price negotiation method similar to that of Government Guidance Price, except for the agreed deliverables.

1. A service project adopting Market Price shall have its service fee determined by the proprietor and contractor, based on the deliverables.
2. A service project adopting Government Guidance Price shall have its adjustment parameter determined by the proprietor and contractor, and the upper and lower floating limits may vary for design and supervision:
 - (1) The adjustment parameter for a general construction design service project may not exceed $\pm 20\%$, but the project that adopts new technology, new working method, new equipment or new material that increases the construction's economic benefits, environment benefits or social benefits may have its adjustment parameter's upper limit increased to 25% [22].
 - (2) The adjustment parameter for a supervision service project may not exceed $\pm 20\%$ [22].

D. Contract Management

1. A design service project is usually paid according to the agreed stage result. For example, 20% of the total service fee is paid upon the signing of the contract, 30% upon completion of basic design drawing and afterward, the proprietor pays the remaining 50% to the contractor according to the drawing work completion percentage in installments. After the completion of the drawings, the proprietor will not withhold any balance payable [29].
2. A supervision service project is usually paid in proportion to the number of a construction's working days [18].

E. Contract Audit

An entity will not examine the actual execution cost incurred to a technical service provider, whether it is a design or supervision project, but the technical service provider must present papers that prove the current stage's completed works (e.g. design drawings) or project progress when requesting payment.

F. Cost Estimation and Payment Perspective

In China, the service design fee accounts for approximately 1.6 to 4.5% of the construction cost, while the supervision service fee accounts for 1.039 to 3.30%; totaling 2.639 to 7.8% of the construction cost. This figure is relatively lower than that

in other countries, but proprietors still believe that the technical service fee is proportionally high, and adopt a stringent control over the technical service provider's service fee [22].

The Chinese adopt measures similar to the Japanese measures. The Chinese conduct industry surveys and establish a standardized service fee calculation formula that serves as the basis for the negotiation between proprietor and contractor.

Under the condition of a somewhat fixed service fee, the Chinese adopt a cost control concept that the better the qualifications and service quality a contractor has, the higher the proprietor's value. Therefore, when they select a contractor, they focus on the factors of contractor qualification, service quality and past contract performance. In addition, similar to the Japanese, the update frequency of standard charge basic price table is the key to reasonably determining service fee. The competent authorities regulating prices in China reestablished a charge standard in 2002 and abolished the charge standard of 1992. The new standard increased the charge standard (56% in design service and 50% in supervision service, on average), and cancelled the double-track charge system of Tangible Fixed (similar to Cost Plus a Fixed Fee) and Estimated Percentage (percentage to construction cost), while the service fee is now categorized by its nature instead of the construction project department.

Regardless of charge method, the Chinese charge system allows the proprietor to negotiate with the bid winner (on adjustment parameter). Despite the bid regulations stipulating that the proprietor may not force a contractor to cost-down on design fee, increase workload and reduce design cycle time as predominant criteria prior to issuing the contract award notice, a contractor desperately in need of a contract from a proprietor that tries to save cost by bargaining on service fee, usually agrees to the proprietor's demand. As a result, there may be a relatively larger difference between the service fee and the execution cost required for a contractor. This phenomenon may explain the relatively low service fee in China.

On the other hand, the Chinese also provide regulations for standard deliverables of design and supervision services ([25], [26]), which is evidence of the adaptation of a charge concept of service fee for service deliverable.

V.UK

According to Yong Jiang [29], the modern charge systems originated from Britain. In 1845, the Royal Institute of British Architects (RIBA) first adopted the rule that the design fee shall be 5% of the total construction cost based on the actual workload and price level at the time; this was followed by adjusting the rate to 6% after World War I. The European countries, US and Japan followed suit until the 1970s, and then evolved onto their own individual tracks [29].

Her Majesty's Treasury of Britain adopts three charge systems of hourly rate (time charge), lump sum and construction cost percentage (ad valorem). Their respective applications are listed in Table IV[10].

TABLE IV
CHARGE SYSTEMS ADOPTED BY HM TREASURY

Name	Applicable
Hourly Rate	Uncertain service scope and deliverables
Lump Sum	Certain service scope and deliverables Produces higher proprietor's value and recommended by the HM Treasury.
Ad valorem	Certain service scope and deliverables Encourages technical service provider to over-design, and is not recommended.

As recommended by HM Treasury, Lump Sum is a charge system commonly adopted for commissioning a technical service project. In addition, for a proprietor's consultant, value management, risk management and cooperation relation management projects that are impossible to estimate their service scope and length, the British provide regulations that allow contracting with a technical service provider by Call-off (non-fixed price contract) if hourly rate or lump sum is adopted. A call-off contract is applicable to a contract of smaller technical service deliverables; service length, deliverable, and per-visit service fee are to be agreed between the procuring entity and the contractor, and the entity calls on the contractor to provide service whenever technical service is required [3].

A. Budgeting

The HM Treasury's operation manual stipulates only the fundamental principles of budgeting for proprietors to comply with (e.g. mandatory deliverables and execution risks considerations), and the calculation parameters and formulas for budgeting are not stipulated. Therefore, budgeting for service fee usually refers to similar cases in the past with considerations of project complexity and risk by the procuring entity.

When the estimated procurement amount exceeds the threshold of labor service procurement stipulated by the European Union, after the procuring entity completes budgeting, the European Union's procurement regulations should be complied with and an open bid, restricted bid or negotiated procurement conducted[7].

B. Consultant Selection

A proprietor must reveal the deliverables, required objectives and milestones, technical service provider evaluation criteria (including personnel level, economic and financial status, and technical capacity), and weighted index that a technical service provider must comply with in the form of a summary or specification, and produce a tender offer letter that invites contractors to place their bids.

The procuring entity needs to produce a Long List of the contractors that have responded to the bid invitations. Through qualification review of these responding contractors, the top 3 or 4 scoring contractors are to be included in a Short List and notified in writing to submit their bid papers.

A bidder's papers are to be enclosed in two envelopes. Envelope A shall enclose the papers concerning the bidder's service quality (e. g. project team members, contract management program), and Envelope B shall enclose the bidder's offer. The evaluation task force of the procuring entity needs to open Envelope A at a designated time to conduct the

examination and evaluation. Envelope B will not be opened before the papers enclosed in Envelope A have passed the quality threshold established by the procuring entity. The bidder that is found to have the highest ratio of proprietor's value (service quality / service fee) through the Value for Money (VFM) model wins the bid.

C. Contract Negotiation

Contract negotiation is only adopted when a service project follows the direct negotiation method (on special conditions) or has its service fee lower than the European Union's procurement threshold. Usually it will be a service project put on open bid or restricted bid, and price negotiation is not a required procedure unless it enhances the proprietor's value provided by a technical service provider (e.g. the expenses requested by a contractor are increased unreasonably compared with the proprietor's budget).

In addition, HM Treasury also provides a standard service contract focusing on the deliverables and payment terms regarding technical service projects for use by entities. HM Treasury also recommends that an entity should avoid adding or amending provisions in the contract to prevent execution risk of a technical service project.

D. Contract Management

A procuring entity should specify in a contract the cost, progress and other services mandatory to a contractor, as well as the format and frequency of data collection (or preservation), and pay the contractor according to the project progress. In addition, an entity should complete payment transaction within 30 days from receiving a payment notice and supporting documents from the technical service provider [20].

E. Contract Audit

An entity may conduct a comprehensive audit or random inspection on the contractor's accounting books, but the focus should be on the proprietor's responsibility to perform the contract, such as compliance with the technical service provider's fee calculation stipulated by the contract or verification of the actual progress claimed by the technical service provider; the technical service provider's proof of execution is not audited.

F. Cost Estimation and Payment Perspective

HM Treasury believes that the technical service fee accounts for only 2% of a project's whole life cost. However, technical service quality directly affects the remaining 98% of the project cost; even if the technical service fee increases by a large portion, it nonetheless accounts for a relatively small percentage of the whole life cost [10]. As a result, HM Treasury's primary aim is to help proprietors gain the highest value from technical service, and the charge system is relatively easy.

HM Treasury, in its charge system, follows a primary logic that allows the contractor that produces the highest proprietor's value to charge a desirable service fee. Therefore, HM Treasury does not lay down an upper limit or reference amount on the technical service fee, and a technical service provider that is

capable of producing the highest proprietor's value (service quality / service fee) may have the opportunity to win a bid. A contractor's quotation of service fee helps a proprietor to understand the contractor's actual execution expenses; in the future, a proprietor may compile a budget that better matches the actual costs incurred to the technical service provider.

In addition, HM Treasury wishes that technical service providers offer integrated technical services for proprietors. In other words, the charge system focuses on the proprietor's value that a contractor may offer, instead of deliverables. Such a concept is similar to the charge system adopted by the American management consultant industry (e.g. financial management) [5].

VI. COMPARISONS OF COST ESTIMATION AND PAYMENT SYSTEMS

Having reviewed the charge systems of several countries, it is clear that a proprietor's awareness of the technical service fee should affect the tightness of audit on charges. When a proprietor considers the fee to be too high, it will adopt a tighter control of the service fee; the contractor has reduced autonomous flexibility and must conduct its budgeting and service fee execution in compliance with the proprietor's requirements. This is the type of system adopted by the DOT of Washington State. This study calls this system a low flexibility charge system.

Conversely, HM Treasury considers that the service fee accounts for a relatively low percentage of the whole life cost and therefore adopts a relatively easier charge system, giving contractors relatively higher flexibility in budgeting and executing service fee. This study calls it a high flexibility charge system. The Japanese MLITT and China adopt systems that fall somewhere between the two abovementioned systems. That is, they consider the service fee to be relatively high in proportion to the entire construction expense, and adopt budget limitation to control the service fee. This study calls it a medium flexibility charge system.

Below is the discussion on the features of charge systems in terms of the execution procedures of commissioned technical service projects. The comparison results are summarized in Table V.

TABLE V
COMPARISON AMONG DIFFERENT CHARGE SYSTEMS

Comparison	Low flexibility	Medium flexibility	High flexibility
Country	DOT, Washington State, US	MLITT, Japan and China	HM Treasury, UK
Proprietor's aspect	Service fee is high in proportion to total construction expense (about 6-12%); fee is stringently reviewed.	Service fee is high in proportion to total construction expense (about 2.639 to 15%); cost (about 2%) and is relatively not important. fee should be controlled.	Service fee is low in proportion to whole life cost and is relatively not important.
Budgeting	Parameters and formulas are revealed as reference for price negotiation.	Japan: Parameters and formulas used in budgeting are revealed. China: Construction percentage is the primary factor.	Only the proprietor's budgeting calculation principles are revealed.
Commonly adopted method	Cost Plus a Fixed Fee	Japan: Lump Sum (budgeting by Cost Plus a Fixed Fee) China: Construction expense percentage	Lump Sum
Concept of cost control	Audit on contractor's cost Service fee is paid according to the actual costs incurred to the contractor that has the best qualification and quality.	Service fee is controlled by budget. Fixed service fee; the higher qualification and service quality a contractor has, the better the contractor.	Service fee is understood through a contractor's price quotation. Service fee is paid to the contractor that produces the highest proprietor's value.
Primary consideration	Quality	Quality	Quality / Price = Proprietor's value
Price negotiation	Negotiation	Negotiation	The principle is not to negotiate.
Examination prior to Stringent	Stringent	None	None

A. Budgeting

By referencing the service fees charged on similar projects in the past, this is a charge system commonly adopted by many governments; however, not all of them reveal the calculation parameters and formulas:

1. Low and medium flexibility charge systems reveal their calculation parameters and formulas.
2. High flexibility charge systems reveal only the calculation principles adopted by the proprietors in their budgeting.

B. Consultant Selection

Despite the fact that most countries adopt a three-stage review and selection procedure for the contractor qualification pre-award review (or restricted qualification), service quality review and price negotiation when selecting a contractor, they adopt different review and selection models according to their respective control of service fees:

1. For a charge system that follows actual cost (low flexibility charge system in the US) or somewhat fixed service fee (medium flexibility charge systems in Japan and China), the primary considerations during review and selection are the technical service provider's qualification and service quality;
2. For a charge system that follows non-fixed price agreement, price is included in the review and selection (medium flexibility in Taiwan) or proprietor's value (service quality / service fee) (high flexibility in Britain) to determine the bid winner.

C. Contract Negotiation

1. Price negotiation is rarely seen after a contract has been awarded under the high flexibility system; the service fee is entirely determined by the contractor.
2. The service fee under either a low or medium flexibility system is determined through negotiation between the proprietor and the contractor. Therefore, the reasonability of service fee is significantly influenced by the proprietor's understanding of the contractor's actual cost of execution.

execution			
Expense audit	Stringent audit on contractor's receipts	Only partial or none of the contractor's receipts are audited.	Only partial or none of the contractor's receipts are audited.
Pros	Helps to keep the service fee reasonable	Budgeting in general is relatively easier	Gives proprietor opportunity to obtain service of higher quality
Cons	A stringent audit standard readily in place and more audit personnel are required	Relatively not so easy to understand a contractor's reasonable costs; possible concern on purposeful suppression on service fee Opportunity for a proprietor to gain service of higher quality is relatively restricted	Requires sufficient amount of data on past project costs to determine the reasonability and viability of the proprietor's value offered by a contractor
Criteria applicability	for A stringent audit standard readily in place and more audit personnel are required	Requires less detailed audit standards and personnel	Requires sufficient amount of data on the costs of past projects
This study's recommendation	Adopting the American system requires a healthy accounting system; it is one of the directions advisable for the governments to also adopted for the governments to invest their efforts in improving construction technical service industry.	Cost Plus a Fixed Fee method may be adopted for budgeting if Lump Sum contract price is also adopted (for China only). Regularly update calculation formulas and parameters; a long interval is not advisable (for Japan only).	Compiling and publishing experience and data from the past will help other countries to learn from the British system.

D. Contract Management

1. Low flexibility systems adopt comprehensive audit on the contractor's costs.
2. Under either a low or medium flexibility system, a contractor's receipts are partially or not at all audited, and it is relatively harder to understand the contractor's actual cost of execution.

E. Contract Audit

Each system offers charge flexibility for contractors in different stages (including budgeting, consultant selection, price negotiation and cost audit), as shown in Fig.1.

1. Low flexibility gives the contractor relatively low flexibility from the budgeting stage to the cost audit stage; the proprietor controls the contractor's execution of costs through a stringent audit system.
2. Medium flexibility uses the budget to control the service fee. In the early stage (e.g. budgeting stage), a contractor is allowed less flexibility (which is controlled within lump sum, standardized budgeting formula or standardized fixed percentage). In the final stage (contract price), the proprietor usually does not conduct a cost audit, and the contractor may have greater flexibility.
3. Under the high flexibility system, a contractor is given greater flexibility from the budgeting stage to the cost audit stage. In other words, the service fee is entirely determined by a contractor, and the proprietor usually does not conduct an audit on the contractor's receipts.

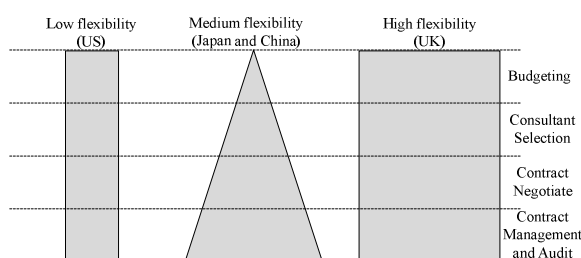


Fig. 1 Comparison of contractor's charge flexibility

VII. CONCLUSION

This study has reviewed the charge systems adopted by different countries and finds that the awareness of a high or low technical service fee affects the design of the charge system. The conclusion is drawn below:

1. In order to control high service fees, the United States (DOT, Washington State) adopts stringent pre-award, interim and final cost audits. A contractor is allowed little autonomous flexibility in budgeting and executing service fee. The major benefit of this low flexibility charge system is that it allows a reasonable service fee, while its major drawback is that it requires a stringent audit standard readily in place and more audit personnel.
2. The UK has the longest history of a technical service charge system. In the early stage, the UK adopted a standardized construction expense percentage system, and evolved to announce only the calculation principles used in the proprietor's budgeting; the bidder that offers the highest proprietor's value (service quality / service fee) wins the bid, and a contractor solely estimates the service fee (lump sum). As a result, the contractor has the greatest autonomous flexibility in budgeting and executing service fee.
3. The UK gives contractors the greatest flexibility because of its awareness of the service fee: the technical service fee accounts for very little in the whole life cost but has considerable influence. A project should not only aim for completion but also thoroughly consider future use and maintenance; this is a concept that other countries may want to adopt.
4. The UK provides only the fundamental principles for budgeting, without stipulating calculation parameters and formulas, while the proprietor's value (integrated service) is the primary consideration in consultant selection, rather than the deliverables. This system gives a proprietor the opportunity to obtain higher quality service. However, this British system is made possible by being established on years of experience and historic data. A proprietor must have sufficient historic cost data from past projects before it may arrive at a sound judgment on the reasonability and viability of the proprietor's value offered by a contractor.

5. The Japanese budgeting adopts the concept of Cost Plus a Fixed Fee (including the actual cost method and the cost estimating method) and produces well-defined calculation parameters and formulas. Despite this system being founded on the premise of fixed deliverables (stipulated standard deliverables) and assuming a fixed level of service quality as well as restricting the opportunity for a proprietor to obtain higher quality service (contrary to the British system), it at least serves the purpose of achieving detailed and realistic budgeting.
6. Both Japan and China adopt a charge system that allows proprietors to negotiate the price after a contract has been awarded. However, it should be noticed that there is a concern of purposeful suppression on service fee if there is no understanding regarding the contractor's reasonable cost. A question remains concerning the appropriateness of price negotiation without an adequate cost database on technical service costs.
7. Yong Jiang [29] proposes that the British and Americans regard technical service providers as professional agencies, and the fee charged by them is the so-called agency fee. For example, like a lawyer, an architect is paid by the hour (service time), and the subject in a transaction is the architect's service (software). In Japan, service time is not important because the subject in a transaction is the tangible result of a design (hardware); the Japanese trade technical services like merchandise. Yong Jiang [29] argues that such a difference in understanding of technical service is attributable to cultural differences between the East and the West. This argument also deserves further discussion.

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