MASTERS OF BUSINESS ADMINISTRATION

PROJECT MANAGEMENT

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Session 6 - 21st April 2021

Agenda

Session 6- 5:00 pm to 9:00 pm	
5:00 pm to 6:00 pm	Project Human Resource Management • Project Organization • Identifying Team members and roles • Communication
6:00 pm to 6:10 pm	**Coffee/Tea- Break**
6:10 pm to 7:00 pm	Procurement • Procurement Process • Selection and Evaluation •
7:00 pm to 7:15 pm	**Coffee/Tea- Break**
7:15 pm to 8:00 pm	Complete Assignment Guidelines • The Main Report • Appendices
8:00 to 8:15 pm	**Coffee/Tea- Break**
8:15 to 9:00 pm	**Reflective and Assignment Questions** • What have you learnt from this module? • Have you used any outcomes in practice? • Any questions regarding the assessment?

PROJECT MANAGEMENT

Five Critical Roles in Project Management

by Harvard Business Review Staff

November 03, 2016

When you're managing a project, To meet your project objectives, you need the right people on board—and they must have a clear understanding of their roles. Here's a breakdown of who does what.

Sponsor

The sponsor champions the project at the highest level in the company and gets rid of organizational obstructions. She should have the clout to communicate effectively with the CEO and key stakeholders, provide necessary resources, and approve or reject outcomes. It's also important that she have "skin in the game"—in other words, accountability for the project's performance.

Project Manager

The project manager identifies the central problem to solve and determines, with input from the sponsor and stakeholders, how to tackle it: what the project's objectives and scope will be and which activities will deliver the desired results. He then plans and schedules tasks, oversees day-to-day execution, and monitors progress until he evaluates performance, brings the project to a close, and captures the lessons learned. The project manager receives authority from the sponsor. In many respects, he's like a traditional manager because he must:

- Provide a framework for the project's activities
- Identify needed resources
- Negotiate with higher authorities
- Recruit effective participants
- Set milestones

- Coordinate activities
- Keep the vision clear and the work on track
- Make sure everyone on the team contributes and benefits
- Mediate conflicts
- Make sure project goals are delivered on time and on budget

Team Leader

Large projects may include a team leader, who reports directly to the project manager. In small projects, the project manager wears both hats. The team leader cannot act like the boss and still obtain the benefits of team-based work. Instead, he must adopt the following important roles:

- *Initiator*. Rather than tell people what to do, the leader draws attention to actions that must be taken for team goals to be met.
- *Model*. He uses his own behavior to shape others' performance—by starting meetings on time, for example, and following through on between meeting assignments. Leaders often rely heavily on this tactic, since they typically cannot use promotions, compensation, or threats of dismissal to influence team members.
- *Negotiator*. He gets what he needs from resource providers by framing the project as mutually beneficial.
- *Listener*. He gathers from the environment signal of impending trouble, employee discontent, and opportunities for gain.
- *Coach*. He finds ways to help team members maximize their potential and achieve agreed-upon goals. Coaching opportunities are abundant within teams because the skills members eventually need are often ones they don't already have.
- *Working member*. In addition to providing direction, the leader must do a share of the work, particularly in areas where he has special competence. Ideally, he should also take on one or two of the unpleasant or unexciting jobs that no one else wants to do.

Team Members

The heart of any project, and the true engine of its work, is its membership. That's why bringing together the right people is extremely important.

Criteria for membership

Although the skills needed to accomplish the work should govern team selection, keep in mind that you're unlikely to get all the know-how you need without providing some training. Consider the following areas of proficiency:

- Technical skills in a specific discipline, such as market research, finance, or software programming
- Problem-solving skills enabling individuals to analyze difficult situations or impasses and to craft solutions
- Interpersonal skills, particularly the ability to collaborate effectively with others—a critical aspect of team-based work
- Organizational skills, including networking, communicating well with other parts of the company, and navigating the political landscape, all of which help the team get things done and avoid conflicts with operating units and their personnel

When forming project teams, people tend to focus too narrowly on technical skills and overlook interpersonal and organizational skills, which are just as important. For instance, a brilliant programmer may thwart team progress if she is unwilling to collaborate. By contrast, an organizationally savvy person with average technical skills may be the team's most valuable member, thanks to his ability to gather resources and enlist help from operating units.

Individuals who are strong on all four skill measures are few and far between. Make the most of the talent available, and take steps to neutralize weaknesses in your group. Look for people not just with valued skills but with the potential to learn new ones. Once you identify a candidate for membership, discuss her potential contribution with the sponsor. Consult her supervisor as well, since team membership absorbs time that would otherwise go toward regular assignments.

You may have to add new members and possibly bid thanks and good-bye to others over time, as tasks and needs change. One note of caution: Team members gradually develop effective patterns for working together, making decisions, and communicating. Cohesion is undermined when too many people join or exit the team.

Contributions and benefits

Free riders—team members who obtain the benefits of membership without doing their share—cannot be tolerated. However, not every member has to put in the same amount of time. For example, a senior manager who must direct much of his attention to other duties may still add value to the project by securing resources or by building support within the organization.

Just as each member must contribute to the team's work, each should receive clear benefits: a learning experience that will pay career dividends, for instance, or a fatter paycheck or bonus. Otherwise, individuals will not participate at a high level—at least not for long. The benefits

they derive from their regular jobs will absorb their attention and make your project a secondary priority.

Alignment

The goals of the project team and those of its individual members must align with organizational objectives. For that reason, everyone's efforts should be coordinated through the company's rewards system. This kind of reinforcement begins at the top, with the sponsor. Since she is accountable for the team's success, some part of her compensation should be linked to the team's performance.

Moving down the line, the project manager and team members should likewise see their compensation affected by team outcomes. Such alignment gets everyone moving in the same direction.

The Project Steering Committee

Some projects have a steering committee, which consists of the sponsor and all key stakeholders. The committee's role is to approve the charter, secure resources, and adjudicate all requests to change key project elements, such as deliverables, the schedule, and the budget.

A steering committee is a good idea when different partnering companies, units, or individuals have a strong stake in the project. Because it represents these various interests, it is well positioned to sort out complicated interfirm or interdepartmental project problems.

Likewise, it can be helpful if you anticipate many change requests. The downside to having a steering committee? It involves another level of oversight, and its meetings take up the time of some of the company's most expensive employees. So don't have a committee if you don't need one.

Adapted from HBR Guide to Project Management*; content originally published in* Harvard Business Essentials: Managing Projects Large and Small*, Harvard Business Review Press, 2004.*

This article is about PROJECT MANAGEMENT

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5 COMMENTS

Jessica Copeland 4 months ago

The article does a nice job of succinctly explaining the role of the project manager. However as a female project management professional, I do take exception to the exclusive use of male pronouns in this article.

Reply 0 0

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In construction projects an independent quantity surveyor is employed to protect the owner's interests by certifying contractors' invoices for progress payments. The engineer's role has some similarities but is wider, and the engineer will be expected to visit the project design offices from time to time to review the contractor's design progress and performance. The engineer will often have to certify the contractor's invoices to the owner (or a funding bank) for design stage payments. The role of the engineer is explained more fully in Marsh (2001).

Project Management Office (PMO)

Unless the organization is too small to support the additional expense, it makes sense to support the project management function by setting up a central project management services group or project management office. This group is staffed with people (not too many!) who are capable of taking on the day-to-day chores of project administration. The initials PMO can mean a project management office, which gives support to the project manager. Alternatively PMO can mean a programme management office, identical in composition with a project management office but more likely reporting to a programme manager or projects director.

Figure 11.2 shows two different ways in which a PMO might fit into a project management organization. Both organizations shown are for multi-project (programme) operations, but in the upper half the company operates as a matrix, whilst in the lower half multiple teams are shown.

A PMO concentrates a company's expertise in the techniques of project management just as any other functional group can enhance a particular professional discipline. Centralization helps to standardize project administration procedures across all projects in a company. It is even possible that a PMO could act as project coordinator for small projects. Some or all of the following roles might be found in a PMO.

Planning engineer

Planning engineers are ideally people who have the ability, one might even say the gift, of looking at the many tasks necessary to perform a project and then, using methods that will be described in Chapters 12 to 16, are able to make sense of complexity and reduce the problems of matching tasks, time and resources to a working plan that everyone can understand and follow. A good planning engineer will be capable of chairing a planning meeting attended by senior members of the project team and, by asking appropriate questions, coaxing out all the information needed to place tasks in their logical sequence and estimate their durations.

Cost engineer

The principal job of a cost engineer is to estimate, or assist in estimating project costs, and thereafter to communicate with the cost accounts department to monitor project costs against budget and report regularly to the project manager.

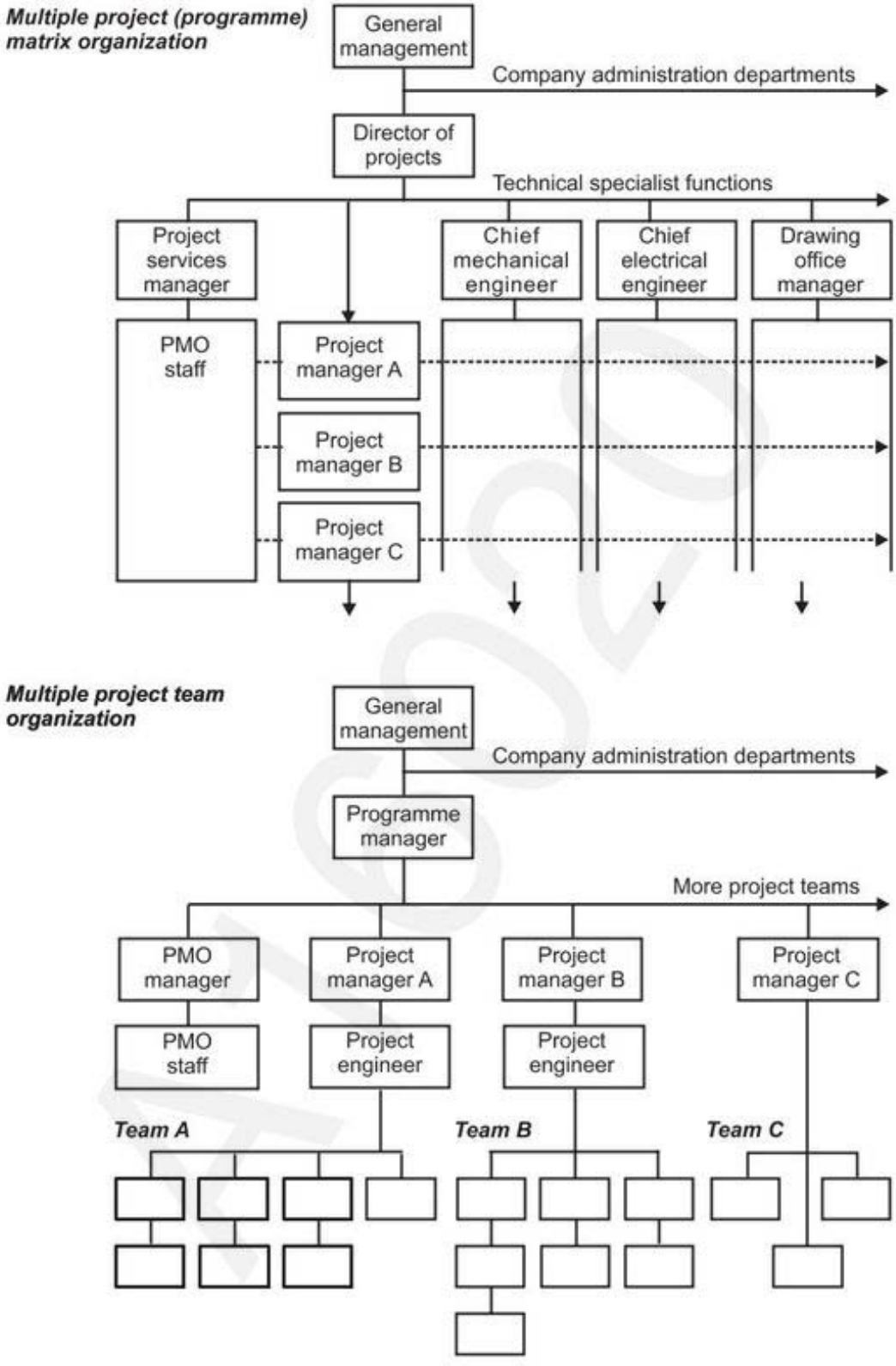


Figure 11.2 Two of very many possible programme organizations

The roles of planning engineer and cost engineer are often combined. People with these skills will also know how to operate earned value analysis (a method described in Chapter 25).

Contracts administrator

Although the initial contract for any external project must usually be agreed under some supervision from a person who is qualified to deal with legal documents, once a project goes live much detailed work of an administrative nature is required to ensure that all details of a contract remain up-to-date and valid as the project progresses through its life cycle, That includes recording all approved changes to the project, whether generated internally or externally as project variations.

A contracts administrator will often have the duty to record claims made for payment and might be required to prepare invoices.

Change coordinator

In a large project a separate person might be required to register and administer project change requests to ensure that they are followed through from initial consideration to implementation and incorporation in project documents and cost records. Change procedures are described in Chapter 23. This is closely associated with the role of contracts administrator and the two roles might be combined in a small organization.

Progress clerk

Some projects need a progress clerk whose duties include distributing work-to lists and then following up on a day-by-day basis to check progress and report back to the project manager, particularly highlighting any exceptions (failures to meet scheduled progress).

Project clerk

Most projects generate many documents and much correspondence and so one or more clerks are needed to ensure that all significant documents are filed safely so that they can later be retrieved. Project clerks are also useful for arranging the carriage of hard copy documents, however received or transmitted. In a large project organization there might be a group of clerks operating in a central registry.

IT support

Some powerful project management computer systems, especially those handling multi-project scheduling, are best placed under the supervision of specially trained experts. Those experts must have a good working knowledge of all the organization's projects and combine that with special training in using the system and safeguarding the integrity of its database and back-up files. The PMO, rather than the organization's regular IT department, can be an excellent place in which to place that responsibility.

Project Management Institute

WHITE PAPER

April 2014

The Project Management Office: Aligning Strategy & Implementation

Organizations talk a good game about strategy. But without the right projects and programs to carry them out, even the most forward-thinking strategies fail. To help bridge the chasm between high-level strategic vision and in-the-trenches implementation, many organizations turn to a project management office (PMO).

"A strong PMO delivers two distinct areas of improvement to the organization," says Greg Wood, managing director of the corporate PMO for Rio Tinto, a metals and mining corporation and a PMI Global Executive Council member in Brisbane, Australia. "It helps organizations choose the right projects to deliver, and it helps them deliver projects correctly."

It's not enough for projects to come in on time and on budget. They must also be in sync with strategy, or "it's just wasted capital," he says.

Organizations continue to struggle: *PMI's Pulse of the Profession®: The High Cost of Low Performance* found less than half (42 percent) of organizations report high alignment of projects to organizational strategy.[1]

That's simply not good enough in today's hyper-volatile business world. Organizations must strike the right strategic response—and they must do it quickly. According to the 2014 PwC survey, at least three-quarters of CEOs acknowledge the need for change or are developing strategies for change in response to global forces.[2]

A 2013 Economist Intelligence Unit (EIU) report sponsored by PMI echoes the findings, with almost 90 percent of senior executives reporting that executing strategic initiatives is essential for their organization's competitive advantage. Yet 61 percent admitted they struggle with executing on those strategies. Moreover, in the last three years an average of just 56 percent of strategic initiatives have been successful.[3]

It's a vicious and expensive cycle—one that PMOs can help prevent.

Source: *PMI's 2013 Pulse fo the Profession® In-Depth Report: The Impact of PMOs on Strategy Implementation*

PMOs deliver an average of

US$71 million

to organizations in the form of revenue or cost reductions.

Source: PMI's *Pulse of the Profession® In-Depth Report: The Impact of PMOs on Strategy Implementation*[iv]

That value takes many forms. Sometimes it's the PMO's ability to establish the processes that enable a major change initiative to deliver results right out of the gate—and into the future. Sometimes it's building the talent that knows when to pass on a pricey megaproject that's not in line with strategy. Other times, it's the PMO drawing on years of rich project performance data to prove a knowledgeable—and objective—voice.

"No other group in the organization understands the real project issues the organization faces more than the PMO," Mr. Wood says. "If executives want to know the truth about projects and the people responsible for them, the PMO is who they should ask."

CASESTUDY PMO IN ACTION

Organization: Verizon Wireless, New York, New York, USA
Industry: Mobile network operations
Lesson Learned: A PMO delivers business results by not only improving the performance of its projects but making sure those projects sync with strategy

When Verizon Wireless, a PMI Global Executive Council member, launched its first PMO in 2005, the new team had few roadmaps to follow. The company had some project management practices in place, but no way of knowing if its projects were helping to achieve its strategic goals.

"At the time, no one had an objective view of what was going on," says Cara Washington, PMO director for the company's marketing department, New York, New York, USA. "There was no system in place to say, 'These are the projects we need to do to meet our objectives,' which meant the loudest voice in the room got his or her project approved."

These days, the PMO assesses a project's business case with a one-to-four scoring system that quantifies how strongly it aligns with strategic goals. "We are smarter about which projects we put forward and about not supporting projects that don't meet those criteria," says Ms. Washington.

The PMO also assigns project managers to projects as soon as they're approved to ensure engagement in planning and decision-making from the outset.

The PMO's push for strategic alignment ensures projects help the company achieve its business goals. And, she says, as Verizon's strategies have changed over the years, so too have the PMO's. The company's current focus, for example, is on reducing project cycle times. And backed by standardized project management processes, teams are delivering real results.

> ***When I first started the PMO, it took 18 to 24 months to get a product out the door. Now we're down to 10.3 months.***
>
> ~ **Cara Washington**, PMO Director
> Verizon Wireless
> New York, New York, USA

RIGHT TIME, RIGHT TYPE

Not every organization needs a PMO, of course, but certain signs could indicate it's time to consider one. If an organization struggles to deliver high-performance projects, that's one clear indicator, says Luis Fernando Torres, PMP, founder and partner-director of project management training firm 2Towers: Treinamento & Tecnologia, São Paulo, Brazil.

Yet that's not the only flag. An organization flush with project successes might still benefit from a PMO if:

- The organization lacks uniform management and oversight processes
- Leadership has trouble gathering information about project progress and results
- Project goals consistently don't align with business goals

If an organization decides to establish a PMO, there's no one-size-fits-all solution. PMI's *Pulse of the Profession: PMO Frameworks* outlines five of the most common[5]:

1. **Business unit PMO:** Provides project-related services to support a division within an organization
2. **Project-specific PMO:** Offers project-related services as a temporary entity to support a specific project or program
3. **Project support controls office:** Initiates processes to continuously support the management of an organization's projects, programs or portfolios
4. **Enterprise PMO:** Responsible for the alignment of projects and programs to corporate strategy
5. **PMO center of excellence:** Supports project work by equipping the organization with standards and tools to better deliver projects

Fujitsu UK&I, a PMI Global Executive Council member, relies on multiple PMOs, including one at the senior management level. That PMO is responsible for setting the organization's project management strategy and focusing on process improvements related to organizational goals, such as growing the business, moving into new markets and increasing social responsibility.

> ***In a sizable organization, if the PMO is too high-level, it can be hard to manage day-to-day project issues. Having business unit PMOs enables us to get a handle on all of our projects at the right level.***
>
> ~ **Paul Jones**, Head of PMO
> Fujitsu UK&I
> London, England

"Most of our projects are customer-facing, so our strategic alignment comes from ensuring that we help deliver business benefits for our customers and that they are happy with the projects we deliver," says Paul Jones, head of the PMO for the London, England-based branch of the global information and communication technology company.

Fujitsu also has PMOs in all of its major business units to ensure they adhere to governance and standards and that their projects meet schedule, budget and quality goals. For a large company like Fujitsu, which at any time may have up to 800 projects worth £600 million, such a network of PMOs helps keep things manageable.

FROM THE TOP DOWN

No matter its structure, a PMO without executive support probably won't get very far. "If the executive team is secretive and unwilling to engage the PMO in strategic planning, it makes it much harder for the PMO to add value to the organization," says 2Towers' Mr. Torres.

Those PMOs considered highly effective at driving business growth report directly to someone in the executive suite, according to Forrester Consulting's "Strategic PMOs Play a Vital Role in Driving Business Outcomes", a research study commissioned by PMI.[vi] The report also found that the majority of the PMO leaders interviewed have highly visible sponsorship at the C-level.

"If organizations want to get the most value out of a PMO, they must put it at the strategic level, so it is close enough to senior management to help it make the best project decisions for the business," says Piotr Stachowicz, PMP, senior vice president at PMI Global Executive Council member Citi.

The Economist Intelligence Unit report reinforced the need for support from the corner office. It found the top reasons for the success of strategic initiatives are leadership buy-in and support. Yet only half of those surveyed said that strategy implementation as a whole receives appropriate C-suite attention.

Rio Tinto decided it needed a PMO based on a consulting group's recommendation. The company's management put Mr. Wood in charge, but he wasn't assigned an executive sponsor. That meant he and his team had to secure buy-in from the rest of the organization largely on their own.

They spent three years building the company's capital management processes, systems and tools, and making presentations to business unit leaders that demonstrated the value of a strong project management practice. Eventually, they won support across many business units and began seeing improvements in project delivery. "It takes much longer for the PMO to add strategic value when you have to take only a bottom-up approach," he says.

CASESTUDY PMO IN ACTION

Organization: Citi, Warsaw, Poland
Industry: Financial services
Lesson Learned: When strategy shifts, a PMO can help map a way forward.

The leadership team at Citi knows strategic goals must change as the marketplace changes. Global economic issues and swings in the competitive landscape can alter the company's business drivers, creating a cascade of change, large and small, across the portfolio.

As priorities shift, the PMO can be a powerful ally in helping executives decide which projects to launch, accelerate, delay or shut down. "That's why it is so important for the PMO to be at as high a level as possible and to have senior-level sponsors," says Citi's Mr. Stachowicz.

In the financial industry, for example, new rules and regulations often force companies like Citi to quickly reprioritize its investments. "We can't afford to risk missing a regulation deadline, so there is no question that those projects are the highest priority," he says.

When such a change occurs, resources dedicated to other projects may need to be reallocated. If a regulatory project requires IT expertise, for example, an internal IT project might be shelved so its team members can support the new initiative. "The PMO works with the business to figure out how we can make room for that regulatory project with minimal impact to the organization," Mr. Stachowicz says.

The PMO looks at each project's expected, measurable value and its alignment with one or more of the company's strategic goals: improving service quality, driving financial performance, supporting innovation, reducing risks and improving the corporate culture.

Projects that don't measure up are likely to be the first to lose resources. "It's challenging, given Citi's geographical presence and scale of business, to say, 'This project is more important than that one,'" but those tough calls are just part of the job, he says.

ALL-STAR TEAM

A PMO's processes mean little without the right talent. High-performing PMOs are more than twice as likely as low performers to have the right skills base (58 percent versus 27 percent) and are much more likely to have adequate numbers of people (42 percent versus 24 percent), according to the Pulse in-depth report on PMOs and strategic implementation.

And when organizations fail to invest in that talent, projects suffer—and so does strategy. More than a third of respondents to the Pulse in-depth report say insufficient human resources (both in terms of raw numbers and appropriate level of training) is one of the biggest barriers to successful strategy implementation.

As a foundation, PMO staffers must understand all of the core project management tools and practices. Rio Tinto's Mr. Wood recommends organizations look for project talent adept at cost control, planning and scheduling, cost estimating, contract management, risk management and project procurement.

PMO staffers must also have strong business acumen, leadership and decision-making skills, advises Mr. Torres. If not, organizations risk staffing a PMO with staff adept at day-to-day tasks but unable to understand the broader strategic impact of their work.

It's a perilous gap given the growing demands on PMOs.

Unlike an organization's other project practitioners, the PMO team doesn't just adhere to core project management practices. It makes sure those processes, policies, training, communication and reporting requirements result in projects that meet schedule and budget goals as well as produce business value, says Krissy Wolle, PMP, PgMP, IT portfolio lead and director of operations in the enterprise PMO at Optum Technology, Plymouth, Minnesota, USA.

PMO staff must lead the way in helping teams understand the organization's strategic goals and equipping them with the tools to deliver projects and programs aligned with those goals.

> ***The holy grail is a PMO staffer who can seamlessly switch between operations and execution, theory and practice, delivering work and leading others to deliver work.***
>
> ~ **Krissy Wolle, PMP, PgMP**
> IT Portfolio Lead and Director of Operations
> Optum Technology
> Plymouth, Minnesota, USA

MEASURING VALUE

With the right processes and the right talent in place, a PMO may be fairly confident it's getting the job done. But the only way to really tell is through the metrics, the lifeblood of a PMO.

"The reason the PMO exists is to improve capital performance," Mr. Wood says. At the very least, metrics should track capital performance across the organization at both the project and portfolio level, with highlights reported to senior management, he says.

Armed with that data, executives can pit current trends against the organization's long-term performance. But the most worthwhile comparisons aren't limited to within the company walls. PMOs should also consider benchmarking themselves against other organizations, Mr. Wood says. "Metrics on their own are OK, but to be effective you need to know where you sit against your peers."

And PMOs should be looking beyond budget, scope and schedule to business-driven metrics, such as time to delivery and customer satisfaction. Almost one half of high-performing PMOs measure themselves by criteria other than simple project metrics, according to the Pulse in-depth PMO report. The high performers' assessment process regularly includes feedback from customers (76 percent), project owners (61 percent) and other stakeholders (60 percent).

> ***The key for the PMO is to look at the organization's strategy and values, and set metrics to support that.***
>
> ~ **Piotr Stachowicz, PMP**
> Senior Vice President, Citi
> Warsaw, Poland

One of Citi's current strategic goals, for example, is to rein in budgets. In aiming to optimize cost structures while bolstering efficiency, he says, the PMO is considering projects to reduce the number of data centers or to virtualize servers.

"These examples are ideas related to strategic execution," he says, moving the needle on metrics that correlate directly to the organization's strategic vision.

CASESTUDY PMO IN ACTION

Organization: Optum Technology, Plymouth, Minnesota, USA
Industry: Healthcare
Lesson Learned: A PMO delivers business value by consistently measuring project progress against strategic goals.

Optum Technology is looking to gain efficiencies by cutting the time it takes to deliver IT projects. To achieve that goal, the PMO team focuses on cycle time right from the start—scrutinizing schedules and looking for spots where tasks can be completed more quickly. Once the project launches, it tracks the project metrics that directly impact cycle time, including whether teams complete estimates and deliver artifacts on time, and when and whether requirements are met.

While the PMO relies on metrics to demonstrate value, it also makes sure they don't get in the way of performance. For example, PMO staffers knew that to improve overall efficiency—and thereby reduce cycle time—teams needed to be better at estimating the time it takes to deliver each task. A jump in forecasting accuracy would help the PMO eliminate overruns, streamline the schedule and set shorter turnaround goals with more confidence.

So Ms. Wolle's team aligned estimating criteria with annual budget goals and set metrics at every project milestone to measure that alignment. But when her team executed the new tracking system, it discovered that the strict requirements actually hurt budget forecasting.

> ***The metrics help us identify what's working and determine where problems are that are impacting cycle time so we can address them.***
>
> ~ **Krissy Wolle, PMP, PgMP**
> IT Portfolio Lead and Director of Operations
> Optum Technology
> Plymouth, Minnesota, USA

"If a project team adjusted its hours or budget in response to a necessary change, it got dinged on its estimating accuracy," she says. So teams began to pad their estimates. When the PMO realized the estimating metrics interfered with the more important forecasting objectives, it adjusted priorities to focus on forecasting accuracy. "Now the forecasting accuracy is improving, which we predict will lead to better results," she says.

The takeaway is clear: "Make sure whatever you measure is tied to the highest-level priorities," Ms. Wolle says. And make sure everyone involved grasps the strategic value of metrics—and the project. "People want to understand how their individual contribution impacts the larger organization."

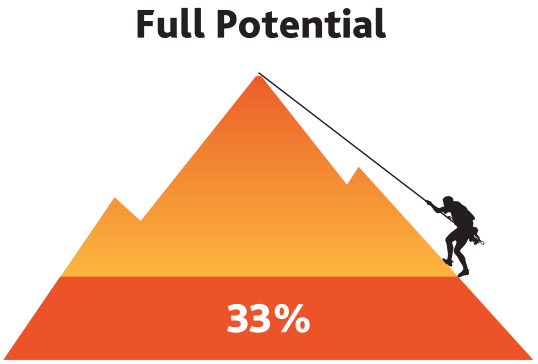
SUMMARY

Not every organization needs a PMO—and creating one isn't an immediate salve to heal project and program woes. The Pulse in-depth report on PMOs revealed that just 33 percent of respondents said their organization's PMO has realized its full potential in contributing business value to the organization.

To fulfill that potential, the PMO must ensure that the organization invests in—and delivers on—the projects and programs that will drive its strategic vision.

The PMO takes an active part by defining and planning the project pipeline, securing resources and regularly monitoring and reporting progress.

~ **Piotr Stachowicz, PMP**
Senior Vice President, Citi
Warsaw, Poland



Source: *PMI's 2013 Pulse fo the Profession® In-Depth Report: The Impact of PMOs on Strategy Implementation*

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Article

Project Procurement Method Selection Using a Multi-Criteria Decision-Making Method with Interval Neutrosophic Sets

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Abstract: Project procurement method (PPM) selection influences the efficiency of project implementation. Owners are presented with different options for project delivery. However, selecting the appropriate PPM poses great challenges to owners, given the existence of ambiguous information. The interval neutrosophic set (INS) shows power to handle imprecise and ambiguous information. This paper aims to develop a PPM selection model under an interval neutrosophic environment for owners. The main contributions of this paper are as follows: (1) The similarity measure is innovatively introduced with interval neutrosophic information to handle the PPM selection problem. (2) The similarity measure based on minimum and maximum operators is applied to construct a decision-making model for PPM selection, through considering the truth, falsity, and indeterminacy memberships simultaneously. (3) This study establishes a PPM selection method with INS by applying similarity measures, that takes account into the determinacy, indeterminacy, and hesitation from the decision experts when giving an evaluation value. A case study on selecting PPM is made to show the applicability of the proposed approach. Finally, the results of the proposed method are compared with those of existing methods, which exhibit the superiority of the proposed PPM selection method.

Keywords: project procurement method selection; multi-criteria decision-making; interval neutrosophic sets; similarity measure

1. Introduction

Intensifying competition among construction companies and increasing project complexity pose project management challenges to owners in the construction industry. The selection of an appropriate project procurement method (PPM) plays a key role in project management [1,2]. The appropriate PPM could reduce project costs by an average of 5% [3]. The most common PPMs in the construction industry include Design Bid Build (DBB), Design Build (DB), Construction Management (CM), Engineering Procurement Construction (EPC), construction management as program management (CM) [4,5], and Public Private Partnership (PPP) [6,7]. Each form of PPM is unique and cannot be effectively

applied to all projects because of their different characteristics [4,8]. To determine the sustainability of a construction project, selecting an appropriate PPM is a key task for owners [1,2].

The PPM selection problem is also called project delivery system (PDS) selection in the engineering field. Researchers have conducted numerous works on PDS selection [5,8–10]. Gordon suggested that an organization and contract strategy should be considered in PDS selection [10]. Alhazmi and McCaffer divided PDSs into three types and proposed a four-step model selection process [8]. Li et al. proposed a PDS selection model wherein information entropy is used to calculate attribute weights and unascertained set theory is applied to select the suitable PDS [11]. Mahdi and Alreshaid proposed a multi-criteria decision-making methodology that utilizes the AHP method for PDS selection [12]. Ng et al. [13] proposed the membership functions of fuzzy criteria in an empirical study. A fuzzy PDS selection model was constructed by incorporating fuzzy relation rules and selection criterion weights [14]. An et al. established a group decision-making model for PDS selection under the interval intuitionistic fuzzy setting, wherein a new weight determination for a decision maker is introduced by using the information utility level [4]. Li et al. developed new similarity measures with interval Pythagorean fuzzy sets and applied them to choose a suitable PDS for a project [15]. Mafakheri et al. utilized the interval AHP to determine the interval priorities for alternative PDSs, which were then ranked using rough set theory [16].

From the existing research, the evaluation information for all criteria affecting PDS selection was characterized by fuzzy sets, such as intuitionistic fuzzy [17,18] and Pythagorean fuzzy [19], which require the sum or square sum of membership and non-membership degrees smaller than one. In other words, there is a constraint to decision experts when giving evaluation values. Actually, too many restraints imposed on decision experts can give a low effectiveness evaluation result, and then lead to the selection of a suboptimal PDS. Neutrosophic sets, introduced by Smarandache [20], need a very loose constraint, in which each component (truth membership, falsity membership, or indeterminacy) is smaller than 1 and larger than 0. Later, the neutrosophic set theory was generalized. Wang et al. [21,22] presented the concepts of single valued neutrosophic sets and interval neutrosophic sets (INS). Peng developed a new multi-parametric similarity measure and distance measure for interval neutrosophic sets, and applied them to evaluate the Internet of Things (IOT) industry decision-making issue [23]. Sahin developed two multi-criteria methods using the interval neutrosophic cross-entropy, and used them to select a company as an object investment [24]. Based on a single valued neutrosophic number, a model for evaluating and selecting a transport service provider was presented by Liu et al. [25].

Though the available research gave abundant theoretical foundation, two major aspects should be approached by further research: (1) The process of calculation in the existing similarity measures is too complex to apply to more practical fields, it is necessary to introduce a general theory measuring the closeness degree between two objects. (2) The existing similarity measures applying to PDS selection under INSs ignore the "true psychological" behavior and degree of confidence from decision experts. Mondal et al. proposed a tangent similarity measure under interval neutrosophic sets, which considered the weighted mean value of the degrees of truth membership, indeterminacy, and falsity membership [26]. Ye presented a cosine similarity measure under a neutrosophic environment, through calculating the relative proportion between truth membership and the Euclid distance of the degrees of truth membership, indeterminacy, and falsity membership [27]. Actually, to ensure the effective evaluation information, the degree of confidence for decision experts plays an important role in the process of PPM selection. To bridge these gaps, this work aims to develop a decision-making model for PPM selection under an interval neutrosophic environment. First, the main difficulty in INSs lies in the comparison of two interval numbers. To overcome this, the interval number is transformed into its alternative representation. Second, a PPM selection method under the interval neutrosophic setting is constructed using the similarity measures presented in [28]. The similarity measures used in this study are superior to other similarity measures because they consider the indeterminacy degrees of judgment from evaluators. Finally, the proposed PPM selection method is applied to solve a PPM selection problem.

The rest of this paper is organized as follows. The decision-making framework for PPM selection is provided in Section 2, including the criteria and the selection process of PPMs. Preliminaries regarding the interval number, neutrosophic sets, INSs, and similarity measures are introduced in Section 3. The establishment of the decision-making model for PPM selection based on similarity measures is discussed in Section 4. An example using the proposed PPM selection model is given in Section 5. The comparative analysis and conclusions are presented in Sections 6 and 7, respectively.

2. Decision-Making Framework for PPM Selection

The PPM for a proposed construction project can be selected from Design Bid Build (DBB), Design Build (DB), Construction Management (CM), and Engineering Procurement Construction (EPC). The DBB is a traditional contract approach in which design, build, and management are distributed to different units by the owner. The DB is a model in which the owner signs a contract with the contractor, and then the contract takes the design and build of the project. The CM is a model including construction and management, which adopts "design and construction" to accelerate the progress of construction. Finally, the EPC is a kind of general contracting, that is, the general contractor not only charges the project design, procurement, construction, and commissioning services, but also takes responsibility for the quality, safety, time, and cost overall responsibility, in accordance with the contract. Li et al. showed that numerous factors should be considered in PPM selection [16], in which all criteria for selecting PPMs are interpreted as shown in Figure 1.

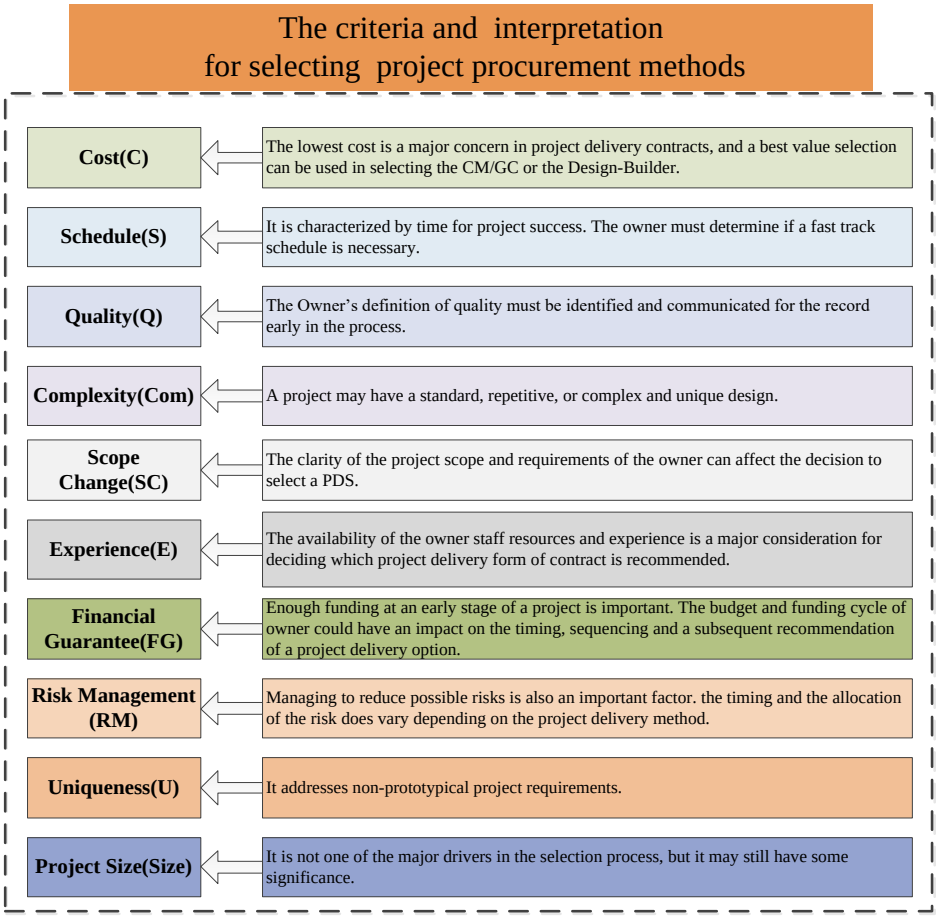

Figure 1. The criteria and interpretation for project procurement method (PPM) selection.

Actually, PPM selection is a typical decision-making problem. Based on the line of decision-making, to obtain the best suitable PPM, the criteria for PPM selection are firstly determined, and the evaluation data about all criteria affecting PPM selection is collected. Then, a matching decision-making approach

is chosen. Finally, combining data given by evaluation experts and a decision-making approach, the suitable PPM is obtained. The selection process of PPMs is shown in Figure 2.

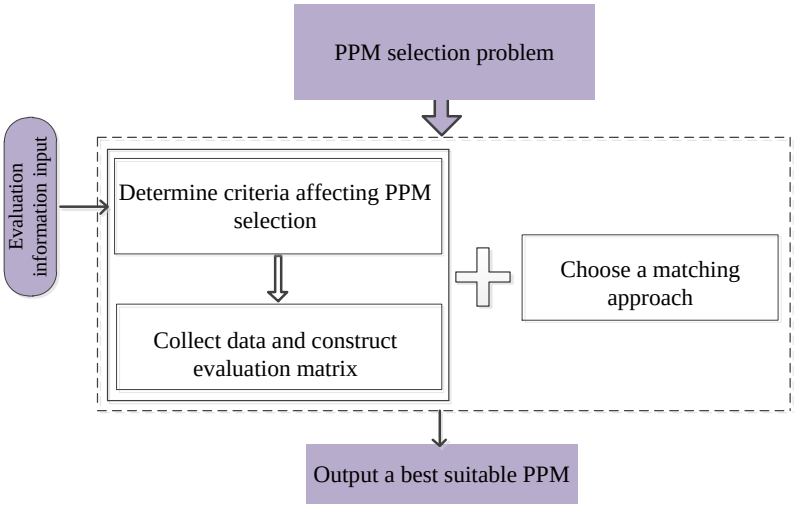

Figure 2. The selection process of PPMs.

3. Methodology for the PPM Selection

This section presents the methodology for PPM selection, which mainly includes two parts—preliminaries about interval numbers and INSs, and similarity measures between INSs based on minimum and maximum operators. These are the basic theories for establishing the selection of PPM.

3.1. Preliminaries

In this subsection, we provide some basic concepts and definitions of interval numbers and INSs, including their operational laws. They are utilized in the analysis.

Interval numbers and their operations are of utmost significance for developing the operations of INSs. Some definitions and operational laws of interval numbers are introduced below.

Definition 1. **[29]** *Let* $\tilde{a} = \left[a^L, a^R\right] = \left\{a \middle| a^L \le a \le a^R\right\}$*, then* $\tilde{a}$ *is called an interval number. In particular, if* $a^L = a^R$*, then* $\tilde{a} = \left[a^L, a^R\right]$ *is a real number.*

Interval number $\tilde{x}$ is alternatively represented as $\tilde{a} = \langle m(\tilde{a}), w(\tilde{a})\rangle$ [29], where $m(\tilde{a}) = \frac{1}{2}\left(a^L + a^R\right)$ and $w(\tilde{a}) = \frac{1}{2}\left(a^L - a^R\right)$.

Accordingly, we provide a representation of an interval number and compare two interval numbers.

Definition 2. **[30]** *Let* $\tilde{a} = \left[a^L, a^R\right]$ *and* $\tilde{b} = \left[b^L, b^R\right]$ *be two interval numbers, then*

$$\tilde{a} + \tilde{b} = \left[\min\left(a^L + b^R, a^R + b^L\right), \max\left(a^L + b^R, a^R + b^L\right)\right];\ \tilde{a} = \left[a^L, a^R\right];$$

$$\tilde{a} \times \tilde{b} = \left[\min\left(a^L \cdot b^R, a^R \cdot b^L\right), \max\left(a^L \cdot b^R, a^R \cdot b^L\right)\right];\ 1/\tilde{a} = \left[1/a^R, 1/a^L\right].$$

Definition 3. **[28]** *Let* $\tilde{a} = \left[a^L, a^R\right]$ *be an interval number, and then*

$$\tilde{a} = m(\tilde{a}) + w(\tilde{a})\mathrm{i}, \tag{1}$$

where $\mathrm{i} \in [-1, 1]$, $m(\tilde{a}) = \frac{1}{2}\left(a^L + a^R\right)$, *and* $w(\tilde{a}) = \frac{1}{2}\left(a^L - a^R\right)$.

Considering two non-negative interval numbers $\tilde{a} = \left[a^L, a^R\right]$ and $\tilde{b} = \left[b^L, b^R\right]$, where $0 \le a^L \le \tilde{a} \le a^R$ and $0 \le b^L \le \tilde{b} \le b^R$, we define the following:

(a) If $m(\tilde{a}) \ge m(\tilde{b})$ and $w(\tilde{a}) \ge w(\tilde{b})$, then $\tilde{a}$ is greater than $\tilde{b}$, that is, $\tilde{a} \ge \tilde{b}$;
(b) If $m(\tilde{a}) \ge m(\tilde{b})$, then $\tilde{a}$ is quasi-greater than $\tilde{b}$, that is, $\tilde{a} > \tilde{b}$.

Definition 4. **[20]** *Let X be a space of points (objects). Then, a neutrosophic set A is defined as $A = \{\langle x : T_A(x), I_A(x), F_A(x)\rangle, x \in X\}$, where functions $I_A(x)$, $T_A(x)$, $F_A(x)$: $X \to [^-0, 1^+]$ are the truth, indeterminacy, and falsity memberships, respectively, and satisfy the condition $^-0 \le \sup T_A(x) + \sup I_A(x) + \sup F_A(x) \le 3^+$.*

In contrast to a neutrosophic set, an INS has a wide range of applications. An INS is defined as follows.

Definition 5. **[31]** *Let X be a space of points (objects) with a generic element $x \in X$. An INS A is defined as $A = \{\langle x : T_A(x), I_A(x), F_A(x)\rangle, x \in X\}$, where functions $T_A(x) = \left[T_A^L(x), T_A^R(x)\right] \subseteq [0,1]$, $I_A(x) = \left[I_A^L(x), I_A^R(x)\right] \subseteq [0,1]$, and $F_A(x) = \left[F_A^L(x), F_A^R(x)\right] \subseteq [0,1]$ are the degrees of truth membership, indeterminacy, and falsity membership, respectively, and satisfy the condition $0 \le T_A^R(x) + I_A^R(x) + F_A^R(x) \le 3$.*

Two INSs have the following relationships:

Definition 6. **[20]** *An INS A is contained in another INS B, i.e., $A \subseteq B$, if and only if*

$$T_A^L(x) \le T_B^L(x),\ T_A^R(x) \le T_B^R(x),\ I_A^L(x) \ge I_B^L(x),\ I_A^R(x) \ge I_B^R(x),\ F_A^L(x) \ge F_B^L(x),\ F_A^R(x) \ge F_B^R(x).$$

Definition 7. **[31]** *Two INSs A and B are equal, i.e., $A = B$, if and only if $A \subseteq B$ and $A \supseteq B$.*

3.2. Similarity Measures Between INSs Based on Minimum and Maximum Operators

This subsection introduces three similarity measures between two INSs, A and B, and their properties, based on the minimum and maximum operators.

Proposition 1. **[28]** *Let A and B be two INSs in a universe of discourse, $X = \{x_1, x_2, \ldots, x_n\}$. Then, the 1-type INS similarity measure:*

$$Y_1(A,B) = \frac{1}{3n}\sum_{i=1}^{n}\left(\frac{\min(T_A(x_i), T_B(x_i))}{\max(T_A(x_i), T_B(x_i))} + \frac{\min(I_A(x_i), I_B(x_i))}{\max(I_A(x_i), I_B(x_i))} + \frac{\min(F_A(x_i), F_B(x_i))}{\max(F_A(x_i), F_B(x_i))}\right), \quad (2)$$

which should satisfy the following properties:

(1) $0 \le Y_1(A,B) \le 1$;
(2) $Y_1(A,B) = 1$ *if* $A = B$;
(3) $Y_1(A,B) = Y_1(B,A)$;
(4) $Y_1(A,C) \le Y_1(A,B)$ *and* $Y_1(A,C) \le Y_1(B,C)$ *if* $A \subseteq B \subseteq C$ *for INS* C.

Proposition 2. **[28]** *Let A and B be two INSs in a universe of discourse, $X = \{x_1, x_2, \ldots, x_n\}$. Then, the 2-type INS similarity measure:*

$$Y_2(A,B) = \frac{1}{n}\sum_{i=1}^{n}\left(\alpha\frac{\min(T_A(x_i), T_B(x_i))}{\max(T_A(x_i), T_B(x_i))} + \beta\frac{\min(I_A(x_i), I_B(x_i))}{\max(I_A(x_i), I_B(x_i))} + \gamma\frac{\min(F_A(x_i), F_B(x_i))}{\max(F_A(x_i), F_B(x_i))}\right), \quad (3)$$

which should satisfy the following properties:

(1) $0 \le Y_2(A,B) \le 1$;

(2) $Y_2(A,B) = 1$ *if* $A = B$;
(3) $Y_2(A,B) = Y_2(B,A)$;
(4) $Y_2(A,C) \le Y_2(A,B)$ *and* $Y_2(A,C) \le Y_2(B,C)$ *if* $A \subseteq B \subseteq C$ *for INS* C, *where* α, β, *and* γ *are the weights of the three independent elements (i.e., the truth, indeterminacy, and falsity memberships) in an INS and* $\alpha + \beta + \gamma = 1$.

Proposition 3. **[28]** *Let A and B be two INSs in a universe of discourse,* $X = \{x_1, x_2, \ldots, x_n\}$, *then the 3-type INS similarity measure:*

$$Y_3(A,B) = \sum_{i=1}^{n} w_i \left(\alpha \frac{\min(T_A(x_i), T_B(x_i))}{\max(T_A(x_i), T_B(x_i))} + \beta \frac{\min(I_A(x_i), I_B(x_i))}{\max(I_A(x_i), I_B(x_i))} + \gamma \frac{\min(F_A(x_i), F_B(x_i))}{\max(F_A(x_i), F_B(x_i))} \right), \quad (4)$$

which should satisfy the following properties:

(1) $0 \le Y_3(A,B) \le 1$;
(2) $Y_3(A,B) = 1$ *if* $A = B$;
(3) $Y_3(A,B) = Y_3(B,A)$;
(4) $Y_3(A,C) = Y_3(A,B)$ *and* $Y_3(A,C) \le Y_3(B,C)$ *if* $A \subseteq B \subseteq C$ *for INS* C.

If the importance of the three independent elements—the truth, indeterminacy, and falsity memberships—in an INS are considered in Equation (2), then Equation (2) is equivalent to Equation (3). That is, when $\alpha = \beta = \gamma = 1/3$, Equation (3) is reduced to Equation (2). Furthermore, if important differences among all the elements in a universe of discourse are considered, $X = \{x_1, x_2, \ldots, x_n\}$, the weight of each element $x_i (i = 1, 2, \ldots, n)$ must be considered in Equation (3). Then, Equation (3) is equivalent to Equation (4). That is, when weight $w_1 = w_2 = \cdots = w_n = 1/n$, Equation (4) is reduced to Equation (3). Finally, when $\alpha = \beta = \gamma = 1/3$ and $w_1 = w_2 = \cdots = w_n = 1/n$, Equation (4) is reduced to Equation (2).

4. Decision-Making Model for PPM Selection Based on Similarity Measures

4.1. Description of Decision-Making for PPM Selection

Let $A = \{A_1, A_2, \ldots, A_m\}$ be a set of alternative PPMs, and $C = \{C_1, C_2, \ldots, C_n\}$ be a set of evaluation criteria for each PPM. We assumed that the weights of the evaluation criteria $C_i (i = 1, 2, \ldots, n)$ were w_i, $w_i \in [0,1]$, $\sum_{i=1}^{n} w_i = 1$, and the weights of the three elements were α, β, and γ, determined by the decision maker. The characteristic of the alternative PPM $A_j (j = 1, 2, \ldots, m)$ is expressed as follows:

$$\begin{aligned} A_j &= \left\{ \left\langle C_i, T_{A_j}(C_i), I_{A_j}(C_i), F_{A_j}(C_i) \right\rangle | C_i \in C \right\} \\ &= \left\{ \left\langle C_i, \left[T_A^L(C_i), T_A^R(C_i) \right], \left[I_A^L(C_i), I_A^R(C_i) \right], \left[F_A^L(C_i), F_A^R(C_i) \right] \right\rangle | C_i \in C \right\}, \end{aligned} \quad (5)$$

where $W_{A_i} = \left[W_{A_i}^L(C_i), W_{A_i}^R(C_i) \right] \subseteq [0,1]$, $W = T, I$, and F, respectively, and $0 \le T_{A_j}^R(C_i) + I_{A_j}^R(C_i) + F_{A_j}^R(C_i) \le 3$ for $C_i \in C$, $i = 1, 2, \ldots, n$ and $j = 1, 2, \ldots, m$.

If the evaluation value, which is usually obtained from the evaluation of an alternative PPM A_j under an evaluation criterion C_i is abbreviated as $d_{ji} = \left\langle \left[x_{ji}^L, x_{ji}^R \right], \left[y_{ji}^L, y_{ji}^R \right], \left[z_{ji}^L, z_{ji}^R \right] \right\rangle$, then the established interval neutrosophic decision matrix is $D = \left(d_{ji} \right)_{m \times n}$.

For a PPM selection problem, the concept of an ideal point is used to identify the best PPM in the alternative PPM set. Although the ideal selection usually does not exist in the real world, it can provide useful theoretical support for the selection of an alternative PPM. Generally, two types of evaluation criteria are used: benefit and cost criteria. In the proposed PPM selection model, an ideal alternative PPM can be expressed by using the maximum evaluation value for the benefit criteria and a minimum

evaluation value for the cost criteria. If we assume that H is a collection of benefit criteria and K is a collection of cost criteria, then a benefit criterion with interval neutrosophic information in the ideal alternative A^* is represented as:

$$\begin{aligned} d_i^* &= \left\langle \left[x_i^{L*}, x_i^{R*}\right], \left[y_i^{L*}, y_i^{R*}\right], \left[z_i^{L*}, z_i^{R*}\right] \right\rangle \\ &= \left\langle \left[\max\left(x_{ji}^L\right), \max\left(x_{ji}^R\right)\right], \left[\min\left(y_{ji}^L\right), \min\left(y_{ji}^R\right)\right], \left[\min\left(z_{ji}^L\right), \min\left(z_{ji}^R\right)\right] \right\rangle, \end{aligned} \tag{6}$$

for $i \in H$; for a cost criterion,

$$\begin{aligned} d_i^* &= \left\langle \left[x_i^{L*}, x_i^{R*}\right], \left[y_i^{L*}, y_i^{R*}\right], \left[z_i^{L*}, z_i^{R*}\right] \right\rangle \\ &= \left\langle \left[\min\left(x_{ji}^L\right), \min\left(x_{ji}^R\right)\right], \left[\max\left(y_{ji}^L\right), \max\left(y_{ji}^R\right)\right], \left[\max\left(z_{ji}^L\right), \max\left(z_{ji}^R\right)\right] \right\rangle, \end{aligned} \tag{7}$$

for $j \in K$.

Another representation of ideal alternative A^* and the value of criteria d_{ji} should be obtained by using Equation (1) in Definition 3. This representation is as follows:

$$\begin{aligned} d_i^{**} = \left\langle x_i^{**}, y_i^{**}, z_i^{**} \right\rangle = \Bigg\langle & \left(\max\left(x_{ji}^L\right) + \max\left(x_{ji}^R\right)\right)/2 + \left(\max\left(x_{ji}^L\right) - \max\left(x_{ji}^R\right)\right)\mathrm{i}/2, \\ & \left(\min\left(y_{ji}^L\right) + \min\left(y_{ji}^R\right)\right)/2 + \left(\min\left(y_{ji}^L\right) - \min\left(y_{ji}^R\right)\right)\mathrm{i}/2, \\ & \left(\min\left(z_{ji}^L\right) + \min\left(z_{ji}^R\right)\right)/2 + \left(\min\left(z_{ji}^L\right) - \min\left(z_{ji}^R\right)\right)\mathrm{i}/2 \Bigg\rangle \end{aligned}, \tag{8}$$

for $i \in H$;

$$\begin{aligned} d_i^{**} = \left\langle x_i^{**}, y_i^{**}, z_i^{**} \right\rangle = \Bigg\langle & \left(\min\left(x_{ji}^L\right) + \min\left(x_{ji}^R\right)\right)/2 + \left(\min\left(x_{ji}^L\right) - \min\left(x_{ji}^R\right)\right)\mathrm{i}/2, \\ & \left(\max\left(y_{ji}^L\right) + \max\left(y_{ji}^R\right)\right)/2 + \left(\max\left(y_{ji}^L\right) - \max\left(y_{ji}^R\right)\right)\mathrm{i}/2, \\ & \left(\max\left(z_{ji}^L\right) + \max\left(z_{ji}^R\right)\right)/2 + \left(\max\left(z_{ji}^L\right) - \max\left(z_{ji}^R\right)\right)\mathrm{i}/2 \Bigg\rangle \end{aligned}, \tag{9}$$

for $j \in K$; and the evaluation value of the alternative PPM A_j is transformed into the following expression:

$$\begin{aligned} d_{ji} = \left\langle x_{ji}, y_{ji}, z_{ji} \right\rangle = \Bigg\langle & \left(x_{ji}^L + x_{ji}^R\right)/2 + \left(x_{ji}^L - x_{ji}^R\right)\mathrm{i}/2, \left(y_{ji}^L + y_{ji}^R\right)/2 + \left(y_{ji}^L - y_{ji}^R\right)\mathrm{i}/2, \\ & \left(z_{ji}^L + z_{ji}^R\right)/2 + \left(z_{ji}^L - z_{ji}^R\right)\mathrm{i}/2 \Bigg\rangle, \end{aligned} \tag{10}$$

$i = 1, 2, \ldots, n$ and $j = 1, 2, \ldots, m$.

Using the similarity measure defined in Equation (2), we have:

$$\begin{aligned} Y_1\left(A^*, A_j\right) = \frac{1}{3n} \sum_{i=1}^{n} \Bigg\{ & \frac{\min\left(\left[x_i^{L*}, x_i^{R*}\right], \left[x_{ji}^L, x_{ji}^R\right]\right)}{\max\left(\left[x_i^{L*}, x_i^{R*}\right], \left[x_{ji}^L, x_{ji}^R\right]\right)} \\ + \frac{\min\left(\left[x_i^{L*}, x_i^{R*}\right], \left[x_{ji}^L, x_{ji}^R\right]\right)}{\max\left(\left[x_i^{L*}, x_i^{R*}\right], \left[x_{ji}^L, x_{ji}^R\right]\right)} & + \frac{\min\left(\left[z_i^{L*}, z_i^{R*}\right], \left[z_{ji}^L, z_{ji}^R\right]\right)}{\max\left(\left[z_i^{L*}, z_i^{R*}\right], \left[z_{ji}^L, z_{ji}^R\right]\right)} \Bigg\}. \end{aligned}$$

Comparing the three terms in (7) and (9), namely, comparing x_i^{**} and x_{ji}, z_i^{**} and y_{ji}, z_i^{**} and z_{ji}, respectively, the minimum and maximum interval numbers in the numerator or denominator can be derived, and the terms in the braces can be calculated in accordance with the rules of interval number division and addition in Definition 2.

Similarly, two other measures, $Y_2\left(A^*, A_j\right)$ and $Y_3\left(A^*, A_j\right)$, can be obtained by applying Equations (3) and (4).

All alternatives can be ranked on the basis of the measures of similarity $Y_1\left(A^*, A_j\right)$, $Y_2\left(A^*, A_j\right)$ or $Y_3\left(A^*, A_j\right)$ $(j = 1, 2, \ldots, m)$ between each alternative and the ideal alternative. Then, the best alternative can be easily identified.

4.2. Steps for Selection of PPM Using the Proposed Method

Due to the complexity of construction projects, the problem of PPM selection is a decision-making issue under an uncertainty environment, and the experts usually can't give an accurate judgement. Therefore, the degree of confidence from experts when giving the evaluation information needed to be considered in the process of PPM selection. Based on this, the proposed method considers the degrees of confidence of experts on truth indeterminacy, and falsity memberships of the evaluation information, and will show power in a wide application field.

The decision steps for PPM selection are shown in Figure 3 in reference to the above illustration. The decision-making procedure of the proposed method is as follows:

Step 1: Decision matrices determined.

The decision information of all alternative PPMs with respect to all criteria were characterized by the INSs. In the first step, the evaluation values of each alternative PPM under the different criteria were obtained from questionnaires to form decision matrices.

$$D = \begin{pmatrix} d_{11} & d_{12} & \cdots & d_{1n} \\ d_{21} & d_{22} & \cdots & d_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ d_{m1} & d_{m2} & \cdots & d_{mn} \end{pmatrix},$$

where $d_{ji} = \left\langle \left[x_{ji}^L, x_{ji}^R\right], \left[y_{ji}^L, y_{ji}^R\right], \left[z_{ji}^L, z_{ji}^R\right] \right\rangle$ is the evaluation value for the alternative PPM A_j given by the kth expert in accordance with criteria C_i, $k = 1, 2, \ldots, l$, $j = 1, 2, \ldots, n$, $i = 1, 2, \ldots, m$.

Step 2: Ideal alternative PPM identified, using Equations (5) and (6).

Step 3: Evaluation matrix D and ideal alternative PPM were transformed into other representations, using Equation (1).

Step 4: The weights of the criteria were calculated.

Many approaches can be used to determine the weights of criteria, including the analytic hierarchy process (AHP) [32], best worst method (BWM) [33], entropy method [34], and the full consistency method (FUCOM) [35]. The averaging weighing method was used for convenience in this study.

Step 5: The measures of similarity between the ideal alternative PPM and each alternative PPM were calculated, using the proposed similarity measures.

Step 6: The alternative PPMs were ranked in accordance with the results obtained in Step 5.

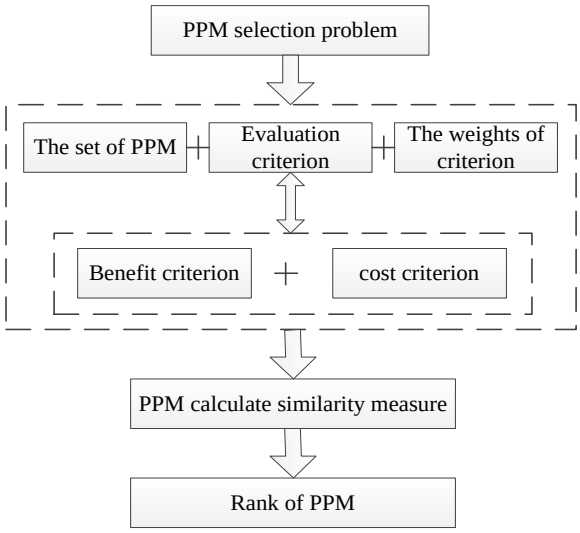

Figure 3. Flow chart of PPM selection using the proposed method.

5. Practical Example

As discussed in this section, the proposed PPM selection model was applied to a real-world infrastructure project. Four alternative PPMs—DB, EPC, the CM method, and DBB—were considered. Their evaluation criteria were cost (C), schedule (S), quality (Q), complexity (Com), scope change (SC), experience (E), financial guarantee (FG), risk management (RM), uniqueness (U), and project size (Size). These criteria are shown as in Figure 1. To ensure the reliability and availability of the data, the experienced experts from different fields (including engineer, economics, law) should be invited to evaluate the project before carrying out the decision-making issue. Firstly, experts were introduced to the capacity and the goal of project by the owners. Secondly, further investigation to the construction site was conducted, and the related principals described the whole project in detail. Finally, according to the score chart and score criterion, the evaluation results of the project from the experts were obtained, and the final evaluation result was given through aggregating the evaluation information of the experts. Using the proposed method in Section 4, the suitable PPM could be selected. The final rank result was delivered to the owner by the experts, and the owner would choose the best suitable PPM according to the characteristics of project and their own management ability. The steps were as follows:

Step 1: The evaluation matrix $A = (A_1, A_2, A_3, A_4)^T$, was constructed, where A_1, A_2, A_3, and A_4 were the evaluation information for the four PPMs, and

$$\begin{aligned} A_1 = \{&\langle[0.58, 0.69], [0.31, 0.48], [0.28, 0.37]\rangle, \langle[0.64, 0.70], [0.44, 0.53], [0.21, 0.30]\rangle, \\ &\langle[0.56, 0.68], [0.46, 0.51], [0.13, 0.36]\rangle, \langle[0.57, 0.66], [0.33, 0.39], [0.12, 0.33]\rangle, \\ &\langle[0.42, 0.51], [0.13, 0.21], [0.12, 0.21]\rangle, \langle[0.40, 0.53], [0.34, 0.44], [0.10, 0.13]\rangle, \\ &\langle[0.55, 0.69], [0.30, 0.41], [0.31, 0.35]\rangle, \langle[0.57, 0.62], [0.29, 0.39], [0.33, 0.35]\rangle, \\ &\langle[0.61, 0.71], [0.11, 0.20], [0.16, 0.21]\rangle, \langle[0.50, 0.58], [0.34, 0.49], [0.14, 0.19]\rangle\} \ ; \end{aligned}$$

$$\begin{aligned} A_2 = \{&\langle[0.66, 0.71], [0.28, 0.34], [0.17, 0.22]\rangle, \langle[0.58, 0.64], [0.32, 0.41], [0.20, 0.31]\rangle, \\ &\langle[0.55, 0.58], [0.10, 0.21], [0.12, 0.21]\rangle, \langle[0.69, 0.71], [0.11, 0.16], [0.16, 0.22]\rangle, \\ &\langle[0.56, 0.63], [0.20, 0.30], [0.11, 0.24]\rangle, \langle[0.63, 0.71], [0.28, 0.36], [0.20, 0.30]\rangle, \\ &\langle[0.58, 0.69], [0.32, 0.41], [0.11, 0.18]\rangle, \langle[0.56, 0.68], [0.15, 0.23], [0.15, 0.21]\rangle, \\ &\langle[0.30, 0.41], [0.22, 0.31], [0.17, 0.28]\rangle, \langle[0.70, 0.76], [0.38, 0.41], [0.19, 0.28]\rangle\} \ ; \end{aligned}$$

$$A_3 = \{\langle[0.35, 0.41], [0.17, 0.31], [0.15, 0.20]\rangle, \langle[0.31, 0.48], [0.22, 0.28], [0.20, 0.28]\rangle, \langle[0.46, 0.56], [0.14, 0.21], [0.16, 0.24]\rangle, \langle[0.38, 0.47], [0.22, 0.31], [0.15, 0.27]\rangle, \langle[0.30, 0.41], [0.39, 0.59], [0.15, 0.22]\rangle, \langle[0.44, 0.58], [0.40, 0.50], [0.20, 0.30]\rangle, \langle[0.39, 0.48], [0.30, 0.41], [0.18, 0.26]\rangle, \langle[0.55, 0.63], [0.12, 0.22], [0.21, 0.28]\rangle, \langle[0.44, 0.54], [0.27, 0.36], [0.13, 0.19]\rangle, \langle[0.37, 0.47], [0.11, 0.20], [0.18, 0.26]\rangle\} ;$$

$$A_4 = \{\langle[0.66, 0.74], [0.10, 0.15], [0.10, 0.20]\rangle, \langle[0.78, 0.89], [0.20, 0.30], [0.20, 0.31]\rangle, \langle[0.65, 0.76], [0.10, 0.20], [0.17, 0.24]\rangle, \langle[0.74, 0.88], [0.15, 0.26], [0.14, 0.23]\rangle, \langle[0.63, 0.72], [0.14, 0.24], [0.18, 0.24]\rangle, \langle[0.70, 0.80], [0.20, 0.27], [0.16, 0.23]\rangle, \langle[0.69, 0.81], [0.10, 0.19], [0.10, 0.20]\rangle, \langle[0.56, 0.65], [0.13, 0.24], [0.15, 0.26]\rangle, \langle[0.60, 0.70], [0.10, 0.17], [0.11, 0.20]\rangle, \langle[0.64, 0.73], [0.20, 0.30], [0.18, 0.25]\rangle\} .$$

Step 2: The ideal alternative PPM was determined, using Equations (8) and (9):

$$A^* = \{\langle[0.35, 0.41], [0.31, 0.48], [0.28, 0.37]\rangle, \langle[0.35, 0.41], [0.31, 0.48], [0.28, 0.37]\rangle, \langle[0.78, 0.89], [0.20, 0.28], [0.20, 0.28]\rangle, \langle[0.38, 0.47], [0.33, 0.39], [0.16, 0.33]\rangle, \langle[0.63, 0.72], [0.13, 0.21], [0.11, 0.21]\rangle, \langle[0.70, 0.80], [0.20, 0.27], [0.10, 0.13]\rangle, \langle[0.69, 0.81], [0.10, 0.19], [0.10, 0.18]\rangle, \langle[0.57, 0.68], [0.12, 0.22], [0.15, 0.21]\rangle, \langle[0.30, 0.41], [0.27, 0.36], [0.17, 0.28]\rangle, \langle[0.70, 0.76], [0.11, 0.20], [0.14, 0.19]\rangle\} .$$

Step 3: The raw evaluation data matrix and the ideal alternative PPM were transformed, using Equation (1).

$$A'_1 = \{\langle 0.64 + 0.06\mathrm{i}, 0.40 + 0.09\mathrm{i}, 0.33 + 0.05\mathrm{i}\rangle, \langle 0.67 + 0.03\mathrm{i}, 0.49 + 0.05\mathrm{i}, 0.26 + 0.05\mathrm{i}\rangle, \langle 0.62 + 0.06\mathrm{i}, 0.49 + 0.03\mathrm{i}, 0.25 + 0.12\mathrm{i}\rangle, \langle 0.62 + 0.05\mathrm{i}, 0.35 + 0.03\mathrm{i}, 0.23 + 0.11\mathrm{i}\rangle, \langle 0.47 + 0.05\mathrm{i}, 0.36 + 0.03\mathrm{i}, 0.17 + 0.05\mathrm{i}\rangle, \langle 0.47 + 0.07\mathrm{i}, 0.39 + 0.05\mathrm{i}, 0.12 + 0.02\mathrm{i}\rangle, \langle 0.62 + 0.07\mathrm{i}, 0.36 + 0.06\mathrm{i}, 0.33 + 0.02\mathrm{i}\rangle, \langle 0.60 + 0.03\mathrm{i}, 0.34 + 0.05\mathrm{i}, 0.34 + 0.01\mathrm{i}\rangle, \langle 0.66 + 0.05\mathrm{i}, 0.16 + 0.05\mathrm{i}, 0.19 + 0.03\mathrm{i}\rangle, \langle 0.54 + 0.04\mathrm{i}, 0.42 + 0.08\mathrm{i}, 0.17 + 0.03\mathrm{i}\rangle\} ;$$

$$A'_2 = \{\langle 0.69 + 0.03\mathrm{i}, 0.31 + 0.03\mathrm{i}, 0.20 + 0.03\mathrm{i}\rangle, \langle 0.61 + 0.03\mathrm{i}, 0.37 + 0.05\mathrm{i}, 0.26 + 0.05\mathrm{i}\rangle, \langle 0.57 + 0.02\mathrm{i}, 0.16 + 0.06\mathrm{i}, 0.17 + 0.05\mathrm{i}\rangle, \langle 0.70 + 0.01\mathrm{i}, 0.14 + 0.03\mathrm{i}, 0.19 + 0.03\mathrm{i}\rangle, \langle 0.60 + 0.04\mathrm{i}, 0.25 + 0.05\mathrm{i}, 0.18 + 0.07\mathrm{i}\rangle, \langle 0.67 + 0.04\mathrm{i}, 0.32 + 0.04\mathrm{i}, 0.25 + 0.05\mathrm{i}\rangle, \langle 0.64 + 0.06\mathrm{i}, 0.37 + 0.05\mathrm{i}, 0.15 + 0.04\mathrm{i}\rangle, \langle 0.62 + 0.06\mathrm{i}, 0.19 + 0.04\mathrm{i}, 0.18 + 0.03\mathrm{i}\rangle, \langle 0.36 + 0.06\mathrm{i}, 0.27 + 0.05\mathrm{i}, 0.23 + 0.06\mathrm{i}\rangle, \langle 0.73 + 0.03\mathrm{i}, 0.40 + 0.02\mathrm{i}, 0.24 + 0.05\mathrm{i}\rangle\} ;$$

$$A'_3 = \{\langle 0.38 + 0.03\mathrm{i}, 0.24 + 0.07\mathrm{i}, 0.18 + 0.03\mathrm{i}\rangle, \langle 0.40 + 0.09\mathrm{i}, 0.25 + 0.03\mathrm{i}, 0.24 + 0.04\mathrm{i}\rangle, \langle 0.51 + 0.05\mathrm{i}, 0.18 + 0.04\mathrm{i}, 0.20 + 0.04\mathrm{i}\rangle, \langle 0.43 + 0.05\mathrm{i}, 0.27 + 0.05\mathrm{i}, 0.21 + 0.06\mathrm{i}\rangle, \langle 0.36 + 0.06\mathrm{i}, 0.49 + 0.10\mathrm{i}, 0.19 + 0.04\mathrm{i}\rangle, \langle 0.51 + 0.07\mathrm{i}, 0.45 + 0.05\mathrm{i}, 0.25 + 0.05\mathrm{i}\rangle, \langle 0.44 + 0.05\mathrm{i}, 0.36 + 0.06\mathrm{i}, 0.22 + 0.04\mathrm{i}\rangle, \langle 0.59 + 0.04\mathrm{i}, 0.17 + 0.05\mathrm{i}, 0.25 + 0.04\mathrm{i}\rangle, \langle 0.49 + 0.05\mathrm{i}, 0.32 + 0.05\mathrm{i}, 0.16 + 0.03\mathrm{i}\rangle, \langle 0.42 + 0.05\mathrm{i}, 0.16 + 0.05\mathrm{i}, 0.22 + 0.04\mathrm{i}\rangle\} ;$$

$$A'_4 = \{\langle 0.70 + 0.04\mathrm{i}, 0.13 + 0.03\mathrm{i}, 0.15 + 0.05\mathrm{i}\rangle, \langle 0.84 + 0.06\mathrm{i}, 0.25 + 0.05\mathrm{i}, 0.26 + 0.06\mathrm{i}\rangle, \langle 0.71 + 0.06\mathrm{i}, 0.15 + 0.05\mathrm{i}, 0.26 + 0.06\mathrm{i}\rangle, \langle 0.81 + 0.07\mathrm{i}, 0.21 + 0.06\mathrm{i}, 0.19 + 0.05\mathrm{i}\rangle, \langle 0.68 + 0.05\mathrm{i}, 0.19 + 0.05\mathrm{i}, 0.21 + 0.03\mathrm{i}\rangle, \langle 0.75 + 0.05\mathrm{i}, 0.24 + 0.04\mathrm{i}, 0.20 + 0.04\mathrm{i}\rangle, \langle 0.75 + 0.06\mathrm{i}, 0.15 + 0.05\mathrm{i}, 0.15 + 0.05\mathrm{i}\rangle, \langle 0.61 + 0.05\mathrm{i}, 0.19 + 0.06\mathrm{i}, 0.21 + 0.06\mathrm{i}\rangle, \langle 0.65 + 0.05\mathrm{i}, 0.14 + 0.04\mathrm{i}, 0.16 + 0.05\mathrm{i}\rangle, \langle 0.69 + 0.05\mathrm{i}, 0.25 + 0.05\mathrm{i}, 0.22 + 0.04\mathrm{i}\rangle\} ;$$

$$A^{**} = \{\langle 0.38 + 0.03\mathrm{i}, 0.40 + 0.09\mathrm{i}, 0.33 + 0.05\mathrm{i}\rangle, \langle 0.84 + 0.06\mathrm{i}, 0.24 + 0.04\mathrm{i}, 0.24 + 0.04\mathrm{i}\rangle, \langle 0.51 + 0.05\mathrm{i}, 0.49 + 0.04\mathrm{i}, 0.24 + 0.04\mathrm{i}\rangle, \langle 0.43 + 0.05\mathrm{i}, 0.36 + 0.03\mathrm{i}, 0.25 + 0.09\mathrm{i}\rangle, \langle 0.43 + 0.05\mathrm{i}, 0.36 + 0.03\mathrm{i}, 0.25 + 0.09\mathrm{i}\rangle, \langle 0.75 + 0.05\mathrm{i}, 0.24 + 0.04\mathrm{i}, 0.12 + 0.02\mathrm{i}\rangle, \langle 0.75 + 0.06\mathrm{i}, 0.15 + 0.05\mathrm{i}, 0.14 + 0.04\mathrm{i}\rangle, \langle 0.63 + 0.06\mathrm{i}, 0.17 + 0.05\mathrm{i}, 0.18 + 0.03\mathrm{i}\rangle, \langle 0.36 + 0.06\mathrm{i}, 0.32 + 0.05\mathrm{i}, 0.23 + 0.06\mathrm{i}\rangle, \langle 0.73 + 0.03\mathrm{i}, 0.16 + 0.05\mathrm{i}, 0.17 + 0.03\mathrm{i}\rangle\} .$$

Step 4: The similarity measures between the ideal PPM and each alternative PPM were calculated, using Equation (4) with $w_1 = w_2 = \cdots = w_{10} = 0.1$ and $\alpha = \beta = \gamma = 1/3$.

$$Y_1^* = 0.8038 + 0.2521\text{i};\ Y_2^* = 0.8006 + 0.2504\text{i};\ Y_3^* = 0.7764 + 0.2590\text{i};\ Y_4^* = 0.8476 + 0.3067\text{i}.$$

Thus, the four options were ranked as $o_4 \succ o_1 \succ o_2 \succ o_3$, that is, EPC ≻ DB ≻ DBB ≻ CM. Therefore, EPC was the best choice among the four options. These results indicate that the ranking order is acceptable for practical application. According to the ranking result, the EPC was in first place, and the DB was second. However, practically, the owner did not have to choose the EPC, due to limited management ability. The final selection needed to consider both the characteristics of project and the owner's management ability, which integrated design, construction, and procurement of the project into a contract to relieve management pressure for the owner.

6. Comparative Analysis

Depending on the line of sensitive analysis in [36], the advantage of the proposed model is determined through comparison with the existing method in this section.

We employed the technique of order of preference by similarity to the ideal solution (TOPSIS) as the comparative method [37]. The line of the classical TOPSIS method was applied to the case study presented in Section 5.

To enable comparison with the classical TOPSIS method, we first introduced the concepts of distance similarity between two INSs and the complement of an INS.

Let $x = \left(\left[T_1^L(x_j), T_1^R(x_j)\right], \left[I_1^L(x_j), I_1^R(x_j)\right], \left[F_1^L(x_j), F_1^R(x_j)\right]\right)$ and $y = (\left[T_2^L(x_j), T_2^R(x_j)\right], \left[I_2^L(x_j), I_2^R(x_j)\right], \left[F_2^L(x_j), F_2^R(x_j)\right])$ be the two INSs [38], then, the normalized Hamming distance is [39,40]

$$\begin{aligned} D_H(x,y) = \tfrac{1}{6n}\sum_{j=1}^{n}\Big(&\left|T_1^L(x_j) - T_2^L(x_j)\right| + \left|T_1^R(x_j) - T_2^R(x_j)\right| + \left|I_1^L(x_j) - I_2^L(x_j)\right| \\ &+ \left|I_1^R(x_j) - I_2^R(x_j)\right| + \left|F_1^L(x_j) - F_2^L(x_j)\right| + \left|F_1^R(x_j) - F_2^R(x_j)\right|\Big), \end{aligned} \tag{11}$$

and the complement of x is $x^c = \left(\left[F_1^L(x_j), F_1^R(x_j)\right], \left[1 - I_1^R(x_j), 1 - I_1^L(x_j)\right], \left[T_1^L(x_j), T_1^R(x_j)\right]\right)$.

We assumed that the weights of ten criteria were $w_1 = w_2 = \cdots = w_n$. The TOPSIS method ranked the four PPMs as EPC ≻ DBB ≻ DB ≻ CM. Thus, EPC was the best option for this project, followed by DBB. The order of the four PPMs obtained by the proposed method was EPC ≻ DB ≻ DBB ≻ CM, as shown in Table 1. The best appropriate PPM obtained by the proposed method was same as that obtained by classical TOPSIS method, that is, the EPC was the best suitable option, according to both methods. The CM was in the last rank using both methods. The DBB was in the second position from the classical TOPSIS and in the third rank for the proposed method.

Table 1. Comparison of the proposed method with the classical TOPSIS method.

PPMs	Classical TOPSIS		Proposed Method	
	Results	Rank	Results	Rank
DB	0.4770	3	0.8038 + 0.2521i	2
DBB	0.5340	2	0.8006 + 0.2504i	3
CM	0.3729	4	0.7764 + 0.2590i	4
EPC	0.6112	1	0.8476 + 0.3067i	1

The rankings of the results exhibited slight differences. The proposed method considered not only the weights of the ten criteria, but also the weights of the truth membership and falsity membership degrees. In other words, the strongest advantage of the proposed method over the existing decision-making methods is the degree of confidence from evaluators, which can be acquired by considering the weights of truth membership and falsity membership degrees. Thus, a more

reasonable final result was generated. In practice, the construction project was implemented under a high level of complexity and uncertainty. The owner had few staff members and limited experience in managing the proposed project, and coordination between design and construction was difficult for the owner. Thus, the owner needed a single-responsibility delivery method for design and construction. A highly efficient and easy operating method was preferred. The development and application of the proposed method could enrich theoretical knowledge and practice.

7. Conclusions

PPM selection plays an important role in influencing the efficiency of project implementation. Selecting the appropriate PPM poses considerable challenges to owners, given the complexity of the objective world and the ambiguity of human thinking in real-life decision-making. INSs show power in dealing with imprecise and ambiguous information and manage complex uncertainties in applications, in which a main obstacle is to compare two interval numbers. To overcome this, the interval number was transformed into another parallel representation. Then, a PPM selection method with interval neutrosophic information was built. An example of the selection of a PPM was given to demonstrate the applications and effectiveness of the proposed selection approach. Finally, to show the advantage of the proposed method, a comparison analysis of results between the proposed and existing methods was given.

The main motivation of this work was to develop a PPM selection model to guide decision-making for owners. INSs can handle imprecise and ambiguous information and manage complex uncertainties in applications. Similarity measures are also important tools for judging the closeness between the ideal alternative PPM and the proposed PPM in decision-making. The contributions of this paper are as follows: (1) This study innovatively introduced the similarity measure under an interval neutrosophic environment to deal with PPM selection problems. (2) Considering the truth, falsity, and indeterminacy memberships simultaneously, the similarity measure based on minimum and maximum operators was applied to construct a decision-making model for PPM selection. (3) This study established a PPM selection method with an interval neutrosophic set by applying similarity measures, which takes account into the determinacy, indeterminacy, and hesitation from the decision experts in the evaluation process. In a practical PPM selection, to make the selected PPM more reasonable and reliable under uncertainty, the "true psychological" behavior and degree of confidence from experts are necessary in the process of PPM selection.

Comparing the results of our proposed method with those of existing methods, the proposed method considers the degree of confidence from the evaluators, which will enhance and expand decision-making knowledge theory. Numerous problems can be solved with the help of the presented method and theory. The proposed PPM selection method has the characteristics of simple design concept and easy implementation. Moreover, in contrast to existing methods, it considers the degree of confidence from evaluators. From the operation process, it realizes that the development of an interval number theory is important for obtaining precise results through the whole process of research and practice. Thus, the applications of similarity measures between INSs would be investigated in other areas, such as pattern recognition, clustering analysis, and image processing. Work on the comparison of intervals should also be conducted.

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A Model of Selective Tendering: Does Bidding Competition Deter Opportunism by Contractors?

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Under contractual incompleteness, a bid-taker is obliged to depend on a self-enforcing contract where a winning bidder puts his reputation at stake. In this case the winning bidder will renege on contractual obligations if any one-shot gain from opportunism is greater than a long-term gain from maintaining his reputation. Since the long-term gain is decreasing in the number of competing bidders, excessive bidding competition may provoke the winning bidder's opportunism. We derive an optimum number of bidders which ensures the self-enforcing contract at the lowest expected procurement cost. We also show how excessive bidding competition leads to the phenomenon of cost overruns.

This paper investigates the role of a bid-taker's discretion in deciding the number of competing bidders in a procurement auction. It has the following features. The bid-taker's utility is increasing in the quality of procurement project and decreasing in the procurement cost. However, the project quality is noncontractible at the bidding stage, i.e., it is observable ex post but non-verifiable. These features imply that in order to avoid opportunism of quality reduction, the bid-taker needs to depend on a self-enforcing contract where a winning bidder puts his reputation at stake. This paper demonstrates that the bid-taker can devise such a contract by controlling the number of bidders prior to bidding competition.

Williamson (1975, ch. 2; 1985, ch. 1) proposes that enhancing competition would mitigate the possibility of opportunistic reneging on contractual obligations (see Crémer and Khalil, 1992, for a formal proof of this proposition in the context of principal-agent contracts). Much procurement auction literature has also focused on the ways in which stimulating competition can increase a bid-taker's utility (see McAfee and McMillan, 1987; Milgrom, 1987 for a survey). Thus, it would be tempting to conclude that bidding competition with free entry of bidders, called public tendering, maximizes the bid-taker's utility.

However, several case studies show that bid-takers usually prefer selective tendering under which they limit entry to a certain group of selected bidders.[1] This seems to be inconsistent with reasonable economic behavior predicted by researchers. In his study of U.S. defense procurement, Gansler (1989) attempts to explain the inconsistency between theory and practice, emphasizing the need of "controlled" or "limited" competition, but somewhat ambiguously:

> ..., having a few highly qualified bidders creates a more *effective* competition than having a very large number of bidders—in contrast with a normal free-market environment, where, as the number of bidders increases, the competition becomes more intense (Gansler, 1989, p. 181, emphasis added).

Later we will further discuss both the relevance of his argument and what observations lead him to this conclusion.

The main purpose of this paper is to develop a model of selective tendering based on the following idea: *excessive* bidding competition could foster opportunism by bidders. This shall clarify the ambiguity in Gansler's argument and show a limit of Williamson's proposition. Though it may not be possible to write a procurement contract that ensures contractual obligations, the winning bidder is willing to abide by the contractual obligations for fear of exclusion from future procurement auctions. However, such a fear of exclusion is credible only when a long-term gain from maintaining his reputation exceeds any one-shot gain from reneging on the contractual obligations. While undoubtedly the main objective of selective tendering is to choose "qualified" bidders ex ante, the analysis in this paper will show that the use of selective tendering may have another justification: to induce a self-enforcing contract via the credible threat of exclusion.

Our analysis has an important policy implication for government procurement. In the commercial sector, a bid-taker with consumer sovereignty can freely debar an opportunistic contractor from future procurement auctions. In the case of government procurement, however, some legal environments may limit procuring agencies' discretion in doing so.[2] Though the main purpose of government procurement laws and regulations is to procure high-quality products at the lowest price through public tendering, Gansler (1989, ch. 6) observes that such laws may actually bring about opportunism of quality reduction as they tend to overemphasize competition. His observations lead him to the argument of controlled competition to create "a more effective competition" with "a few highly qualified bidders" (to use words of Gansler, 1989).

Our argument of a self-enforcing contract clarifies, however, that selective tendering is still needed even if all the potential contractors are well qualified ex ante. Moreover, this may provide a logical foundation for understanding the welfare effects of recent merger policies in the U.S. defense industry: although recent mergers in defense industry reduced competition, such mergers might be necessary for the government's maximization of utility if it preferred high quality over expected cost minimization. Specifically, faced with cuts in Pentagon

spending as the cold war was over, the government was obliged to reduce the number of competing suppliers in order to keep the desired quality.

To be more precise our model runs as follows. A bid-taker wishes to procure a high-quality project by the use of a sealed-bid auction. However, transaction costs of making and enforcing a state-contingent contract make it difficult to ensure that the project procured is of high quality.[3] This situation involves two types of potential opportunism at the production stage. First, the bid-taker may threaten to cancel the procurement in order to renegotiate the contract price. In this paper, however, we rule out this opportunism by assuming that the bid-taker precommits himself to a firm fixed price.[4] Second, the winning bidder (or contractor) may provide low quality in order to cut down on production costs. (Hereafter we shall interchangeably use the terms winning bidder and contractor.)

If the bid-taker can commit himself to exclude opportunistic contractors from future auctions, then "reputable" bidders can put their reputations at stake in order to show their commitment to high quality.[5] It is now natural to ask whether bidding competition will affect bidders' such commitment ex ante, i.e., whether bidding strategies will depend on ex post opportunism as well as bidders' cost observations. The answer is positive if there are "too many" competing bidders. We demonstrate that, other things equal, a reputable bidder's long-term gain will decrease with an increased number of bidders. To avoid the hazard of opportunism, therefore, the bid-taker must control the number of bidders prior to bidding competition so that the long-term gain exceeds any one-shot gain from opportunism. An important implication of this observation is that excessive bidding competition may jeopardize Williamson's proposition on opportunism and competition.

This argument will also throw light on the problem of cost overruns, as the phenomenon of cost overruns can be seen as the mirror image of the underbidding phenomenon (Tirole, 1986). Since quality reduction occurs as a result of a contractor's underbidding at the bidding stage and since a bid-taker is willing to pay additional costs (or cost overruns) to get high quality at the production stage, we can interchangeably use quality reduction and cost overruns. Several explanations may exist for cost overruns: inefficient monitoring of procurement contracts with agency problems and unanticipated adoption of superior design (Tirole, 1986); and contracting parties' lack of commitment to a contract (Lewis, 1986). Researchers agree, however, that cost overruns occur because renegotiation is possible after signing a contract.

This paper demonstrates that, even in the absence of renegotiation, cost overruns (corresponding to quality reduction in our context) may occur in equilibrium. This is because excessive bidding competition through public tendering may give bidders incentives to submit bid-prices for low quality instead of bid-prices for high quality, though they are well qualified ex ante to provide high quality. Specifically, we derive three different equilibria:

1. If the long-term gain is less than the gain from opportunism regardless of uncertainty in the production stage, cost overruns always occur;
2. If the long-term gain exceeds the gain from opportunism regardless of uncertainty, cost overruns never occur; and
3. If the comparison between the two gains depends on uncertainty, cost overruns may or may not occur.

A comparative statics analysis of our model produces several policy recommendations for the bid-taker. The bid-taker can allow more bidders if: (i) a time period of a project is short; or (ii) an opportunity-cost differential among bidders is great; or (iii) a production process is well established; or (iv) uncertainty about future economic environment is small. This is because the gain from maintaining reputation becomes greater as: (i) the short time-period allows the bid-taker to observe the product quality earlier, which means a smaller discount rate for the gain from maintaining reputation; (ii) the bigger opportunity-cost differential brings a bigger profit to a winning bidder; and (iii) lucrativeness of opportunism is increasing in uncertainty regarding both the production process and future economic environment.

At this point, we should note the relationship between this paper and Spulber (1990), which is the only article we know that explicitly analyzes how the effectiveness of auction mechanism hinges on ex post incentives for performance, though his analysis differs from ours in scope and focus.[6] He considers an auction model where bidders have private information about their own abilities to perform, characterized by the size of potential cost overruns in the performance stage. He shows that, in the absence of proper legal enforcement, adverse selection problems cause the bidding process to fail.[7] He examines a number of alternative legal compensation schemes to regain the effectiveness of auctions when the contractor can renege on the contractual obligations. To do this, Spulber (1990) assumes that the legal system of liability is perfect and that the bid-taker is better informed about the details (more specifically, about a nonrecoverable project-specific investment) of the project than the bidders. These assumptions fundamentally differentiate his model from ours.

In the next section we begin by describing our problem as an extensive form game. Section II examines the benefits for the bid-taker of bidding competition when contracts are complete and the liability system is perfect. This provides a benchmark for the subsequent analysis. In Section III we analyze a static version of dynamic auctions in which the bid-taker has discretionary powers to set the number of competing bidders prior to bidding competition. We show that when the product quality is not contractible, different numbers of competing bidders result in three different equilibria regarding cost overruns. We also derive an optimum number of competing bidders and explore its comparative statics. Section IV discusses several issues associated with our model, especially the role of the bid-taker's discretionary powers and incumbent bidders' advantages over entrants.

I. DESCRIPTION OF THE MODEL

Consider a prospective buyer who wishes to procure an infinite sequence of projects.[8] The risk-neutral buyer, whom we shall call the bid-taker, uses a first-price sealed-bid auction to award each procurement project to one of many bidders. The bid-taker prefers high quality over expected cost minimization if the costs for high quality are not too high. He precommits himself to a fixed price for each project. We model this situation as an extensive form game between the bid-taker and bidders. Here the bidders, who are also risk-neutral and expected payoff maximizers, refer to the potential contractors who attend bidding competition.

We begin by formulating each procurement as a three-stage game. We then describe a cost structure, uncertainty, and feasible strategies for bidders. Finally, we introduce simplifying assumptions on the dynamic structure of the game.

A. Sequence of Events

There are three stages in the game. In the first stage (the pre-auction stage), the bid-taker either selects an appropriate number of bidders from the pool of potential contractors or allows free entry of potential contractors.[9] At the end of STAGE 1, the number of competing bidders, n, is commonly known.

At the beginning of STAGE 2 (bidding stage), each bidder observes his opportunity cost, which is assumed to vary from bidder to bidder. As in Holt (1980), such differences in opportunity costs may be due to differences in planned investment opportunities. By the rules of the first-price sealed-bid auction, then each bidder submits his bid both simultaneously and noncooperatively. The lowest bidder wins, but other bidders neither pay nor receive anything. If two bidders quote the lowest price, the flip of a coin determines the winner. The bid-taker then makes a contract for high quality with the winning bidder at his bid-price.

At the beginning of STAGE 3 (production stage), "nature" resolves technological uncertainty about the production cost, independently of the winning bidder's opportunity cost. We may interpret this uncertainty as an economic environment in STAGE 3, such as the uncertain input price for the production. Given the revelation of uncertainty, the contractor provides either a high- or a low-quality product. Though, in general, quality of a procurement project consists of a number of characteristics such as product quality, delivery date and after-sale service, here we assume that these have been converted into a quality equivalent, which takes only two values, high (H) and low (L).

At the end of STAGE 3, the bid-taker accurately assesses the product quality, though this quality may not be observable to third parties. If the contractor provides low quality, the bid-taker will permanently debar him from future auctions. Otherwise, the bid-taker allows him to attend the future auctions. Then the play

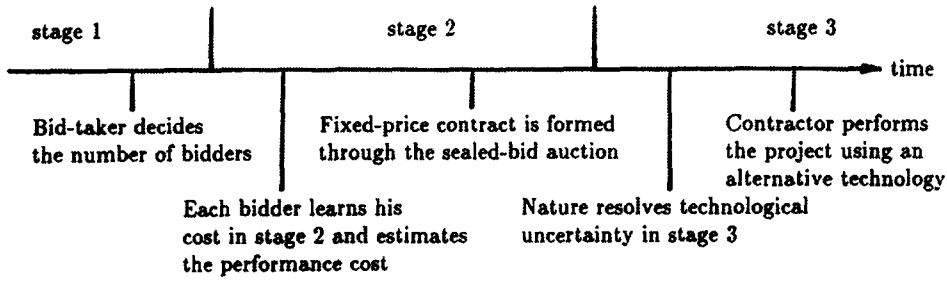

Figure 1. **Time of the Model**

proceeds to the subsequent procurement auction. Figure 1 describes the timeline summarizing the sequence.

B. Costs and Strategies

As in Holt (1980), a bidder faces an opportunity and production costs for the auctioned project. We assume that all the bidders are equally qualified ex ante, i.e., they have a common technology for the production of the project, while the opportunity cost varies across bidders. At the bidding stage, each bidder observes his own opportunity cost and estimates a common expected production cost. As we have assumed a fixed-price contract, a bidder's decision of bid-price must consider the expected production cost as well as his opportunity cost.

The opportunity cost parameter, c_i, of bidder i, $i = 1, 2, \ldots, n$, is distributed independently and identically, drawn from a common-knowledge two-point probability distribution on $\{0, \bar{c}\}$, $\bar{c} > 0$. Bidder i knows c_i, but his opponents only know that $c_i = 0$ with probability $1 - p$ and $c_i = \bar{c}$ with probability $p > 0$.

We represent the technological uncertainty in STAGE 3 by the state set, which takes only two states, "good" and "bad." It is commonly known that the state is good with probability $1 - p_B$ and bad with probability $p_B > 0$.

Given the realization of a state in STAGE 3, the contractor produces the project using one of the two alternative actions: a "faithful" and an "opportunistic." With the faithful action, the contractor provides high quality H at cost c_H in the good state, and at cost γc_H in the bad state, where $\gamma > 1$ represents the effects of the technological uncertainty. Similarly, with the opportunistic action, the contractor provides low quality L at cost c_L in the good state, and at cost γc_L in the bad state, where $c_H > c_L$. Table 1 summarizes the structure of information and costs in STAGES 2 and 3 associated with alternative actions.

Table 1. **The Structure of Information and Costs**

Quality & Probability	STAGE 2 (asymmetric information)		STAGE 3 (uncertainty)	
	Low Cost (0)	**High Cost ($\bar{c}$)**	**Good State**	**Bad State**
H	0	$\bar{c}$	c_H	γc_H
L	0	$\bar{c}$	c_L	γc_L
Probability	$1-p$	p	$1-p_B$	p_B

C. Payoffs and Assumptions on Repeated Auctions

The payoff for a faithful contractor is the sum of the present profit and the present value of expected profits from all possible future contracts, while the payoff for an opportunistic contractor is just the present profit.

To make our model tractable, we make three assumptions on the dynamic structure of the game: (i) bidder i draws c_i anew at each procurement auction; (ii) a bidder's reputation is only related to his possible opportunism, but not to the event of winning or losing; and (iii) there is no sequential learning about production costs in STAGE 3 between projects. Note that, without the second and the third assumptions, a bidder may have an incentive to engage in predatory pricing in order to discourage his opponents from attending future auctions and/or in order to accumulate experiences in production. With the above three assumptions, however, the same three-stage-game described in the previous subsection repeats infinitely.[10]

II. COMPLETE CONTRACTS AND FULL ENFORCEMENTS: THE BENCHMARK

In this section we analyze the three-stage-game described in the previous section under the assumptions that contracts are complete and that the liability system is perfect. We use this analysis, in Section III, as the benchmark to study the effects of contractual incompleteness on the number of competing bidders.

We employ the standard backward argument to tackle the three-stage-game. However, the problem of quality provision in STAGE 3 automatically resolves, since the assumptions of complete contract and full enforcement imply that a contractor is bound to provide only high quality at his bid-price. Therefore, we can now move into the bidders' problems in STAGE 2.

We employ a Nash equilibrium as the solution concept for the auction. We first derive symmetric equilibrium bid-functions with two bidders. Our analysis of a low-bid auction with two bidders builds on that of Maskin and Riley (1985), although they deal with a high-bid auction.

Hereafter, we will refer to a bidder who observes cost of $\bar{c}$ in STAGE 2 as a high-cost bidder, and a bidder who observes cost of zero in STAGE 2 as a low-cost bidder. It would be helpful to think that a bidder (a low- or a high-cost type) has two opponents: a high-cost opponent with probability p and a low-cost opponent with $1 - p$.

From Table 1, at the bidding stage, a bidder's estimation of expected cost of providing high quality H is $\hat{c}_H = p_B c_H + (1 - p_B)c_H$. As in Maskin and Riley (1985), in equilibrium, the "Bertrand-like competition" results in bid $\bar{c} + \hat{c}_H$ for high-cost bidders. That is, competition among bidders forces high-cost bidders to earn expected profit of zero.

Now let us consider low-cost bidders. Since the distribution of cost observations is discrete, there is no equilibrium in pure strategy for low-cost bidders.[11] Let $G(b)$ be the cumulative distribution function of a low-cost bidder's bid b. Let $\underline{b}$ and $\bar{b}$ be the lowest and the highest bids, respectively. Maskin and Riley (1985) prove that $G(b)$ is continuous over a common support $[\underline{b}, \bar{b}]$ and that there can be no subinterval of $[\underline{b}, \bar{b}]$ over which $G(b)$ is constant.[12]

Since high-cost bidders always bid $\bar{c} + \hat{c}_H$ in equilibrium, a low-cost bidder can bid up to $\bar{c} + \hat{c}_H$ without losing the auction to a high-cost bidder, i.e. $\bar{b} = \bar{c} + \hat{c}_H$. This is because the argument of Footnote 12 implies that the low-cost bidder bids $\bar{b}$ with probability zero. Since, in equilibrium, any bid b as part of a mixed strategy must generate the same expected payoff, the following equation must be true:

$$\Pr(\text{win}\,|\,b)(b - \hat{c}_H) = \lim_{b \to \bar{b}} \Pr(\text{win}\,|\,b)(b - \hat{c}_H). \tag{1}$$

A low-cost bidder's probability of winning with b, $\Pr(\text{win}\,|\,b)$, is $p + (1 - p)(1 - G(b))$, since he can beat a high-cost type opponent with probability one (which results in the first term p of the probability) and beat a low-cost opponent when the opponent bids higher than b (which results in the second term $(1 - p)(1 - G(b))$ of the probability). And since $\bar{b} = \bar{c} + \hat{c}_H$ we can rewrite Equation 1 as:

$$[p + (1 - p)(1 - G(b))](b - \hat{c}_H) = p\bar{c}. \tag{2}$$

Since Equation 2 must hold for any b in an equilibrium support and since $G(\underline{b}) = 0$ by definition, the infimum (or largest lower bound) of b is $\underline{b} = p\bar{c} + \hat{c}_H$. Thus, the equilibrium support of b is the interval $[p\bar{c} + \hat{c}_H, \bar{c} + \hat{c}_H]$. One can easily recognize that with three bidders, Equation 2 becomes $[p^2 + 2p(1 - p)(1 - G(b)) + (1 - p)^2(1 - G(b))^2](b - \hat{c}_H) = p^2\bar{c}$.

Let $\underline{b}_n$ be the infimum and $G_n(b)$ the cumulative distribution function of a low-cost bidder's bid b with n bidders. Using the same logic with two bidders, Lemma 1 characterizes a symmetric Nash-equilibrium bidding strategy with n bidders.

Lemma 1: *Suppose that contracts are complete and that the liability system is perfect. Then, in equilibrium, (i) high-cost bidders bid* $\bar{c} + \hat{c}_H$, *and (ii) low-cost bidders bid according to the strategy*

$$[p^{n-1} + (n-1)p^{n-2}(1-p)(1-G_n(b)) + \ldots + (1-p)^{n-1}(1-G_n(b))^{n-1}](b - \hat{c}_H) = p^{n-1}\bar{c} \tag{3}$$

for all $b \in [\underline{b}_n, \bar{b}]$, *with* $\underline{b}_n = p^{n-1}\bar{c} + \hat{c}_H$.[13]

The following lemma states the folk wisdom of bidding competition: the bid-taker can lower the expected procurement cost by increasing the number of competing bidders n. This is because the more bidders there are, the lower on average is the realization of the lowest bidder. Thus, increasing the number of bidders decreases the expected procurement cost on average of the bid-taker.

Lemma 2: *The expected procurement cost converges to* $\hat{c}_H$ *as* $n \to \infty$.

PROOF: Consider Equation 3 when $n \to \infty$. The right-hand side of Equation 3 converges to zero. But the bracketed expression of the left-hand side of Equation 3 does not necessarily converge to zero, as shown in Footnote 13. In order for Equation 3 to hold, therefore, equilibrium bid-price b must be $\hat{c}_H$ when $n \to \infty$. By the rules of the first-price sealed-bid auction, then this b is equal to the bid-taker's procurement cost. Q.E.D.

Integrating Equation 3 over the equilibrium support shows that a low-cost bidder receives expected profit of $p^{n-1}\bar{c}$. Note that a bidder realizes low cost with probability $1 - p$. Also note that, in equilibrium, a high-cost bidder's expected profit is zero. Since $0 < p < 1$, the following lemma, as a mirror image of Lemma 2, is immediate.

Lemma 3: *A bidder's expected profit from an auction,* $(1-p)p^{n-1}\bar{c}$, *is decreasing in n.*

Now let us consider the bid-taker's problem in STAGE 1. As shown in Lemma 2, the bid-taker can minimize the expected procurement cost by maximizing the number of competing bidders. Since the provision of high quality is automatic with complete contracts, the bid-taker in STAGE 1 will allow free entry of bidders.

III. REPUTATION AND SELF-ENFORCING CONTRACTS

Now suppose that the product quality is non-verifiable by third parties, though it is observable ex post to the bid-taker and contractor. Then a contractor is now

free to choose between high quality H and low quality L.[14] On the other hand, the bid-taker, who precommits himself to a fixed price, can punish an opportunistic contractor by permanently debarring him from future auctions. With this threat, a bidder who wishes to invest in reputation-building is willing to make a credible commitment to H by posting his reputation as a "hostage" in Williamson's word. Hereafter we shall call such a bidder a reputable bidder.[15]

As in Section II, we employ the standard backward argument by starting with the contractor's problem at STAGE 3: choosing quality. Let V be the present value of a reputable contractor's expected profits from all possible future contracts, which is feasible only when he has provided H (and thus receives permission to attend the infinite stream of future auctions). Note that we implicitly assume a stationary policy for V. In deciding whether to provide high or low quality, then the contractor chooses between maintaining V with the faithful action or obtaining some one-shot profit from the opportunistic action.

The contractor chooses quality after nature resolves technological uncertainty by selecting either good or bad state at the beginning of STAGE 3. Suppose that nature selects the bad state. If the contractor provides H, he incurs cost γc_H. However, if he provides L, he incurs cost $\gamma c_L + V$, as he must sacrifice V. Thus, the contractor chooses product quality H if $V \geq \gamma(c_H - c_L)$ and L if $V < \gamma(c_H - c_L)$, assuming that he chooses H in the border case. Similarly, if nature selects the good state, the contractor chooses H if $V \geq c_H - c_L$ and L if $V < c_H - c_L$.

We now examine a bidder's problem of submitting a bid-price at STAGE 2. It would be convenient to divide a bidder's bid-price into two components: bid-price based on the opportunity cost in STAGE 2 and bid-price based on the expected quality choice for the production stage. The opportunity cost is equivalent to a sunk cost for the contractor, as he must forgo his best alternative profit opportunity regardless of his potential opportunism at STAGE 3.[16] This implies that contractual incompleteness does not affect the bid-price based on the opportunity cost.

Let b_3 denote the bid-price based on the expected quality choice. Note that b_3 is independent of a bidder's cost observation in STAGE 2, since the quality choice in STAGE 3 depends on the comparison either between V and $\gamma(c_H - c_L)$ or between V and $(c_H - c_L)$, but not on the opportunity cost in STAGE 2. Let $\hat{c}_L = p_B\gamma c_L + (1 - p_B)c_L$ and $\hat{c} = p_B\gamma c_L + (1 - p_B)c_H$. Note that $\hat{c}_L$ denotes the expected production cost for low quality, while $\hat{c}$ is the expected production cost for low quality with probability p_B and for high quality with $1 - p_B$. Then the following lemma summarizes an equilibrium b_3.

Lemma 4: *If the product quality is not contractible, then an equilibrium bid-price based on expected quality choice for the production stage is*

$$b_3 = \hat{c}_H \qquad \text{for } V \geq \gamma(c_H - c_L) \tag{4.1}$$

$$\hat{c} + p_B V \qquad \text{for } c_H - c_L \leq V < \gamma(c_H - c_L) \tag{4.2}$$

$$\hat{c}_L + V \qquad \text{for } V < c_H - c_L. \tag{4.3}$$

PROOF: The basic idea of the proof is again the Bertrand-like competition for high-cost bidders, as in Lemma 1. We will prove only Equation 4.2, since the proofs of Equations 4.1 and 4.3 are essentially similar. Suppose that a high-cost bidder wins with $\bar{c} + b_3$. Then, condition $V < \gamma(c_H - c_L)$ implies that the winning bidder will provide L in the bad state, while condition $c_H - c_L \leq V$ implies H in the good state. It is then obvious that the production cost for this strategy is $\hat{c}$ and that the contractor will not lose V with probability $(1 - p_B)$. Thus, the following equation must be true at the bidding stage:

$$\bar{c} + b_3 - \bar{c} - \hat{c} + (1 - p_B)V \geq V. \tag{5}$$

The left-hand side of Equation 5 is the sum of the high-cost winning bidder's expected profits from the present and future auctions by bidding $\bar{c} + b_3$, while the right-hand side of Equation 5, V, is the present value of a losing but reputable bidder's incumbency. By the Bertrand-like competition for high-cost bidders, in equilibrium, Equation 5 becomes the equality of Equation 4.2: $b_3 = \hat{c} + p_B V$. Q.E.D.

See Figure 2, which is the graphical statement of Lemma 4. First consider the case where $V \geq \gamma(c_H - c_L)$. Even though nature selects the bad state, V with providing H is greater than or equal to the cost saving, $\gamma(c_H - c_L)$, with providing L; thus, in equilibrium, H is always provided regardless of the state of nature. As in Lemma 1, therefore, a high-cost bidder bids $\bar{c} + \hat{c}_H$, where $\bar{c}$ is the bid-price based on the opportunity cost in STAGE 2 and $\hat{c}_H$ is b_3, while a low-cost bidder randomizes his bid-price in accordance with Equation 3.

When the value of reputation is relatively small, i.e., when $V < c_H - c_L$, the description of the Nash equilibrium in Lemma 4 pertains to the recognition of Tirole's (1986) conjecture about the problem of underbidding (or cost overruns). Remember that cost overruns corresponds to quality reduction in this paper. To explain cost overruns in the presence of rational expectations, Tirole (1986) proposes a hypothesis that, if renegotiation is possible after signing a contract, the estimate of production cost at the bidding stage represents only a lower bound on the transfer in case of implementation.

On the other hand, Equation 4.3 and a part of Equation 4.2 in Lemma 4 imply that, even in the absence of renegotiation, if the bid-taker fails to provide a necessary value of incumbency V for H, then cost overruns (quality reduction in our context) can occur. This is because V is less than the cost saving with providing L in the good state as well as that in the bad state. In the case of Equation 4.3, a high-cost bidder bids $\bar{c} + \hat{c}_L + V$, where $\bar{c}$ is the bid-price based on the opportunity cost in STAGE 2 and $\hat{c}_L + V$ is b_3, while a low-cost bidder randomizes his bid-price according to Equation 3 but substituting $\hat{c}_H$ with $\hat{c}_L + V$.

Next consider the intermediate case where $c_H - c_L \leq V < \gamma(c_H - c_L)$. In this case, the contractor will provide L with probability p_B and H with probability $1 - p_B$ at STAGE 3. This type of partial failure of providing H explains how uncertainty can affect cost overruns: the phenomenon of cost overruns can also occur as a result of

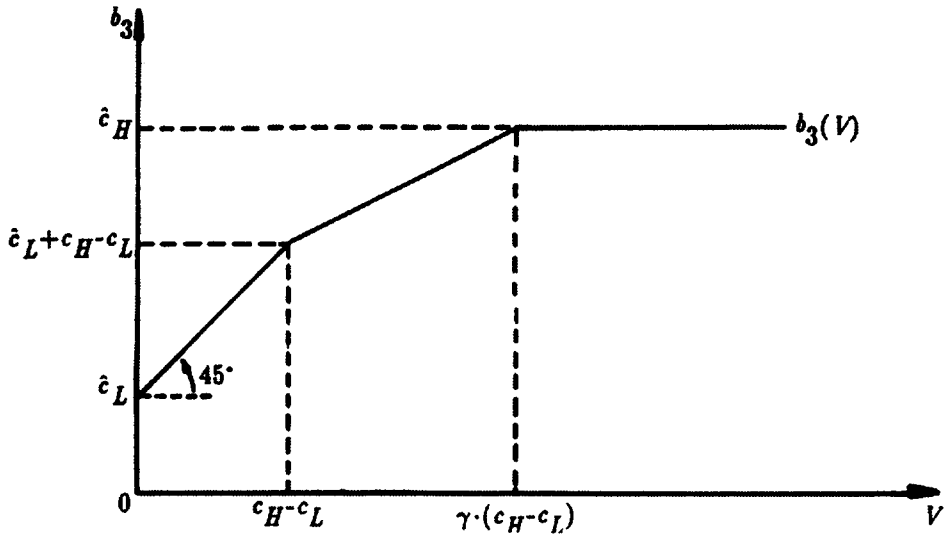

Figure 2. **Equilibrium Bid-Function for a Performance in STAGE 3, b_3**

unfavorable economic environment (or bad state) at the production stage. A high-cost bidder in this case bids $\tilde{c} + \hat{c} + p_B V$, where $\tilde{c}$ is the bid-price based on the opportunity cost in STAGE 2 and $\hat{c} + p_B V$ is b_3, while a low-cost bidder randomizes his bid-price according to Equation 3 but substituting $\hat{c}_H$ with $\hat{c} + p_B V$. The following proposition then summarizes the main implication of Equations 4.2 and 4.3 in Lemma 4.

> **Proposition 1:** *If the product quality is not contractible and if a one-shot gain from opportunism is greater than the present value of expected profits from maintaining reputation, then, in equilibrium, bidders have no incentives to provide high quality, though they are well qualified ex ante to provide it. This distortion in incentives, together with bidding competition, drives the bidders to bid so low that a winning bidder can provide only low quality.*

Proposition 1 implies that the bid-taker has to pay additional costs (or cost overruns) in order to get H when the value of incumbency, V, is too low to enduce H. To avoid quality reduction, in real-life situations, governments have frequently paid cost overruns in government contracts ex post, if the associate costs are not too high.

We now move into the bid-taker's problem in STAGE 1: deciding the number of competing bidders. As a contractor is now free to choose a product quality, the implication of utility maximization with public tendering in Lemma 2 becomes substantially limited. This is because now a conflicting force is at work:

a contractor becomes tempted to adopt the opportunistic action if the bid-taker tries to reduce the expected procurement cost by admitting more bidders to an auction. The contractor's such an incentive results from the fact that an increase in the number of competing bidders makes his expected profits from maintaining reputation less important than his feasible profits from opportunism, as explained in Proposition 1. The trade-off between the assurance of the value of incumbency V and the maximization of competition shall determine the optimum number of competing bidders.

As the bid-taker prefers high quality to expected cost minimization, he tries to minimize the expected procurement cost under the condition that no contractor provides low quality at any circumstances. Lemma 3 shows that a reputable contractor's expected profit from a specific contract is a decreasing function of the number of bidders n. And V is the reputable contractor's present value of expected profits from all feasible future contracts. Thus, $V = V(n)$ and $V'(n) < 0$. We assume that the size of V is large enough to allow at least two bidders in the auction. Using Equation 4.1 and Lemma 1, we define a high-quality equilibrium as follows.

DEFINITION 1: A high-quality equilibrium is a pair of a number of bidders and a bidding strategy, $(n, B(n))$, such that

$$V(n) - \gamma(c_H - c_L) \geq 0, \tag{6}$$

and bidding strategy $B(n)$ satisfies the Nash equilibrium in Lemma 1.

Proposition 2 describes the existence of the high-quality equilibrium. An asterisk will indicate the optimal value of n, and r denotes a discount rate. To do some comparative statics, it would be convenient to ignore the restriction that n must be an integer.

Proposition 2: *Fix the values of p, p_B, r, γ, $\bar{c}$ and $c_H - c_L$. Then there exists a unique high-quality equilibrium, $(n^*(p, p_B, r, \gamma, \bar{c}, c_H - c_L), B(n^*(\cdot)))$, which ensures a self-enforcing contract at the lowest expected procurement cost.*

PROOF: Suppose that Equation 6 holds; and thus, no contractor has an incentive to provide L. Lemma 3 shows that a bidder's expected profit from an auction is $(1-p)p^{n-1}\bar{c}$. Thus, when n is the number of bidders for the present and future auctions, the present value of reputation is

$$V(n) = \frac{(1-p)p^{n-1}\bar{c}}{1+r} + \frac{(1-p)p^{n-1}\bar{c}}{(1+r)^2} + \ldots = \frac{(1-p)p^{n-1}\bar{c}}{r}. \tag{7}$$

Since $V(n)$ is monotonically decreasing in n while $\gamma(c_H - c_L)$ is constant, there must be the unique n^* such that $V(n^*) - \gamma(c_H - c_L) = 0$. Q.E.D.

From Equations 6 and 7, we have

$$\frac{(1-p)p^{n^*-1}\bar{c}}{r} - \gamma(c_H - c_L) = 0. \tag{8}$$

Using logarithmic transformation, one can then easily check that the optimum number of competing bidders, n^* in Equation 8, has the following comparative statics.

COROLLARY 1: (i) $\partial n^*/\partial r < 0$; (ii) $\partial n^*/\partial \bar{c} > 0$; (iii) $\partial n^*/\partial(c_H - c_L) < 0$; (iv) $\partial n^*/\partial \gamma < 0$.

With a given technology and self-enforcing contracts, several parameters affect n^*. First, the discount rate r is inversely proportional to n^*. This result is quite well-known in the literature of reputation. A smaller r can result from a short time period of a project, as for a given r per unit of time, r per period grows with the information lag. This implies that the shorter the time period, the easier it is for the bid-taker to introduce competition, because he is able to observe the product quality earlier.

Second, n^* is increasing in $\bar{c}$. That is, when the opportunity-cost differential increases, so does n^*. This is because an increase in the opportunity-cost differential makes the present value of incumbency V become more valuable than a one-shot gain from opportunism; thus, the bid-taker can exploit some of it by introducing more competition.

Third, as the difference between cost for H and cost for L, $c_H - c_L$, becomes larger, n^* becomes smaller. Note that $c_H - c_L$ reflects the degree of the lucrativeness of opportunism in STAGE 3. If the process of the production is well established, i.e., if the difference $c_H - c_L$ is relatively small, then a contractor is less able to exploit his ex post monopoly position for the project. Put differently, the bid-taker's ability to introduce more competition decreases with the relative lucrativeness of opportunism.

Finally, since γ represents the relative size of the technological uncertainty affecting the relative lucrativeness of opportunism, the same argument as in the difference $c_H - c_L$ applies to γ. If a procurement contract involves both higher technological uncertainty γ and greater lucrativeness of opportunism, $c_H - c_L$, the benefit of bidding competition will easily be reduced.

If $n^* < 2$, then the bid-taker with the preference for high quality prefers single tendering (where a single, selected bidder is invited to tender) to an auction mechanism. An interesting extension of the present analysis would involve a comparison of selective tendering with single tendering (see Bulow and Klemperer, 1996, for a similar direction in a different context).

IV. CONCLUDING REMARKS

Our relatively simple model has provided a straightforward explanation of why selective tendering is so widely used in the procurement market. Some extensions of our model seem important: (i) considering asymmetry between incumbent and entrant bidders; (ii) adjusting a bid-taker's discretionary powers to legal environments; and (iii) comparing selective tendering with some alternative institutions. We shall comment briefly on each of these.

For expositional simplicity, we have assumed that the number of bidders is large enough to allow selective tendering and that the bidders are equally well qualified to provide high quality. Suppose that there are two types of bidders—qualified (incumbent bidders) and less qualified (entrants). Also assume that the number of the incumbents is less than an optimum number of bidders considered in Proposition 2. Then the introduction of the entrants into bidding competition seems to be beneficial to the bid-taker. The basic argument in support of the introduction of the entrants is that concern over losing the contract to an entrant will cause the incumbent bidders to bid more aggressively. However, two important factors may favor the incumbents: lower production costs and lower financing requirements with established reputation in the product market. If an opportunistic entrant, observing high cost at the bidding stage, believes that his wealth including the financing ability is insufficient to invest in reputation-building, then he may try to mimic a low-cost entrant's strategy. This opportunistic behavior of the high-cost entrant influences the incumbents' strategies as well as other low-cost entrants' strategies, which then have feedback effects on the high-cost entrant's opportunism. As discussed in Spulber (1990), this may jeopardize the auction mechanism and cause the bid-taker to block potentially beneficial entry.

The second issue we have not developed in this paper is the relationship between a bid-taker's discretion and legal environments. The U.S. Congress enacted the Competition in Contracting Act (CICA) of 1984, providing procurement contractors with better access to the government procurement market. Under the CICA, however, it may not be easy for a government procuring agency (as a bid-taker) to ensure that the previous performance of a contractor should play a major role in evaluating his qualifications for present and future procurement auctions. Put differently, the CICA may have substantially limited discretionary powers of procuring agencies necessary to prevent contractors' opportunism.[17] Kelman (1990, p. 1) raises a solid argument against restriction on procuring agencies' discretion: "The problem with the current system is that public officials cannot use common sense and good judgement in ways that would promote better vendor performance."

Finally, there are a few other alternatives which may increase the bid-taker's utility in a similar way as selective tendering does: a minimum financial or technical requirement for bidders and a bid-taker's favoritism toward a specific group of bidders such as domestic firms.[18] Comparing selective tendering with

these alternatives could produce some policy implications in the design of procurement auctions.

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NOTES

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1. In the United Kingdom, for instance, 50% of government procurement funds in 1962-63 were allocated by selective tendering, and 49% by single tendering where a single, selected contractor is invited to tender (Baldwin, 1970, p. 60). During the first half of fiscal year 1985, contracts through public tendering accounted for only 4.6% of procurement funds of the U.S. Department of Defense (U.S. Department of Defense, 1986). In the case of government procurement, we may have to consider a political motive for selective tendering: correcting balance-of-payments inequities in international trade or promoting economic development in less developed regions (see Kim, 1994, 1997, for discrimination against foreign bidders). In her study of the construction industry, however, Hillebrandt (1974, p. 79) observes that the commercial sector more frequently uses selective tendering than the government sector and that there is a steady upward trend in the use of selective tendering.

2. The Competition in Contracting Act of 1984 would be a good example, under which excluded contractors and losing bidders can protest the actions of U.S. government procuring agencies. In his study of U.S. government's computer procurement, however, Kelman (1990) argues that such regulations interfere with reasonable discretion of procuring agencies' .

3. It might be feasible to write and enforce complete (or state-contingent) contracts, but simply too costly to do so. Contracts cannot be complete because of transaction costs that result from: (i) ex ante, bounded rationality associated with uncertainty, and (ii) ex post, opportunism and imperfect legal enforcement. See Williamson (1975, Ch. 2; 1985, Ch. 1) for more detailed description of transaction costs.

4. Here the assumption of the fixed-price contract helps us concentrate only on the effect of the bidders' opportunism. However, the fixed-price contract is indeed the most common form of contract.

5. Klein and Leffler (1981) first recognize and Shapiro (1983) develops further the idea of reputation in a competitive market where product quality is unobservable prior to purchase: sellers have an incentive to provide high quality because of reputation related to repeated purchases.

6. As we deal with the case where a bidder's knowledge of other bidders' opportunity costs does not change his opportunity cost (independent private-value model), we do not consider the interesting issues arising from the bidders' ex ante need to gather information about the true value of the auctioned object (common-value model). Using a com-

mon-value model, French and McCormick (1984) argue that the bid-taker may deter free entry of bidders if he must bear the costs associated with the bidders' efforts to gather information.

7. We may roughly summarize his argument as follows. If contract law cannot force bidders to abide by the contractual obligations, high-cost-overrun bidders will submit bid-prices too low to cover their performance costs, foreseeing that they can renege on the contractual obligations when a cost overrun occurs. This changes the bidding strategies of both high- and low-cost-overrun bidders to the point at which the auction mechanism fails to distinguish between bidders on the basis of their private information about anticipated cost overruns.

8. The assumption of an infinite sequence is justifiable in the present context since the bid-taker is a government or a firm and not an individual. Even if the bid-taker is a one-shot player, the reputation mechanism still works if he can communicate with other bid-takers by using word-of-mouth so that all bid-takers in the industry know a specific contractor's reputation.

9. In the case of selective tendering, it is somewhat troublesome to determine which potential contractors should be selected and entitled to be incumbent bidders. But it may be plausible to assume that selection and incumbency result from both the bid-taker's random selection and the history of the industry.

10. This makes the exposition of the model much easier, because it allows the dynamic structure of the game to be reduced to a static model. The dynamic approach may capture long-run behavior more accurately but it is too complicated to consider problems such as Nash equilibrium bidding strategies and the optimum number of competing bidders in each procurement auction.

11. To see this, assume that a low-cost bidder, say bidder 1, submits $\bar{c} + \hat{c}_H - \varepsilon$. Then the other low-cost bidder's best response is to bid $\bar{c} + \hat{c}_H - 2\varepsilon$, in which case bidder 1 again would deviate to $\bar{c} + \hat{c}_H - 3\varepsilon$, and so on. If the decreasing bid-price hits some low price, however, a low-cost bidder's best response is to bid $\bar{c} + \hat{c}_H - \varepsilon$ again, realizing it would be better to beat only a possible high-cost opponent. Then the cycle of price cutting continues.

12. Theorem 6 in Dasgupta and Maskin (1986) is a general proof of the existence of a symmetric mixed-strategy equilibrium. The reasoning of no atom over the interval is roughly as follows. Suppose to the contrary that in equilibrium, a low-cost bidder i submits $b_i \in [\underline{b}, \bar{b}]$ with positive probability. Then there must be some interval $[b_i, b_i + \varepsilon]$ over which his low-cost opponent j will not bid since bidder j's probability of winning increases discontinuously if he replaces his bid in this interval with one that is infinitesimally smaller than b_i. Then bidder i can increase b_i to $b_i + \varepsilon$ without reducing his probability of winning. But this contradicts the assertion that the original b_i with positive probability was an equilibrium.

13. When $b = \underline{b}_n$, the bracketed expression of the left-hand side of Equation 3 is $p^{n-1} + (n-1)p^{n-2}(1-p) + \ldots + (1-p)^{n-1} = [p + (1-p)]^{n-1} = 1$, since $G_n(\underline{b}) = 0$ by definition. Thus, $\underline{b}_n = p^{n-1}\bar{c} + \hat{c}_H$.

14. One may argue that the contractor can save furthur cost by not providing any quality at all instead of by providing L. But this is not the case, since such an option is verifiable and thus contractible.

15. Remember that all bidders are identical in terms of qualification, i.e., if a bidder is reputable, so are all other bidders. Proposition 2 will show that a bidder's decision to be reputable or not depends on n.

16. An opportunity cost is not a sunk cost to a losing bidder, as he can walk away without incurring any cost. A bidder computes his bid-price, however, wishing that he would be the contractor. Thus, it would be convenient to think that the opportunity cost is equivalent to a sunk cost for a bidder until the contractor is known.

17. The CICA also increases the delays and bottlenecks in the procurement system. Gansler (1989, p. 191) quotes an article from the Washington Post as an example of such problems. According to it, the number of protests went from a few hundred a year to over 3,000 a year within four years of the law's passage. One company, with only 10 employees, submitted 50 protests in the three years following the passage of the law.

18. Steinberg (1993) argues that when for-profits and nonprofit organizations compete for a project, favoring nonprofit organizations may enhance social welfare (or the bid-taker's utility in our context).

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THE REPUBLIC OF TRINIDAD AND TOBAGO

MINISTRY OF FINANCE

CENTRAL TENDERS BOARD

INFORMATION BOOKLET

FOREWORD

Welcome and thank you for taking the time to read this simple yet comprehensive Information Booklet. This handbook was compiled to provide the reader with a brief overview of the Central Tenders Board Division and its role and function within the Financial Regulatory System.

The booklet also contains procedures followed by the Central Tenders Board and pertinent information for persons registered with or interested in registering their business with the Division. It is advised that persons read the booklet in its entirety to achieve maximum benefit.

This booklet should be viewed as a companion piece to the Central Tenders Board Ordinance (Act No. 22 – 1961; subsidiary legislation of the Laws of Trinidad and Tobago) and its subsequent amendments.

Please contact the Central Tenders Board for verification of the information presented within and for further information which may be required. Readers may also wish to visit the Central Tenders Board website at:

www.finance.gov.tt

Thank You.

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INTRODUCTION

CENTRAL TENDERS BOARD

ESTABLISHMENT

The Ministry of Finance is the agency charged with the responsibility of spending public funds and is therefore accountable to the population for such expenditure. The majority of this expenditure involves the procurement of goods and services. Approximately 75% of the Budget allowances for this procurement are through the Tendering Process.

The Central Tenders Board was therefore established by Act No. 22 of 1961 to ensure that the proper procedures are followed to obtain the most suitable supplies and services from available resources. The Central Tenders Board forms an integral part of the Financial Regulations as it is the Government Agency responsible for awarding contracts as requested by Government Ministries, Departments and certain Statutory Bodies.

FUNCTION

The Central Tenders Board Ordinance No. 22 of 1961, as amended, provides for the establishment of a Central Tenders Board which has the sole and exclusive authority, except as provided for in Sections 20 and 35 of the Legislation:

- **to act for, in the name and on behalf of the Government of Trinidad and Tobago and Statutory Bodies to which the Ordinance applies, in inviting, considering and accepting or rejecting offers for the supply of articles or for the undertaking of works or any services in connection therewith, necessary for carrying out the functions of the Government or any of the Statutory Bodies**

- **to dispose of surplus or unserviceable articles and real estate property belonging to the Government of Trinidad and Tobago or any of the Statutory Bodies**

The Board also performs other functions and duties as the President may by order prescribe from time to time.

ORGANIZATIONAL GOALS AND OBJECTIVES

MISSION

To provide procurement and disposal services for the Government of Trinidad and Tobago efficiently, cost effectively and with a commitment to fair treatment for all.

VISION

To be a leader in procurement, providing excellent services to the public and private sectors through the expertise of a well-trained staff, supported by efficient/workable systems that are in keeping with local and international standards.

CORE VALUES

To promote the principles of integrity, transparency, accountability, equity, high performance standards, customer satisfaction and value for money in government procurement.

GENERAL

To develop the human resource, so that staff is equipped to deal with environmental as well as technological changes as they unfold.

To ensure through training, that the staff is equipped with the necessary knowledge and skills required to enable the organization to attain its objectives while at the same time to meet individual growth potential.

To provide technical and support services to foreign as well as local clients to enable them to respond to procurement requirements with a high degree of efficiency.

To seek to educate the general public on the role and functions of the Central Tenders Board.

CORPORATE PLAN OF THE CENTRAL TENDERS BOARD

In the light of Vision 2020, and in keeping with one of the goals of the Ministry of Finance Strategic Plan to reinforce its structures, operations and processes, the Central Tenders Board is cognizant of its role in enabling competitive business and promoting good governance principles and practices.

In order to allow free competition and drive innovation and entrepreneurship, the public procurement functions must be developed to such a strong base with State of the Art Information Technology Systems to achieve such goals. This development will also enhance the promotion of e-Government, e-Business, e-Procurement, e-Auctioning and e-Registration.

STRATEGIC OBJECTIVES

The Corporate Plan of the Central Tenders Board encompasses the following strategic objectives:

- **Amendment of Legislation (referred to in White Paper on Government Procurement – 2005)**
- **Training of staff involved in procurement (Central Tenders Board, Ministries, Departments and Statutory Bodies)**
- **Computerization to accommodate the procurement process**
- **Restructuring of the Organization**
- **Office accommodation relating to upgrading of present location or relocation on expiration of lease**

ORGANIZATIONAL STRUCTURE

STRUCTURE OF THE ORGANIZATION

The current structure of the Board with particular reference to the Technical Section has been so designed to facilitate maximum utility of the human and other resources. Strategies are to be developed for promoting transparency, accountability and value for money towards a new procurement regime which would enhance output and outcomes while at the same time promoting a culture of loyalty and commitment.

TECHNICAL SECTION

This section falls under the Director of Contracts who is Head of the Central Tenders Board Division and also Chairman of the Board. It is divided into three (3) sub groups; one group of technical officers being supervised by the Deputy Director and each of the remaining two being supervised by Assistant Directors.

The primary responsibilities of the three (3) managers are:

- **to assist the Director in determining policy and procedures for the award of contracts and the disposal of unserviceable/surplus articles owned by Government**
- **to advise Government Agencies of the principles and practices governing tendering procedures and the award of contracts**
- **to monitor specific areas of the Central Tenders Board's activities**

To assist in the realization of the functions as outlined above, the Directorate, comprising the Director, Deputy Director and Assistant Directors, is assisted by a cadre of twenty (20) Contracts Officers.

ORGANIZATIONAL STRUCTURE

ADMINISTRATIVE SECTION

This section complements the Technical Section and provides administrative support to the Central Tenders Board. An Administrative Officer IV manages this section. There are twelve (12) officers along with ten (10) manipulative persons assigned to this section to assist in the day-to-day operations.

SECRETARIAT

This section interfaces and acts as a link between the Technical Section and the Board. It comprises an Administrative Officer II as Secretary to the Board and two (2) other officers.

COMPOSITION OF THE BOARD

COMPOSITION OF THE CENTRAL TENDERS BOARD

The Legislation defines the composition of the Board, sub-committees and special committees with specific financial limits for the making of awards and disposal of surplus and unserviceable articles. All committees act for and on behalf of the Board and follow the same procedures.

The President appoints at least five (5) Public Officers, and three (3) Members at large, as may be necessary, to complete the membership of the Board.

The present Board is composed of eight (8) Members consisting of the following:

1) **Director of Contracts – Chairman of the Board**
2) **Deputy Director of Contracts – Deputy Chairman of the Board**
3) **Permanent Secretary, Ministry of Trade and Industry**
4) **Comptroller of Accounts**
5) **Chief State Solicitor**
6) **Member at large**
7) **Member at large**
8) **Member at large**

COMPOSITION OF SUB-COMMITTEES OF THE BOARD

TENDERS COMMITTEES IN REGIONAL AND MUNICIPAL CORPORATIONS AND STATUTORY BOARDS

Such Committees are composed of five (5) Members consisting of the following:

1) **Member of the Directorate of the Central Tenders Board – Chairman**
2) **Member of the Respective Corporation's Council**
3) **Member of the Respective Corporation's Council**
4) **Member at large**
5) **Member at large**

Members are nominated by the Honourable Minister of Local Government and are appointed by the Honourable Minister of Finance.

COMPOSITION OF THE BOARD

COMPOSITION OF SUB-COMMITTEES OF THE BOARD

TENDERS COMMITTEES IN MINISTRIES AND DEPARTMENTS

Such Committees are composed of three (3) Members consisting of the following:

1) **Member of the Directorate of the Central Tenders Board – Chairman**
2) **Member – ex-officio Officer**
3) **Member – ex-officio Officer**

The Chairman is a member of the Directorate of the Central Tenders Board. Members are nominated by the Honourable Minister of the relevant Ministry or the Head of the Department and are appointed by the Honourable Minister of Finance.

SPECIAL MINISTERIAL COMMITTEES OF REGIONAL CORPORATIONS

Such Committees are composed of three (3) Members consisting of the following:

1) **The Permanent Secretary responsible for the Regional Corporations or his representative – Chairman**
2) **The Chief Executive Officer – Member**
3) **The County Superintendent – Member**

COMPOSITION OF THE BOARD

COMPOSITION OF THE SPECIAL COMMITTEE OF THE BOARD

THE OFFICE MACHINES, APPLIANCES AND FURNITURE COMMITTEE

There is one (1) Special Committee of the Board which "shall be comprised of such officers as the Minister of Finance shall from time to time nominate, one of whom shall be an ex-officio Member of the Board".

The composition of this committee is as follows:

1) **Director of Contracts – Chairman**
2) **Director of Budgets**
3) **Director, Property and Real Estate Management Services Division, Ministry of Public Administration**
4) **Property Manager, Furniture Branch, Ministry of Works and Transport**

REPRESENTATION ON OTHER TENDERS COMMITTEES

The Director of Contracts or his/her nominee represents the Central Tenders Board on Tenders Committees of State Agencies/Statutory Bodies, even though the State Agency or Statutory Body does not fall under the purview of the Board.

In most cases, the Board is represented where the value of contracts exceeds the stipulated financial limit e.g.:-

- **Port Authority of Trinidad and Tobago – over TT$5,000,000**
- **Public Transport Service Corporation – over TT$250,000**

The Board is also represented on the Special Tenders Committee of the Ministry of National Security whenever the value of contracts is over one hundred thousand dollars (TT$100, 000).

AGENCIES UNDER THE BOARD

GOVERNMENT MINISTRIES

The Central Tenders Board accepts written requests from ALL Government Ministries for the Supply or Purchase of Articles, Services or Works for projects. All requests are accompanied by the relevant Tender Documents and an indication that the necessary funding is available.

STATE DEPARTMENTS AND AGENCIES

The Central Tenders Board also accepts written requests for the Supply or Purchase of Articles, Services or Works for particular projects from the following State Agencies:

- **Auditor General**
- **Integrity Commission**
- **Judiciary (Supreme Court and Magistracy)**
- **Industrial Court**
- **Office of the President**
- **Ombudsman**
- **Parliament**
- **Personnel Department (Chief Personnel Officer)**
- **Service Commissions Department**
- **Sugar Industry Labour Welfare Committee**
- **Tax Appeal Board**

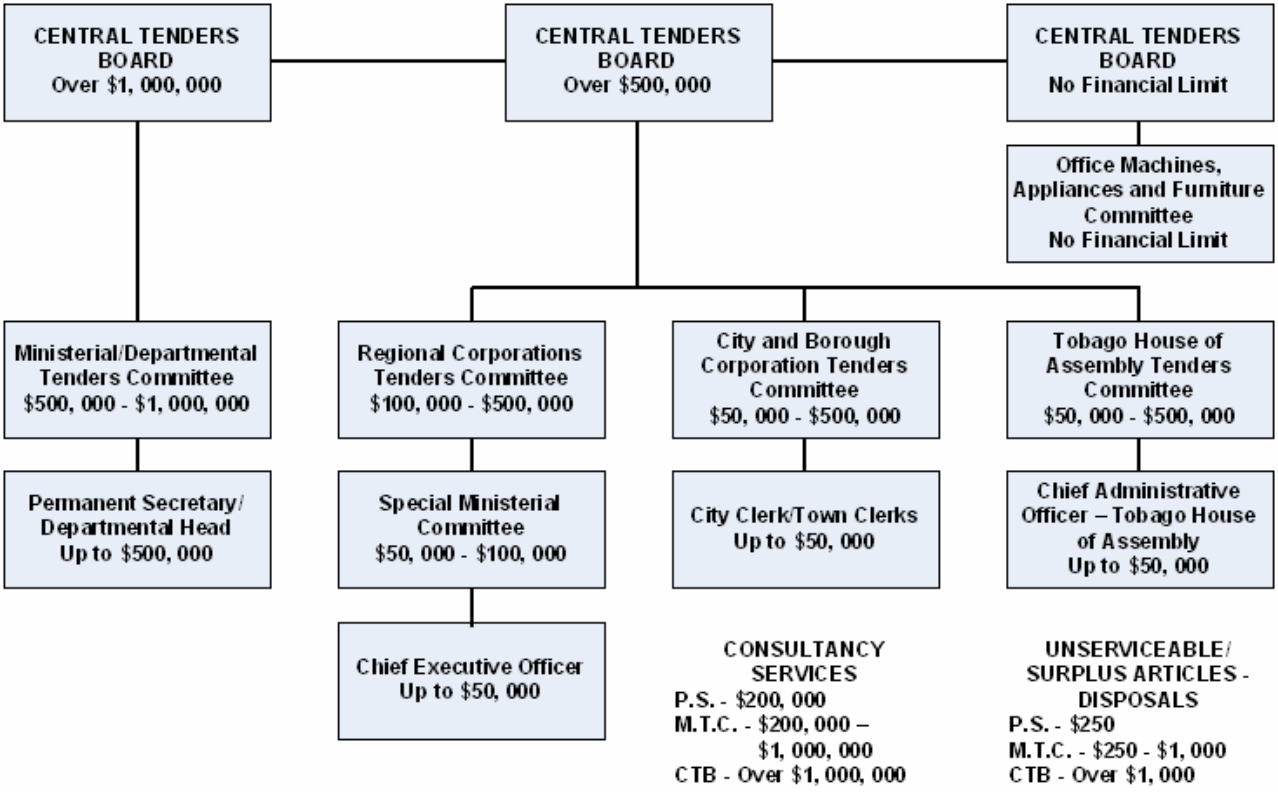
RELATIONSHIP OF THE BOARD WITH EXTERNAL AGENCIES

The Board has had on occasions to spend time to align its requirements and procedures with those of the international lending agencies such as the:

- **Inter-American Development Bank (I.D.B.)**
- **International Bank for Reconstruction and Development (IBRD)**
- **European Economic Community (E.E.C.)**
- **Caribbean Development Bank (C.D.B.).**

All efforts are made to preserve the sovereignty of our legislation, but for harmonious relationships, there is agreement where it does not infringe the law.

CENTRAL TENDERS BOARD AND SUB-COMMITTEES
FINANCIAL LIMITS



REGISTRATION PROCESS

THE CENTRAL TENDERS BOARD REGISTRATION PROCESS FOR SUPPLIERS, CONTRACTORS AND CONSULTANTS

Any person (individual or firm) interested in registering their business with the Central Tenders Board is advised to follow the proceeding steps:

1) **Each applicant is required to obtain the relevant registration forms (Supplier, Contractor or Consultant) from the Central Tenders Board office or download from the Ministry of Finance website at http://www.finance.gov.tt.**

2) **Applicants must complete the forms, with all necessary information required therein, and return the registration forms to the Central Tenders Board along with the following documents:**

   - **Certificate of Incorporation of the applicant's company**
   - **Certificate of Registration under the Business Names Act (in the case of a partnership)**
   - **Certificate of Continuance**
   - **Income Tax Certificate with File Number**
   - **Value Added Tax (VAT) Registration Certificate and Number**

3) **All documentation returned to the Registration Clerk will be verified and assessed for compliance with the requirements.**

4) **Once applications have been approved, the applicant or company is notified in writing, by the Board's Secretariat that they have been registered under the particular category for which they have applied.**

REGISTRATION PROCESS

CONSULTANCY SERVICES

In the case of Consultancy Services, the form is assessed by the Central Tenders Board's Cabinet appointed Panel for compliance with the requirements. If the Panel requires clarification on any one aspect of the information in the form, the applicant can be called in for an interview or written to, so that the necessary information can be submitted to the Central Tenders Board.

Once the Central Tenders Board Panel completes its assessment, a recommendation is submitted to the Board for its consideration in the particular discipline of registration.

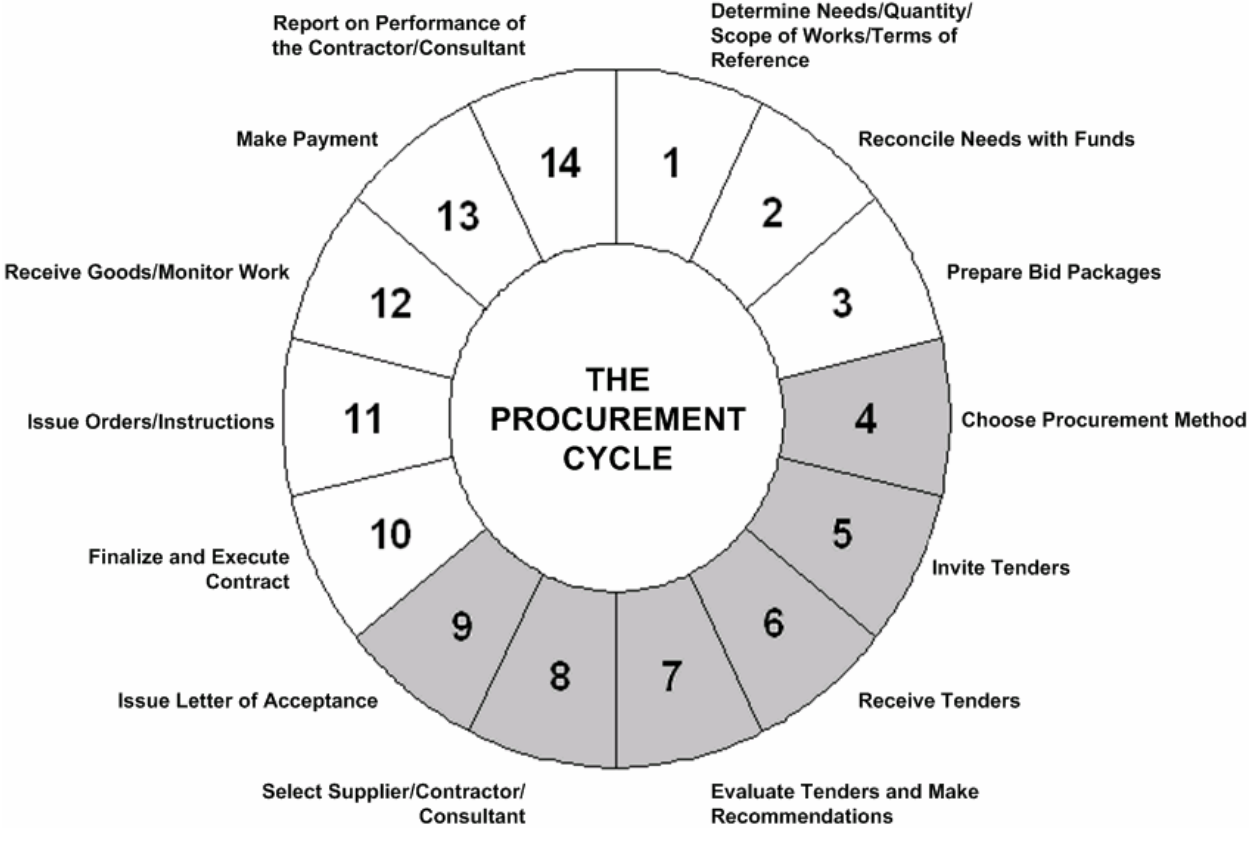
Once applications have been approved by the Board, the applicant or company is notified in writing, that they have been registered under the particular discipline/category for which they have applied.

REGISTRATION RECORD

At the Central Tenders Board, there are Two (2) Registers kept for recording information on the Registration of an individual, partnership, firm or company, consortium, or joint venture; one is for Consultants and the other is for Contractors in the categories of Supplies and Services, including Civil Works and Building Construction.

These Registers are frequently consulted when inviting persons selectively to tender. The Registers are updated on an annual basis but persons are free at any time during the year to submit updated information on their registration whenever they have expanded or diversified their business.

THE CENTRAL TENDERS BOARD INVOLVEMENT IN THE PROCUREMENT CYCLE (STEPS 4-9)



PROCUREMENT METHOD

PROCUREMENT DEFINED

Procurement can be defined as the acquisition of goods and services including the undertaking of works and consultancy services for use by the client organization. Procurement is therefore a comprehensive process that includes inter-alia design, publicity, tendering, receiving, opening and evaluation of offers, award and signing of contract, guarantees, installation, testing and start up operation, service and maintenance.

Public Procurement refers to the acquisition by public bodies, such as Government Ministries, Departments, Municipal Bodies and State Enterprises, of various goods, property and services that are required to accomplish specified public purposes. This is done by entering into a contract with another entity. Public monies are used to facilitate this process.

THE PROCUREMENT METHOD OBSERVED BY THE CENTRAL TENDERS BOARD

The current legal and regulatory framework embodied in the Central Tenders Board Ordinance (No. 22-1961, as amended) applies mainly to Government Ministries and Departments and some statutory authorities. There are other agencies, including State-owned enterprises, statutory authorities and civil society, which utilize public funds and follow procurement practices that fall outside the umbrella of the Ordinance. Currently public procurement is largely limited to the tendering stage in which offers of supply are invited and contracts are awarded.

The following is a synopsis of the Procurement Method observed by the Central Tenders Board:

- **The Client Ministry or Department conducts a needs assessment, reconciling its needs with available funding. A Bid Package is subsequently prepared and submitted to the Central Tenders Board Division.**

- **Upon receipt of the Bid Package, the Central Tenders Board reviews the documents and ensures that they conform to the Central Tenders Board Regulations and Procedures.**

THE PROCUREMENT METHOD OBSERVED BY THE CENTRAL TENDERS BOARD (CONT'D)

- **Once all documentation received from the Client Ministry is reviewed and found to be within the proper procedures, the Central Tenders Board invites Bids/Tenders publicly or selectively.**

- **Tenders are invited publicly by advertising Tender Notices locally, in the Press and in at least two (2) newspapers of wide circulation; and internationally, in reputable Journals and the Development Business Forum. Tenders are also available for download on the Central Tenders Board's website: www.finance.gov.tt.**

- **Tenders are invited selectively from a shortlist of Registered Contractors, Consultants and Firms that have all undergone a Prequalification Exercise.**

- **Tenders received are opened publicly on the closing date of the Tender and are forwarded to an Evaluation Team approved by the Board.**

- **The Central Tenders Board then reviews the Evaluation Reports prepared by the team. The Evaluation Team may also be required to provide explanations of aspects of their report.**

- **The Award of Contract is subsequently decided upon by the Central Tenders Board.**

- **Letters of Acceptance are issued to successful bidders by the Central Tenders Board Division.**

- **In the case of major projects, the form of contract Agreement is prepared by the Chief State Solicitor's Office who formally arranges the execution of the contract Agreement by parties to the contract.**

- **All Contracts awarded are published monthly by the Central Tenders Board in the Trinidad and Tobago Gazette and on the**

THE PROCUREMENT METHOD OBSERVED BY THE CENTRAL TENDERS BOARD (CONT'D)

organization's website. Copies of the Contracts awarded are also submitted to the Auditor General.

- The Client Ministry or Department is responsible for administering the contract. However, the Central Tenders Board may become involved in this stage of the process only if called upon to resolve a dispute or approve a variation to the contract outside of the client's jurisdiction.

- A report is submitted to the Central Tenders Board, upon completion of the contract, which in turn authorizes the release of Performance Bonds and the refund of deposits. The Auditor General is responsible for financial audits.

- Tender committees within the Client Ministries or Departments may act for the Central Tenders Board within limits, as provided by the Central Tenders Board Ordinance (No. 22-1961, as amended). Such committees are chaired by representatives of the Central Tenders Board and follow the procedures of the Division. In cases where the value of the acquisition is below a certain limit, the committee has the ability to award the contract.

- Permanent Secretaries and Departmental Heads can also procure goods and services below a certain financial limit. All Financial Limits are defined in the Regulations, Rules and Procedures of the Central Tenders Board.

- Most statutory bodies, all State-owned enterprises and NIPDEC are fully responsible for their own procurement procedures. Agencies/Bodies outside of the governance of the Central Tenders Board may be engaged by Government Ministries as Contractors for major capital works.

- State enterprises are required to invite a representative of the Central Tenders Board to sit on panels considering Tenders above a certain level. The award of contracts by these agencies is subject to monitoring by a Central Audit Committee, established within the Ministry of Finance.

TENDERING PROCESS

The following is a synopsis of the Tendering Process carried out by the Central Tenders Board:

- **The Client or Ministry forwards a written request to the Central Tenders Board for the Supply or Purchase of an Article, Service or Works for a particular project. This request is accompanied by the relevant Tender Documents and a Memorandum from the Permanent Secretary of the Ministry of Finance, indicating that the necessary funding is available. Requests include:**

1) **Estimated cost of project**
2) **Project specifications**
3) **The Client's contact Information (addresses, telephone numbers, etc.)**
4) **Reasons for selective tendering**

- **The Central Tenders Board, through its Technical Unit, then:**

1) **Reviews the Tender Documents to ensure conformity to Central Tenders Board Regulations and Procedures**
2) **Seeks the approval of the Board's for selective tendering**
3) **Requests the approval of the Minister of Finance, if selective tendering is necessary**

- **The Central Tenders Board then prepares the Bid Package which includes:**

1) **Tender Notice OR Letter of Invitation (stating the closing date and time for the submission of bids)**
2) **Project Specifications**
3) **Instructions to Tenderers**
4) **Draft Contract from the Chief State Solicitor**
5) **Terms and Conditions of Contract**

- **The Invitation to Bid/Tender Notice is advertised in the newspapers and on the Central Tenders Board's website: www.finance.gov.tt**

OR

The Letter of Invitation is issued to selective tenderers with a closing date for the receipt of bids/offers

TENDERING PROCESS (CONT'D)

- **Interested persons (individuals or firms) collect the relevant Bid Package/Tender Documents from the scheduled Contracts Officer after paying a specified deposit to the Cashier in the Accounting Section.**

- **Prospective Bidders deposit bids in the Tenders Box, located at the Central Tenders Board Division, on or before the appointed closing date. ALL BIDS RECEIVED AFTER THE CLOSING DATE WILL BE REJECTED.**

- **The Tenders Box is closed at the stipulated time. The tenderers or their representatives present at the opening must sign the attendance register.**

- **Two members of the Board are present to publicly open the Tenders Box. The Bids/Proposals received are opened soon after the appointed closing time and date. The names of the Tenderers and tender prices and/or name/s of the Consultants are announced by the Board's representative. All tenders or proposals received are recorded on the Schedule of Tenders Received Form. A report is made on the Tender Opening process.**

- **Thereafter, the Bids/Proposals are sent to the Chairman of the Evaluation Team for evaluation by members of the Evaluation Committee on the basis of predetermined criteria.**

- **The Chairman of the evaluation team forwards their recommendations to the Central Tenders Board in the form of an Evaluation Report.**

- **Once the Evaluation Report, including recommendations, is received from the evaluation team, the following steps are taken by the Division:**

TENDERING PROCESS (CONT'D)

1) The Evaluation Report is checked for conformity with the Central Tenders Board Regulations and Procedures
2) The recommendations are submitted to the Board for consideration

- The Board meets twice per month to consider and award contracts to the lowest evaluated bidder that satisfies the project specifications or criteria. The Board also has the authority to reject tenders.

- The Secretariat of the Board will inform the Technical Unit of the Board's decision. In the case of acceptance by the Board, the Contracts Officer will prepare the appropriate Letter of Award for approval and signature by a member of the Directorate.

- The Central Tenders Board Division will subsequently issue:

1) The Letter of Award and Specimen Performance Bond to the successful bidder

2) A Memorandum to the Client Division and the following attachments:
   - A copy of the accepted Tender and accompanying brochures
   - The Letter of Award of Contract
   - The Contract Completion Report Form

3) Letters to unsuccessful tenderers

TENDERING PROCESS (CONT'D)

- **The successful Contractor pays a Cash Performance Deposit or provides a Performance Bond stamped by the Board of Inland Revenue. If the Cash Performance Deposit or Bond is not paid or established within the stipulated time, the Central Tenders Board Division issues a reminder note. Once the Cash Performance Deposit or Bond is paid or established, the Client is informed and the order issued. The Cash Performance Deposit is paid by either cash or by certified cheque to the Director of Contracts.**

- **An agreement is signed between the Client and the Contractor. The agreement is prepared by the Office of the Chief State Solicitor.**

- **The Client Division then ensures that all services/equipment are delivered and the Terms and Conditions of the contract are fulfilled.**

- **At the end of the actual contract period, a Contract Completion Report is submitted to the Central Tenders Board by the Client.**

- **If the contract is reported as satisfactorily completed the Central Tenders Board either:**

1) **Writes a letter to the Contractor arranging for the refund of the Cash Performance Deposit and issues an internal Memorandum to the Accounting Assistant of the Central Tenders Board**

OR

2) **Authorizes the release of the Bond by issuing a letter to the Contractor and Financial Institution (Surety)**

TENDERING PROCESS (CONT'D)

- **However, if the Client Ministry reports that the Contractor's performance is unsatisfactory, the Firm is asked by the Central Tenders Board Division for explanations within a given deadline. The Client Division is then asked to comment on the explanations received from the Contractor. Thereafter the Central Tenders Board decides if to:**

1) **Refund or Release the Cash Performance Deposit/Bond**

OR

2) **Forfeit the Cash Performance Deposit/Bond**

The Contractor is notified accordingly of the Board's decision.

INSTRUCTIONS TO TENDERERS

SUBMISSION OF TENDERS

Contractors are advised to take note of the following when submitting Tenders:

- **Carefully read all instructions included in the Tender Notice or Letter of Invitation.**

- **Collect all Tender Documents in accordance with the instructions in the Tender Notice.**

- **Comply with all instructions given in the tender documents.**

- **Ensure that the following documents are submitted along with the Tender:**
  1) **Valid Income Tax, Value Added Tax, and National Insurance Compliance Certificates**
  2) **Tender Deposit Receipt (where applicable)**
  3) **Bid Bond duly stamped by the BIR (where applicable)**
  4) **Properly completed and signed Tender Form**
  5) **Supportive literature, pamphlets and brochures**

- **The Tender must be signed by the person making the offer or by an authorized officer.**

- **The Tender must have the following information as requested in the Tender Documents:**
  1) **Address, telephone and fax numbers, E-Mail addresses**
  2) **The Company's profile**
  3) **Customer references**
  4) **Bank references**
  5) **Permission to contact references**
  6) **Completed Bills of Quantities**
  7) **List of key personnel**
  8) **List of completed projects**
  9) **List of current projects**
  10) **List of equipment**
  11) **Three (3) years audited financial statements (where applicable)**
  12) **Price (Contractors are advised to show the Tender price separately from VAT)**

SUBMISSION OF TENDERS (CONT'D)

- **Submit the number of copies as requested in the Tender Notice or Letter of Invitation.**
- **Initial all corrections.**
- **Seal and address envelopes as stated in the Tender Notice or Letter of Invitation.**
- **Place the completed Tender in the Tenders Box located at the Central Tenders Board Division before the published closing date and time. LATE TENDERS WILL NOT BE ACCEPTED UNDER ANY CIRCUMSTANCES.**
- **The Tenderer or authorized representative may attend the Public Opening of Tenders.**

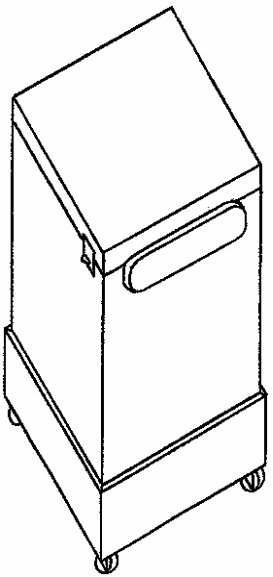
TENDERS BOX DIAGRAMS

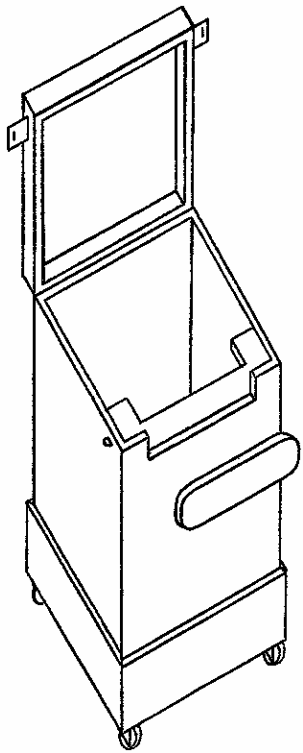
Tenders Boxes are housed at the Central Tenders Board Division and are used to receive Tenders/Bid packages submitted by prospective Tenderers. The Tenders Box is secured by two (2) heavy-duty padlocks. One (1) set of keys is held by the Chairman of the Board and the other set is held by another member of the Board.

The Tenders Box is opened publicly by the Chairman and one Board member on the appointed closing date and time for receipt of Tenders. The Tenders Boxes used by the Division are composed of wood and are approximately 60cm x 60cm x 100cm (Length x Breadth x Height). The slot to accommodate Tenders/ Bid packages is approximately 37.5cm x 5.5cm (Length x Breadth).

The following pages illustrate both isometric and orthographic views of the Tenders Box utilized by the Central Tenders Board Division.

TENDERS BOX DIAGRAMS





CENTRAL TENDERS BOARD	
TENDER BOX DIAGRAM	
ISOMETRIC VIEW	
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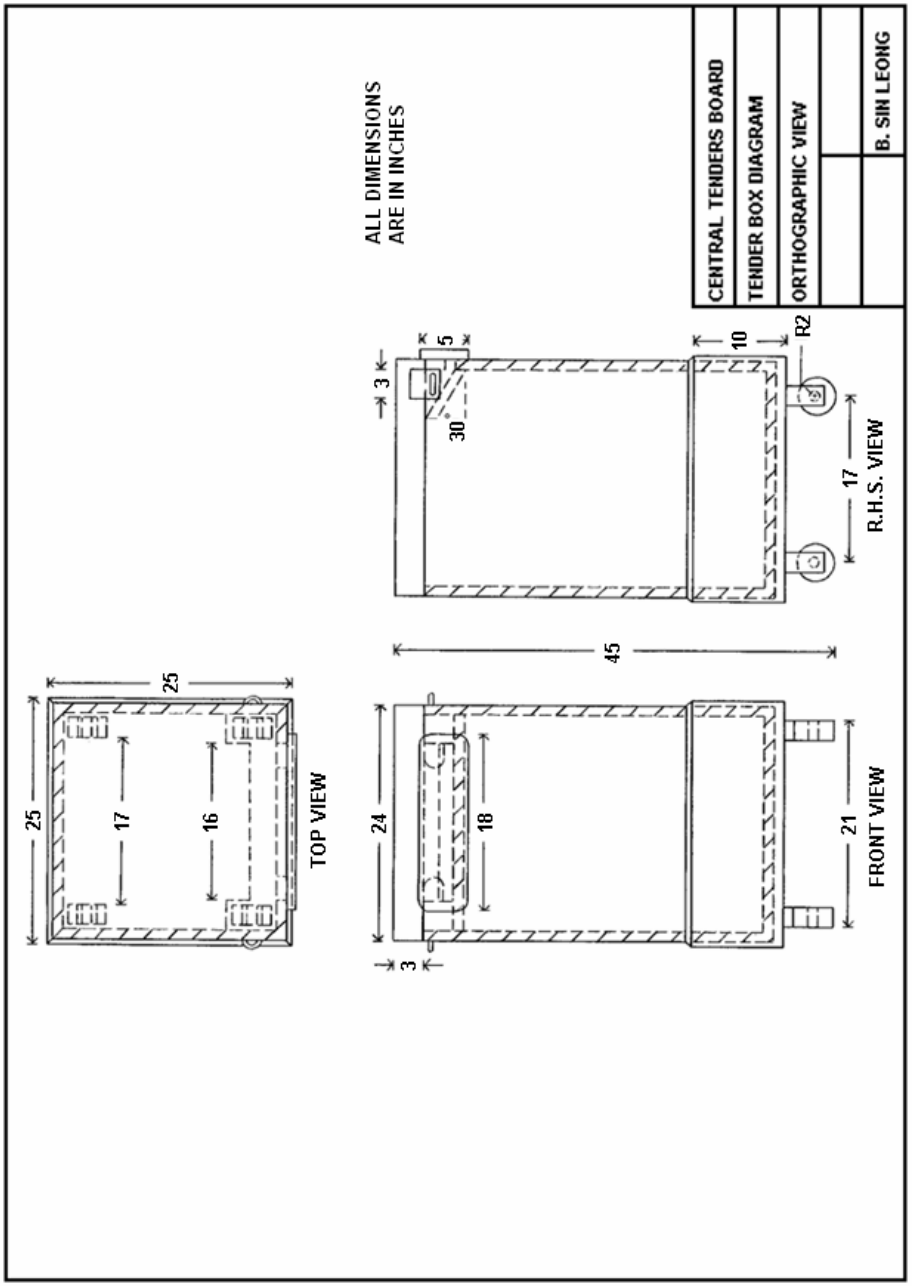
TENDERS BOX DIAGRAMS



PROCEDURES FOR HIRING CONSULTANTS

The following procedures are to be followed when hiring Consultants:

1) **The Ministry/Department requesting the engagement of the Consultant should have established the objectives for the consultancy services and prepared Requests for Proposals or Terms of Reference for submission to the Central Tenders Board along with the official request and evidence of funding.**

2) **When requested, the Central Tenders Board Division will invite expressions of interest from prospective Consultants through a public notice in the daily newspapers or International Journal of wide circulation.**

3) **An Evaluation Committee approved by the Board will be asked to evaluate the applications/questionnaires received and prepare a Short List for approval by the Board.**

4) **Proposals will be invited from all approved short listed consultants. Documents to be collected include Request for Proposal or Terms of Reference and a copy of draft Contract Agreement.**

5) **The Evaluation Committee will then evaluate the proposals received and submit an Evaluation Report with merit ratings including detailed scorings of the consultants based on weighted criteria, which were included in the Terms of Reference.**

6) **The Central Tenders Board will then consider:**

   - **the merit rating,**
   - **the commencement of negotiations with the 1st ranked consultant,**

   and grant approval accordingly.

PROCEDURES FOR HIRING CONSULTANTS (CONT'D)

7) **Following successful negotiations with the 1st ranked consultant, the Central Tenders Board will consider the award of a consultancy contract. If negotiations fail, the Evaluation Committee will then proceed to negotiate with the 2nd ranked consultant and so on.**

8) **A contract Agreement with the preferred consultant will be prepared by the Chief State Solicitor's Office and executed by the parties to the contract (i.e. Client Ministry/Department and Consultant).**

9) **The Client Ministry/Department will then issue the written instructions to the successful consultant to commence the consulting services for the project.**

10) **Upon completion of the consultancy contract, a Performance Evaluation Report on the Consultant is prepared by the client Ministry/ Department and submitted to the Central Tenders Board.**

EVALUATION PROCESS

Tenders or Proposals submitted to the Central Tenders Board are evaluated to determine the lowest evaluated bid or preferred proposal presented. The Evaluation Criteria is stated in the Tender or proposal Documents. The Evaluation Process is confidential and the Evaluation Team, recommended by the Client Ministry, must first be approved by the Central Tenders Board. The Chairman and Members of the Evaluation Team are notified in writing of their selection to the team.

The following procedures are also observed with respect to the evaluation of offers:

- **The relevant Permanent Secretary or Departmental Head is informed in writing of the Evaluation Team's approval.**
- **The Chairman of the Evaluation Team should be informed, beforehand, of any member's inability to remain as a member of the team.**
- **The team should include personnel in the relevant field of study (for example, Construction Projects should be evaluated by a team consisting of Engineers, Architects, etc.).**
- **Additional Technical Expertise is provided by Resource Personnel, where applicable.**
- **Persons instrumental in preparing Specifications, Scope of Services and Terms of Reference or Request for Proposal are not usually allowed to sit on the same team to evaluate Tenders or Proposals. In exceptional cases where this is unavoidable, due to limited resources within which to work, such persons, may at times, form part of the Evaluation Team. Nevertheless, this is not a preferred method of operation.**
- **The Chairman is charged with the responsibility of guiding the team to a final decision without unduly influencing or persuading the members throughout the process.**
- **A Confidentiality Clause is attached to all Letters of Appointment.**

EVALUATION PROCESS

(CONT'D)

- **The Chairman is responsible for arranging a place, date and time that are all mutually convenient to the team, to conduct the Evaluation Exercise.**

- **Notifications of any member's inability to attend any sitting of the Evaluation Exercise are usually submitted beforehand.**

- **Only approved members of the team are allowed to participate in the exercise.**

- **The Committee may also co-opt personnel in an advisory capacity, with the Board's approval.**

- **A meeting is held where the Chairman distributes documents to be perused and the weighting system is discussed. In the case of complex projects, documents may be distributed a few days prior to the meeting and the team may be divided into sub-committees for more detailed work.**

- **A Preliminary Examination is conducted to ensure that relevant requirements are submitted such as:**
  - **Bids are properly completed and signed**
  - **The Bid security is attached**
  - **The relevant documents and clearance certificates (Tax, N.I.S., V.A.T., etc.) are attached**
  - **Computation errors are detected and rectified**
  - **Major deviations from the Terms and Conditions of the contract are identified**
  - **Technical aspects are scrutinized and a substantial responsiveness is produced**

- **A summary of the offers is usually prepared and should highlight the following:**
  - **Comparable prices, converted to one currency**
  - **Delivery time/Completion period**
  - **Make and model of items**
  - **Terms of Guarantee**
  - **Terms of Payment**

EVALUATION PROCESS

(CONT'D)

- **Technical Factors such as capacity, productivity, operating costs, maintenance and upkeep, life expectancy, quality, compatibility and standardization**

BRIEF ON THE CRITERIA FOR EVALUATION

Each criterion is assigned points, the total of which should be 100. The mean of the points of each member of the Evaluation Team is calculated and this mean is a reflection of the score attained by the prospective Tenderer or Consultant. The Evaluation Criteria must also reflect the minimum score, usually 70, which must be attained for the offer or Proposal to be considered further. Offers or Proposals are subsequently ranked in order of merit. In the case of consultancy, the financial proposals of the highest ranked firm are opened and negotiations are commenced. If an agreement cannot be reached, negotiations are then closed and negotiations are then initiated with the second ranked firm, and so on, until an agreement is reached.

EVALUATION REPORT

The Chairman of the Evaluation Team tallies the points and finds the average score for each Tenderer or Consultant. An Evaluation Report is then prepared, signed by each member, and is then submitted to the Central Tenders Board for approval. If any member dissents, a separate report, called a Minority Report, is prepared and signed by that member and submitted to the Central Tenders Board.

CONFIDENTIALITY

All persons having an official duty or who are employed in the Administration of the Central Tenders Board's Ordinance must regard and deal with all documents as confidential. The Division cannot therefore respond to requests for any explanation(s) as to why any Contractor or Consultant did or did not receive an award. However, aggrieved persons can seek information on contracts awarded by following the process under the Freedom of Information Act – 1999, except in the case of exempt documents such as Evaluation Reports.

EVALUATION CRITERIA

CRITERIA FOR EVALUATION

Applicants wishing to register with, or submit a Tender or Proposal to the Central Tenders Board, are advised to pay special attention to the following basic Criteria for Evaluation:

PREQUALIFICATION

- **General background and Organization of the Firm**
- **Available manpower, plant and equipment resources**
- **Similar Work Experience/Past performance/Track Record**
- **Financial Capability**

SUPPLIES OF GOODS INCLUDING VEHICLES

- **Type of Organization/Organizational Structure**
- **Past performance/Track Record/Reliability**
- **Conformance to Specifications**
- **Delivery period/Completion period**
- **Ability to train personnel**
- **Price/available discount price**
- **Make and Model**
- **Specification of vehicle**
- **Availability of spares/replacements**
- **Track Record/Performance of similar type vehicle**
- **Warranty offered and maintenance service available**

SECURITY SERVICES

- **Organizational Structure of Firm**
- **General Experience**
- **Available resources**
- **Financial capability**

CONSTRUCTION (MAJOR WORKS)

- **Organizational Structure of Firm**
- **Key Qualification/General Experience of personnel for the project**
- **Construction capacity/Technical capability**

EVALUATION CRITERIA

CRITERIA FOR EVALUATION (CONT'D)

- **Work load of the Firm**
- **Maximum value of contracts which can be undertaken by the Firm**
- **Proposed Methodology /Programme of Execution**
- **Financial capability/Annual turnover of the Firm**
- **Type of Organization**
- **Past performance/Track Record**
- **Ability to train personnel**
- **Conformance to Specifications**
- **Guarantees offered/After sales service**
- **Delivery period/Completion period**
- **Payment terms**
- **Cost**

CONSULTING/CONSULTANCY SERVICES

- **Conformance to Terms of Reference**
- **Qualification/Experience of assigned personnel for the project**
- **Understanding of the assignment/Objectives of the consultancy**
- **Proposed Methodology/Sequencing of activities, inclusive of innovative ideas, level of detail, maximum compression and ability to provide services**
- **Programme of Execution/ Implementation Plan/Schedule inclusive of relationship of manpower to schedule, Completion Time, and the supply of progress documentation such as Manpower Charts, Gantt Charts**

CRITERIA FOR EVALUATION (CONT'D)

- **Available manpower resources, requirements and the utilization of the resources**
- **Environmental impacts (e.g. the necessity of C.E.C. in the case of a Civil Works Project)**
- **Interaction with other agencies (e.g. WASA, T&TEC)**
- **Technology to be utilized**
- **Assessment of future needs**
- **Management Support:**
  - **Quality Assurance and Control systems inclusive of testing, on and off site supervision and Quality Assurance Procedures**
  - **Support Systems inclusive of key computers/equipment assigned to the project, software (e.g. AutoCAD), hardware/equipment adequacy, transportation, communication, a Cost Control/Accounting System, and a Reporting System**
- **Use of Local Consultants**

SYSTEM OF BONDED SUPPLIERS AND CONTRACTORS

In an effort to have a speedy flow of materials to Government Divisions with the least possible delay, and to assist them in meeting with requirements of the Exchequer and Audit Act, the related Regulations and the Central Tenders Board Ordinance, the Board seeks Bonded Suppliers for the supply of various items to Ministries and Statutory Boards under the Ordinance on a yearly basis. Such a contract can be described as a Standing and Continuous Offer made by the Contractor and accepted by the Central Tenders Board on behalf of Government and the Statutory Boards.

It must be noted that on each occasion an invoice order for items is placed on the Contractor, a distinct and separate contract is formed between the Contractor and the Ministry or Statutory Body issuing the order. The Central Tenders Board is therefore not involved in the administration of the contract. The Ministry/Department concerned must be guided by the general conditions of contract as is embodied in the "List of Contracts of Supplies and Services for Central Government and Local Government Councils.

Any bonded supplier can terminate his contract by giving the Central Tenders Board thirty (30) days notice in writing from the date of the receipt of the letter at the Central Tenders Board. The Board endeavours to find new suppliers within the thirty day period and issues bulletins to amend the list of contractors when such occasions arise. The conditions also provide, the procedure to be followed if the bonded supplier fails to meet his contractual obligations. The principal benefits derived from a standing offer contract are as follows:

- **It provides for continuity of supply and a protected contract price.**

- **It permits contracting for the essential requirements of all Ministries and Departments on the long term basis and provides a guaranteed price in those situations where exact quantity requirements cannot be determined by the Government Divisions/Bodies.**

SYSTEM OF BONDED SUPPLIERS AND CONTRACTORS (CONT'D)

- **It safeguards a definite standardization of the best product.**
- **The simplicity of this type of contract results in substantial economic and administration advantages.**

STANDING ORDER CONTRACTS

The conditions relating to this type of contract are usually found in the "Annual List of Contracts for Supplies and Services". The tenderer must submit their offers in accordance with the specifications for the various items received from the Central Tenders Board and adhere to the conditions of contract which are attached to the tender forms.

The Central Tenders Board issues a Circular Memorandum, as early as the third month in each year (March), to all Ministries/Departments and Statutory Bodies under the Ordinance inviting comments as stated hereunder on existing schedules:

- **Whether any new items should be added to the list of supplies**
- **Whether new items should be included in an existing schedule or be recorded in an entirely new schedule**
- **Whether an existing item should be excluded**
- **Whether the description of any article now listed should be changed in any way**

STANDING ORDER CONTRACTS (CONT'D)

Around the month of January of each year, the Central Tenders Board invites Ministries/Departments to submit reports on any unsatisfactory performance by the bonded contractors, which will be given due weight in the consideration of awards for the following year. Such reports must reach the Director of Contracts before the end of March of each year.

It is advised that purchasing officers peruse the annual list of contracts for supplies etc. as soon as they have been released to avoid audit queries.

ANNUAL SUPPLIES & SERVICES CONTRACTS

TENDERING PROCESS

Contracts are awarded for supplies and services for the Central Government, Local Government and Statutory Bodies on an annual basis. These contracts constitute a standing and continuing offer by the contractor bonded to the Government to supply particular items at the contracted price, if and when ordered by any of the various Agencies/Bodies during the contract period of one (1) year,

The Tendering Process will begin towards the middle of the year (the issue of invitations – June/July and receipt of tenders – August/September). Evaluations are carried out by various technical units including user agencies e.g. the Ministry of Works and Transport, the Project Unit of the Ministry of Education, the Chief Chemist of the Food and Drugs Division, and a team of Nutritionists drawn from Health Institutions. The contracts are awarded by the Central Tenders Board for a one-year period beginning January 1.

Some of the Annual Supplies and Services Schedules are as follows:

- **Groceries**
- **Hardware**
- **Household Articles**
- **Imported Lumber**
- **Petroleum Products**
- **School Furniture**
- **Services (Auctioneer and Customs Brokerage)**
- **Supply and Transport of Materials**
- **Water and Sanitary Fittings**

OFFICE MACHINES, APPLIANCES & FURNITURE

The Office Machines, Appliances and Furniture Committee (OMAF) awards contracts for the supply, delivery and installation (where necessary) of Office Machines, Appliances and Furniture for Central Government, Local Government and Statutory Bodies on an annual basis. These contracts constitute a standing and continuing offer by the contractor bonded to the Government to supply particular items at the contracted price, as and when ordered by any of the various Agencies/Bodies during the contract period of one (1) year – January to December.

The Tendering Process begins towards the middle of each year with the issue of invitation in June/July and the receipt of offers in August/September. The evaluation of the offers received is carried out by technical officers of the Ministry of Works and Transport, the Ministry of Education and Government Printery Division. The contracts are awarded by the Office Machines, Appliances and Furniture Committee for a one (1) year period beginning January 1.

Listed below are the categories that fall under Office Machines, Appliances and Furniture Supplies:

- **Air Conditioning Units (Mini-Split Type)**
- **Air Conditioning Units (Window Type)**
- **Calculating Machines (Heavy Duty)**
- **Digital Stencil Duplicators**
- **Electronic Typewriters**
- **Gas Cooking Ranges (Pedestal Type)**
- **Metal Furniture for Offices and Quarters**
- **Photocopying Machines**
- **Steel Filing Cabinets and Steel Cupboards**
- **Stenographer Posture and Typist Chairs**

PROCEDURES FOR DISPOSAL

DISPOSAL OF UNSERVICEABLE/SURPLUS ARTICLES BELONGING TO THE GOVERNMENT

The Central Tenders Board is responsible for the disposal of all Real Estate Property, Unserviceable or Surplus Articles, owned by the Government, with an original value of over $1,000.00. This method is determined by the recommendations of a Board of Survey carried out on behalf of the Comptroller of Accounts. The Board of Survey may recommend that the articles be repaired, destroyed, donated or sold by public auction.

The Central Tenders Board must approve the recommendations and is required to monitor the method of disposal. A representative of the Central Tenders Board Division is charged with the responsibility of attending and reporting on the public auctions. In the case of the destruction of articles, appropriate certification of this activity is forwarded to the Central Tenders Board. The Central Tenders Board is also informed when the repairs and donations have taken place.

Ministries/Departments may act for the Board to dispose of unserviceable and surplus articles as set out in Section 15 of the Central Tenders Board's Regulations. Statutory Boards and Regional Corporations also follow the same stipulations in Section 15 of the Central Tenders Board's Regulations. The Central Tenders Board is also vested with the authority to dispose of Real Property owned by the Government, by virtue of Presidential Order contained in Legal Notice No. 179 dated 25/7/97.

The Financial Limits for Disposals are as follows:

P.S. – Up to $250.00 on original value of item
M.T.C. – Over $250.00 - $1,000.00 on original value of item
C.T.B. – Over $1,000.00 on original value of item

PROCEDURES FOR DISPOSAL

PROCEDURES FOR DEALING WITH APPLICATIONS FOR THE DISPOSAL OF UNSERVICEABLE/SURPLUS ARTICLES BELONGING TO THE GOVERNMENT

The following procedures are observed by the Central Tenders Board when dealing with Applications for the Disposal of Real Estate Property, Unserviceable or Surplus Articles belonging to the Government:

- **Applications for Disposal are received by the Central Tenders Board Division from the Office of the Comptroller of Accounts with an application number assigned by that office.**

- **Upon receipt of such applications:**

1) **The scheduled Contracts Officer reviews the form for completion and verifies that it is properly completed. If the application is improperly completed, the Client Ministry or the Office of the Comptroller of Accounts is contacted and the application returned for corrections or explanations.**

2) **Once the application form is in order, it is registered and updated in the Disposal Register (Note Book).**

- **Applications for Disposal are submitted to the Central Tenders Board Division with recommendations to:**

1) **SELL**
2) **DONATE**
3) **DESTROY**
4) **REPAIR**

PROCEDURES FOR THE DISPOSAL OF ARTICLES RECOMMENDED TO BE SOLD

The following procedures are observed by the Central Tenders Board when dealing with articles that have been recommended to be sold:

- **The Client Ministry is written to verify that arrangements should be made for the sale of such items.**

- **The Ministry is requested to provide the contact information (name, address, telephone number, e-mail address, etc.) of a Contact Person with whom the Auctioneer can communicate (a copy of the Application for the Disposal of Unserviceable Articles is attached to the request).**

- **Upon receiving a response from the Ministry, a Note is prepared and submitted for the consideration of the Central Tenders Board. If the Note involves vehicles, then the age of the vehicle must be provided in the submission.**

- **Upon approval by the Board, the Auctioneer is given instructions to arrange for the sale of these items by Public Auction. The name of the Contact Person is then given to the Auctioneer.**

- **If the items are vehicles, the following information must be provided to the Auctioneer:**
  1) **Registration Number**
  2) **Model**
  3) **Chassis Number**
  4) **Engine Number**
  5) **Location of Vehicle**

- **For other items, the following information must be provided to the Auctioneer:**
  1) **Descriptions**
  2) **Serial Numbers (where applicable)**
  3) **Location of Articles**

PROCEDURES FOR THE DISPOSAL OF ARTICLES RECOMMENDED TO BE SOLD (CONT'D)

- **The Client Ministry is informed that the Central Tenders Board has approved the application for disposal of the unserviceable articles by Public Auction and that the Auctioneer has been instructed to arrange the sale. A copy of the letter to the Client Ministry is sent to the Auctioneer. A memorandum is also sent to the Stock Verification Unit of the Treasury Division.**

- **After consultation with the Ministry, the Auctioneer arranges for the sale and informs the Central Tenders Board Division of the date, time and location of the sale and a list of the items to be sold are also provided.**

- **The Central Tenders Board Division informs the Commissioner of Police, Ministry of National Security that security arrangements are to be put in place for all Auction Sales conducted on behalf of the Board.**

- **The Auctioneer and the Contracts Officer will both submit a report on the sale upon its completion. The Auctioneer will also present to the Division, the receipt from the Comptroller of Accounts, showing that the proceeds of the sale were deposited.**

- **The receipt is examined to ensure that the correct amount was deposited and it is then returned to the Auctioneer. A copy of the receipt is placed in the appropriate file.**

- **The two (2) prepared reports are circulated for the information of the Central Tenders Board.**

PROCEDURES FOR DISPOSAL

PROCEDURES FOR THE DISPOSAL OF ARTICLES RECOMMENDED TO BE DONATED

The following procedures are observed by the Central Tenders Board when dealing with articles that have been recommended to be donated:

- **The Application for Disposal, from the Client Ministry, is reviewed and should be accompanied by a written confirmation from the recipient Ministry or Organization, stating that they are willing to receive the items.**

- **If no written confirmation is included along with the application, the recipient Ministry or Organization is issued a letter inquiring as to their willingness to accept the items.**

- **Upon receiving a response from the recipient Ministry or Organization, a Note is prepared for the consideration of the Central Tenders Board.**

- **Upon receiving approval from the Central Tenders Board, the Client Ministry is informed of the Board's decision to donate the items to the recipient Ministry or Organization.**

- **The receiving Ministry or Organization is also informed of the Board's approval of the donation of the items.**

- **A copy of the Memorandum is issued to the Comptroller of Accounts.**

- **The Client Ministry is advised to inform the Central Tenders Board as to the completion of the transactions.**

PROCEDURES FOR DISPOSAL

PROCEDURES FOR THE DISPOSAL OF ARTICLES RECOMMENDED TO BE DESTROYED

The following procedures are observed by the Central Tenders Board when dealing with articles that have been recommended to be destroyed:

- **A Note is prepared for the consideration of the Central Tenders Board.**

- **Upon receiving approval from the Central Tenders Board, the Client Ministry is informed of the Board's decision to destroy the items. The Ministry is also advised to observe all the rules and regulations of the Environmental Management Authority (EMA).**

- **A copy of the Application for Disposal is forwarded to the Client Ministry and a memorandum is sent to the Stock Verification Unit, Treasury Division and the Auditor General.**

- **Thereafter, a Destruction Certificate is to be submitted by the Client to the Central Tenders Board.**

PROCEDURES FOR THE DISPOSAL OF ARTICLES RECOMMENDED TO BE REPAIRED

The following procedures are observed by the Central Tenders Board when dealing with articles that have been recommended to be repaired:

- **A Note is prepared for the consideration of the Central Tenders Board.**

- **If articles recommended to be repaired are approved by the Central Tenders Board, the Client Ministry is advised to take the necessary action to have the items repaired and returned to service.**

- **Thereafter the Client Ministry informs the Central Tenders Board of the repairs that have been carried out.**

ORGANIZATIONAL CHART

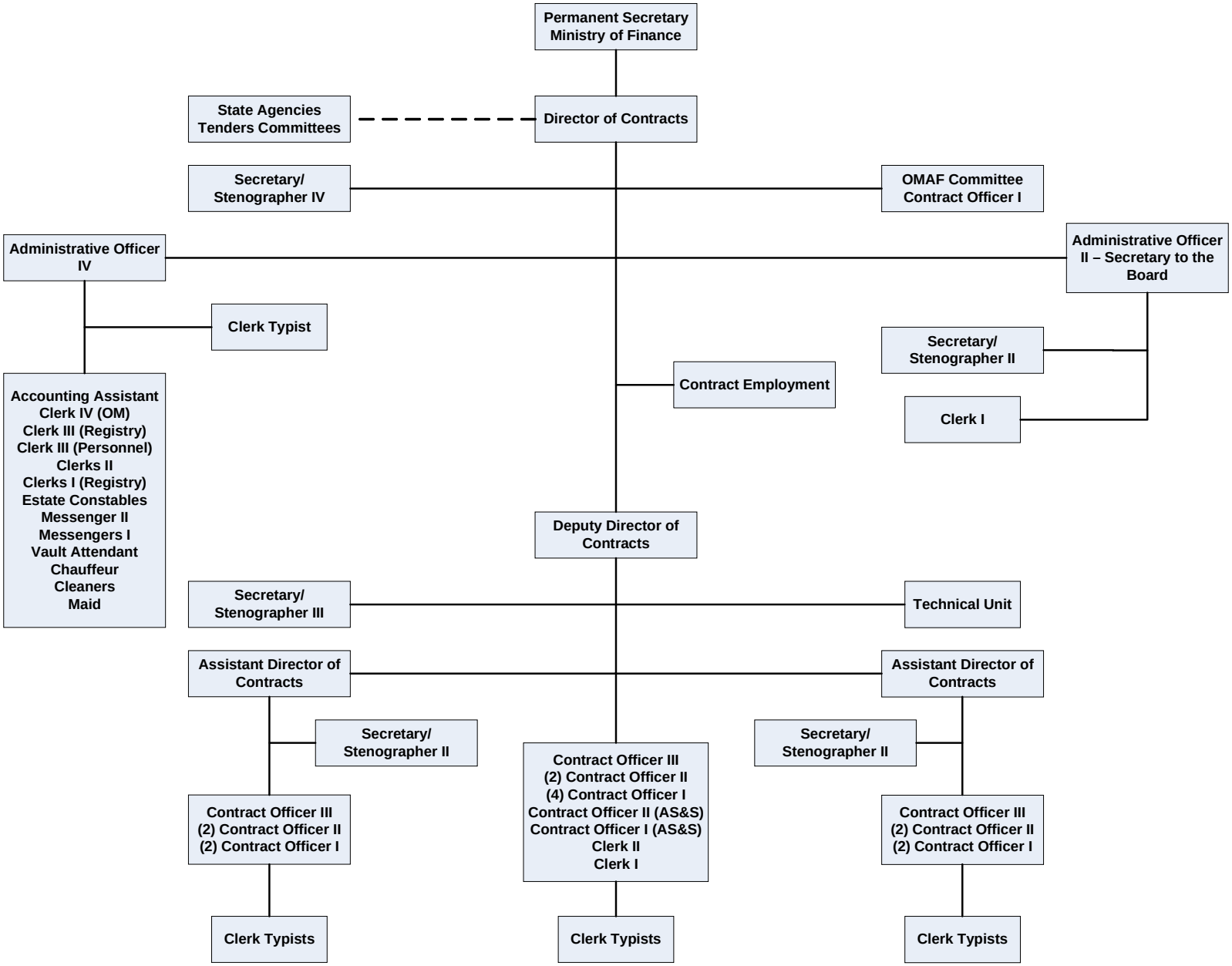


FIGURE 1
ORGANIZATIONAL CHART OF THE CENTRAL TENDERS BOARD

www.finance.gov.tt

The information presented herein is subject to change. Please contact the Central Tenders Board Division for verification of the information presented.

CONTENT PRESENTED BY:

The Director of Contracts
&
The Central Tenders Board Division

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