

A Study on Enhanced International Competitiveness for Japanese Civil Engineering Consulting Firms (JCECFs)

— Toward Developing PPP Project Management System led by JCECFs —

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Abstract: The Japanese market for Japanese Civil Engineering Consulting Firms (hereafter referred to as "JCECFs") and the overseas market that makes use of ODA are both on shrinking, and the only solution is to develop new infrastructure markets. However, despite Asia's annual 1.7 trillion-dollar demand for infrastructure (according to forecasts adjusted for climate change), JCECFs are simply not in the running. We believe that the reason for this is not because JCECFs are inferior to their Western counterparts, but because their industry-established processes and differences in institutional design and market environment have spawned a gap in terms of their ability to compete in overseas markets. In this paper, we confronted the reality that there are no public-sector coordinators for international infrastructure projects like the kind that JCECFs have relied on until now, and suggested that building their PPP project management capacity will contribute to enhancing their international competitiveness.

Keywords: O&M oriented consulting services, PPP Project Management System (PPP-PMS), Functions and roles by Consulting Engineer, Japanese Civil Engineering Consulting Firms (JCECFs), Infrastructure development in Asia

1. Introduction

The Japanese market for Japanese Civil Engineering Consulting Firms (hereafter referred to as "JCECFs") and the overseas market that makes use of ODA are both on shrinking, and the only solution is to develop new infrastructure markets. However, despite Asia's annual 1.7 trillion-dollar demand for infrastructure (according to forecast amounts that have been adjusted for climate change),

JCECFs' share of this market is a mere 2.4%, and they are simply not in the running compared to their Western counterparts. We believe that the reason for this is not because JCECFs are inferior to their Western counterparts, but because their industry-established processes and differences in institutional design and market environment have spawned a gap in terms of their ability to compete in overseas markets.

Since the Meiji Era, public works projects in Japan have been carried out by the government directly, beginning from project development to Operation and Maintenance (O&M). These projects have been conducted in “Two actors project execution system”, with a contractor carrying out projects that have been ordered by the government. Even now this structure remains essentially unchanged, with JCECFs participating in such projects by acting on the substitute position of government functions. On the other hand, for international infrastructure projects, Consulting Engineers (CE) serve as professional independent third parties, and the project structure follows “Three actors project execution system”¹⁾.

In this paper, we began by conducting a general survey of JCECFs' industry formation processes, and analyzed how establishment processes and market environments etc. differ between top consulting firms in both the international and Japan. Next, we suggested possible roles that JCECFs can and arguably should shoulder for PPP projects, which are quickly becoming the default form of infrastructure development in Asia. Then we suggested that by deducing the requirement that JCECFs are expected to meet for international development, and building their PPP project management capacity, JCECFs can improve their ability to compete in international markets.

2. JCECF Industry Formation Processes

2.1 Pioneering Success with Civil Engineering

After the Meiji Restoration, the Meiji Era government (which lasted from 1868 to 1912) hired numerous foreign engineers for the purpose of bringing Japan up to the modern standards of industrial revolution-era Western civilization. In particular, there was an especially large number of civil engineers (146) focused on building a railway system.

Once Japan entered its Taisho and early Showa Eras

(1912 to the 1920s and 1930s) there were some engineers among those who worked in Japan's then new territories of Taiwan, Korea, and the China Tohoku region (which were acquired after the Sino-Japanese War; 1894-1895) who abandoned their positions as engineering bureaucrats and transferred to the private sector, where they worked hard to found civil engineering consultant firms after World War II (1936-1945). These engineers include Yutaka Kubota, the founder of Nippon Koei Co., Ltd. who completed the world-class Sup'ung Dam; Kiyoharu Utsumi, the founder of CTI Engineering; and Fukujiro Hirayama, who was co-founder of Pacific Consultants Co., Ltd. after retiring from the Ministry of Railways and working on the South Manchuria Railway. In the hydropower and railway businesses, these engineers brought a wide-ranging management perspective born of hard-earned experience to planning, design, construction, and O&M, and achieved eye-opening results in both Japanese and overseas infrastructure development. These engineers were at the forefront of project management as a complete package, and were the first to include civil engineers all the way from the development phase of infrastructure projects to the final O&M lifecycle. In addition, these men were aware of the responsibilities that engineers like them bore, and subsequently sought to raise engineers' legitimate social standing by founding the Japan Society of Civil Engineers (1914) and the Industry Club of Japan (which later became the Japan Technology Analyst Association in 1920).

2.2 JCECFs' Beginnings and Growth

Japan's reconstruction in the wake of their defeat in 1945 brought about a major change in construction and production systems, creating such huge demand for the construction industry that it could not be met without the government stepping in to manage it directly. Despite the dramatic progress of the construction industry and the resulting creation of JCECFs that this

demand for outsourcing brought about thanks to the institution of a Western-style construction and production system, it did not change the fact that this kind of work was primarily based on helping public works. In 1959 the administrative vice-minister for the Ministry of Construction announced that design and construction of public works would be strictly separated, and in 1964 the Minister of Construction introduced civil engineer consulting firm registration regulation that went on to increase orders placed for design work, etc. As a result, most of the work done on the design of public works was carried out by JCECFs.

During the Japanese economy's high growth period (1959-1973), stable growth period (1974-1990), and stagnation period (the bubble bursting in 1991 to the present day), the demand for civil engineer consulting continued to grow, and the JCECF industry had been almost fully realized as a result. However, the assistive nature of their work (specifications and design oriented) remained an obstacle to their autonomy as engineers and kept their unilateral contractibility low. In other words, the direct government management system was unable to cope with the huge infrastructure demand arising from the postwar reconstruction to the high economic growth period, and this, in tandem with the unique two actors project execution system based on separating design and construction, gave rise to the conditions that enabled JCECFs to come about.²⁾

2.3 Structural Changes Surrounding JCECFs

Followed by recent societal changes in Japan, there has been a reevaluation of the separate design and construction system for public works projects as well, including the implementation of a Design/Build (D/B) ordering system, and major changes to the construction and production system, including the establishment and dissemination of a PFI/PPP system. This series of actions shows that the role of both the public and private sectors has been reconsidered, and that

management has become increasingly important to ensure transparency, fairness, and high-level engineering prowess for future endeavors. As such, the trend away from traditional public works projects towards PPP-based infrastructure development and operations has reached international levels, and as management becomes increasingly important as a way to ensure transparency, fairness, and high-level engineering prowess for future endeavors, we will need to reconsider the role that JCECFs ought to serve going forward.

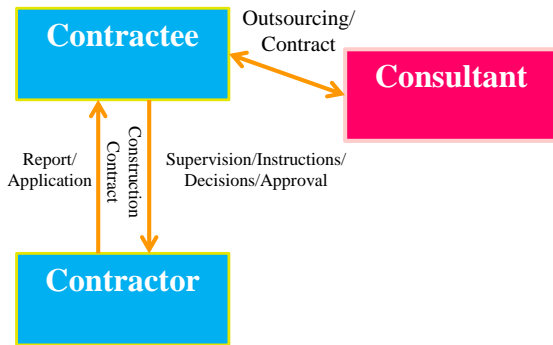
3. Changes in the Definition and Role of CE Consulting

3.1 The Definition of CE Consulting in Japan

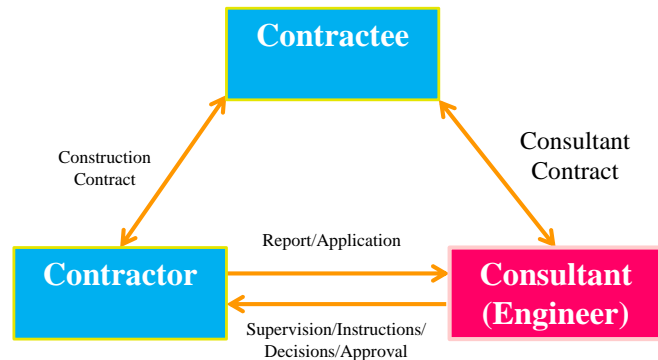
CE consulting as we know it began in Japan around the 1950s, so it has a shallower history compared to its Western counterparts or even other Japanese industries. As an occupation, it was categorized by Japan's now defunct Management and Coordination Agency as falling under Services > Specialized Services > Civil Engineering and Architectural Services. Nowadays, according to Article 19, Section 3 of the Law Concerning the Business of Insuring Advance Payments for Public Works, a CE consulting is defined as "one who contracts for the design or supervision of civil engineering and architecture, including surveying, planning, designing, or advising." This defines CE consulting strictly as a service provided to contractees, once again showing that Japan treats it as a two actors project execution system divided by contractor and contractee (Fig1).

3.2 The Establishment Process and Definition of International Consulting

Japan's Two Actors Project Execution System



FIDIC Contract-Based Three Actors Project Execution System (International Standard Practice)



The Japanese infrastructure market, following the Meiji Restoration and World War II, came face to face with changes in the third market environment in the form of PPP-based infrastructure development and management. As the construction production system continues to undergo significant changes, the importance of management that can ensure project transparency, fairness, and advanced technology is increasing, and we need to reconsider what the role of JCECFs should be.

Fig1 Definition of Civil Engineering Consultant³⁾

Looking at international consultants, we can see that a profession classified as "professional engineer" (PE) arose in the late 18th century to meet the demand spurred by the industrial revolution. This is regarded to be the origin of today's modern consulting engineer (CE). In the West, CEs have long supported private manufacturing activities, been cultivated by private sector needs, and served as a check and balance system for industrial activities. In other words, having CEs that had been separated/made independent from production and construction handle design and other civil engineering-related tasks was considered to be the best production system, leading to the establishment of a three actors project execution system where the contractee, contractor, and consultant all work together based on a mutually agreeable contract (Fig1). This definition of CEs in the West led to the establishment of the consulting industry as we know it in the first half of the 20th century.

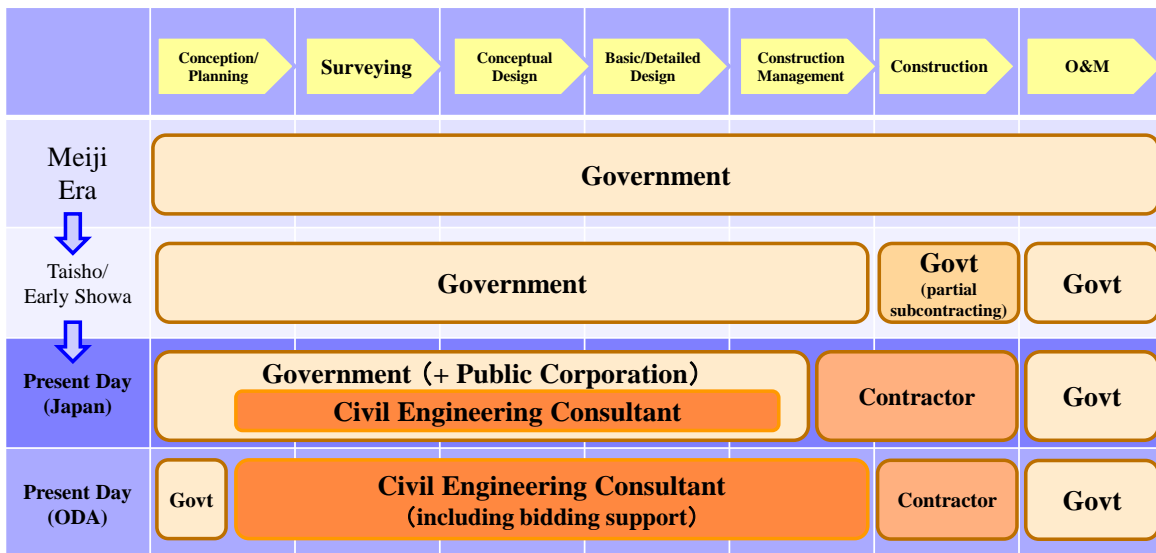
3.3 Changes in the Role Played By JCECFs

Fig2 shows the roles that the Japanese government,

JCECFs, and construction companies played in Japan from before World War II to the present day.

Starting in the Meiji Era and lasting until the end of World War II, the Japanese government had been conducting everything from conception and design to O&M with in-house engineers, but as of today CE consultants now shoulder some of that burden. However, even today, the roles that CEs play in Japan and outside Japan (ODA) are very different. In Japan, the number of cases where CEs participate in the conception and planning stages are increasing, but in general, they still just participate in projects at the design stage. Meanwhile, for ODA international infrastructure projects, CEs are usually involved right from the conception and planning stages, and even once the project has been confirmed, they continue to be involved in all stages, including design, supervision, document preparation, bidding support, and construction until the project is completed.

Meanwhile, JCECFs have only engaged in limited domains of authority, primarily as a means of assisting administrative work performed by the government. As



Source: Created by authors based on Hirofumi (2012) ⁴⁾

Fig2 Changes in the Role Played by JCECFs

such, there was almost no direct scrutiny from construction companies, citizens, etc. regarding the responsibilities accompanying this authority. Under these circumstances, it is undeniable that JCECFs have focused on meeting the needs of government organizations, which until now have been far and away their primary contractees. CEs are positioned as belonging to the service industry, yet their real purpose lies in meeting the needs of all parties involved in infrastructure projects, not only those of the government. Today, the wave of PPP infrastructure development and management, the now mainstream structure outside of Japan, is closing in fast on the Japanese market, and as PPP projects continue to increase in the future, CE customers will include private entities as well as government ones, and the above role will only continue to expand.

4. Comparing JCECFs to International Consultants

4.1 The Asian Infrastructure Market and JCECFs Positioning

According to the Asian Development Bank (ADB), the amount of investment in the infrastructure that Asia requires (according to forecast amounts adjusted for

climate change) is estimated to span 26 trillion dollars from 2016 to 2030, or 1.7 trillion dollars per year. Broken down by field, the largest categories are electricity, which is expected to account for 14.7 trillion dollars (56.3%), and traffic and transportation with 8.4 trillion dollars (31.9%). Looking at the ratio of GDP by region, the Pacific region is the largest at 9.1%, followed by 8.8% in South Asia, 7.8% in Central Asia and 5.7% in Southeast Asia.

Meanwhile, the annual infrastructure investment in the region for 2015 is estimated at 880 billion dollars. Of this, 24 countries, excluding China, amounted to 195 billion dollars. In order to close the gap between this 503 billion dollar investment demand and the 308 billion dollar deficit (for a GDP rate of 5.0%), the fiscal reforms of each country make it necessary to attract private investment as well as increase public investments. The ADB reports that in order to do this, it is necessary to increase the amount of private investments by about \$63 billion in 2015 to \$250 billion annually over the period covering 2016 to 2020.⁵⁾

In Asia, which makes up the largest engineering market in the world, US companies have 40% market share, followed by the UK, China and Canada. Japan is

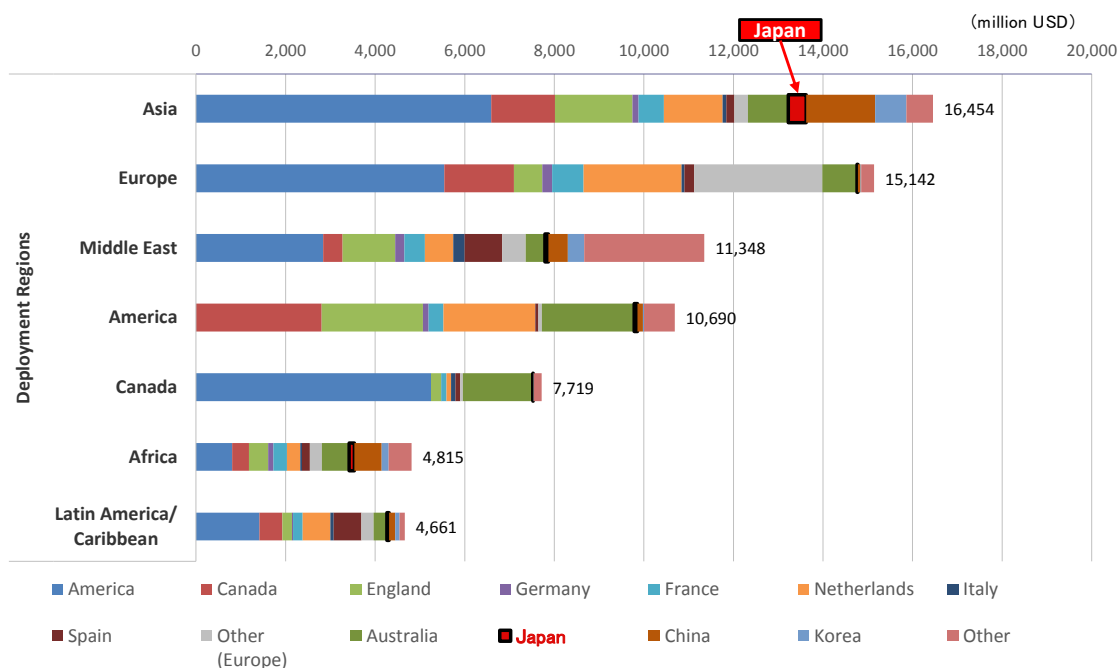


Fig3 Per-Region Share of Overseas Sales by International Engineering Companies (2014)⁶⁾

dominated by European, North American, Australian, and Chinese companies, and even in the Asian region close to our shores, our share remains at a mere 2.4% (as of 2014) (Fig3). Given the size and growth potential of the region's infrastructure market, and given Japan's experience and know-how when it comes to building and maintaining high-quality infrastructure under particularly strict natural conditions while also facing a shrinking domestic market, the need for us to expand into the rapidly growing Asian market is all but inevitable.

4.2 Comparing Top International Companies and Top Japanese Companies

The top tier of International consulting companies accounts for 40–80% of overseas sales, and provides project planning, design, PM/CM, technical consultation, and other professional engineering consulting services for both government agencies and private infrastructure ventures. And thanks to proactive M&A, their annual sales are rapidly expanding from a few billion dollars to over 10 billion dollars.

Meanwhile, the top tier of JCECFs has around 30%

share of overseas sales, with a focus on work for government agencies both in Japan and abroad. These projects include providing technical consulting services centered around planning and designing, and in recent years they have also advanced into the field of infrastructure management. Their annual sales are expanding moderately at several hundred million dollars, an order of magnitude smaller than top International consulting firms.

4.3 Japanese Government Infrastructure Export Policies

In May 2013, at the Cooperative Infrastructure Strategy Council, the Japanese government decided on a strategy for infrastructure system exports, setting a goal that orders for infrastructure systems would total about 30 trillion yen in 2020 (compared to about 10 trillion yen in 2010, and including the amount of income derived from project investments, etc.)

Also, in May 2015, they announced a "high quality infrastructure partnership" aimed at strengthening support measures for overseas infrastructure investment⁷⁾. Specifically, they laid out plans for the

following policies:

- 1) Investing 110 billion dollars in Asian infrastructure over a span of 5 years
- 2) Having the ADB and JICA collaborate
- 3) Reforming the JBIC (thereby expanding risk investment)
- 4) Making high-quality infrastructure investments an international standard

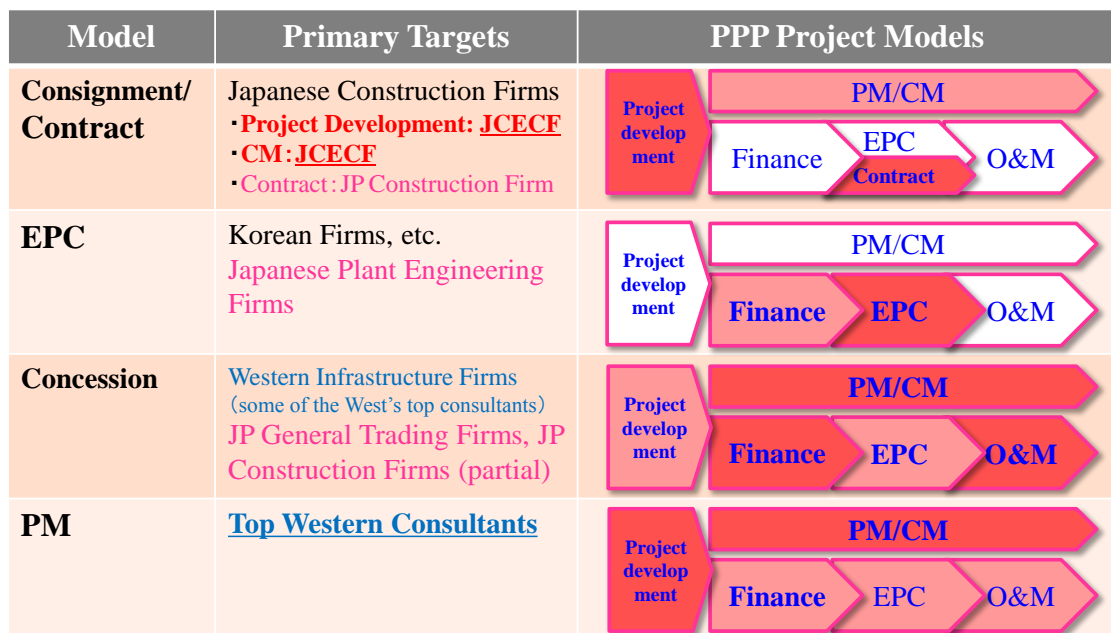
At the G7 Ise Shima Summit held in May 2016, the Japanese government declared their intentions to create a "High Quality Infrastructure Export Expansion Initiative" and laid out a policy to strengthen high quality infrastructure partnerships from the financial side of things. It is expected that these initiatives will supply about 200 billion dollars (their stated goal) for global infrastructure projects over the next five years to help respond to the enormous infrastructure demand throughout Asia and the world, and further boost orders and opportunities for Japanese companies.

In response to the strong demand for infrastructure across Asia and the rest of the world, these policies are being heavily promoted by the Japanese government as a means of strongly pushing Japanese companies to participate in exporting infrastructure overseas, thereby

catching up with the leading International companies and responding to the rise of developing countries. In the meantime, JCECFs are expected to serve a new function by taking on orders for overseas infrastructure development in addition to supporting Japanese companies' efforts to expand internationally.

4.4 Consulting Businesses for PPP Schemes

PPP takes advantage of both the public and private sector's strengths in order to construct and implement infrastructure projects, with a contract serving as a common foundation. The role of the public and private sectors and their respective degrees of involvement vary depending on the country and the project, but PPP nonetheless works as a concept that encompasses all forms of business involving public and private partners. There are various forms that PPP projects can take. Some of these have private companies handling some or even all of a project's lifecycle, including surveying, planning, design, procuring funds, construction, upkeep, and operations. Fig4 shows an example of a representative PPP project model. It is divided into four types: consignment and contracting work characteristic of Japanese companies, EPC common to chemical



Source: Created by authors based on Munehiro (2014)⁸⁾

Fig4 PPP Project Model Types

plants, Concession projects relating to BOT, and PM specialized for management. The hatching indicates the scope of each project scheme, and thin hatching may be excluded by individual projects.

JCECFs tend to primarily work on project development, but Western consulting firms cover everything from project development to O&M. Western firms also have an advantage in that they can arrange to procure funding thanks to the trust their PMs and EPCs enjoy.

4.5 Comparing International Consultants and JCECFs

JCECFs have played the role of contractor partner at the construction stage under Japan's unique two actors project execution system, but in the overseas market they will need to acquire experience as an independent contractor entity in accordance with the three actors project execution system. Specifically, they will need to transition from a specification-oriented, where they are provided with conditions, to performance design-oriented, where they are the ones setting the conditions. Furthermore, in order to become an independent entity as a third-party organization, JCECFs will be expected to meet high ethical standards. By repeating this over time, we believe they should be

able to improve their social status.

In the Japanese market, JCECFs are limited to planning and designing, but in overseas markets, they will need to have experience and know-how on dealing with the entire lifecycle of a project, including project development, financing, bidding, vendor selection, construction management, O&M. Also, while in the Japanese market, the rule is that the contractee shoulders all risk management, in developing countries the contractee cannot shoulder the risks even if they want to, so consultants are required to manage risk when working in countries with developing markets.

In other words, International consultants and JCECFs differ greatly in their establishment processes and institutional designs, resulting in differences in their respective ability to handle infrastructure projects. In overseas markets and PPP, consultants are required to have general risk management capabilities for projects, something JCECFs have no experience with in their conventional domestic market. In the future, in order for JCECFs to continue to expand and grow their business in overseas markets and in PPP, they will need to 1) expand their area, 2) expand their customer base, and 3) expand their service scope. Going forward, securing these risk management skills will be essential goals.

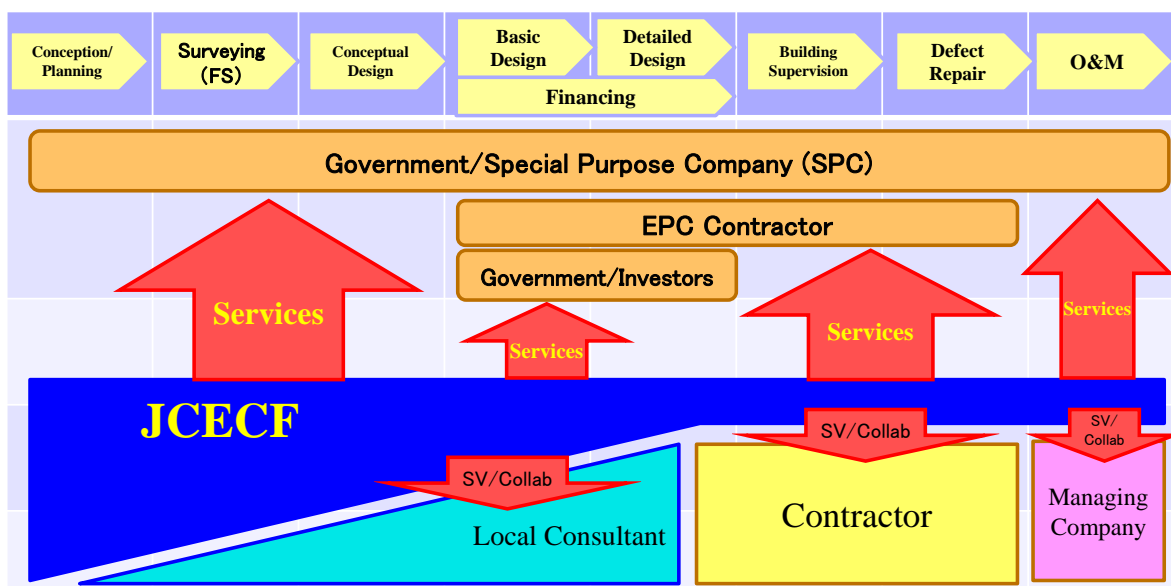


Fig5

Possible Positioning and Roles for JCECFs in PPP Projects³⁾

5. Functions and Roles Expected of JCECFs

Business areas for international infrastructure companies are primarily based on BOT (Build Operate Transfer) which involve private enterprise constructing, maintaining, and operating facilities, then transferring ownership to the public after the contract expires, Turn Key, and EPC (Engineering Procurement Construction). In such markets, the functions and roles required of JCECFs are not as they were in the past. As shown in Fig2, in the Japanese domestic market, under the government's management (the contractee), the role of a consultant was to be responsible for part of the design consignment. Now, as DB (Design Built) transitions to EPC and BOT, where the private sector runs the show, we believe that situations will arise in which consultants play a new role in planning, coordination and management, the same areas that the Japanese government has been responsible for in their conventional market. Major international construction companies such as Hochtief (Germany) and Vinci (France) have their own consulting functions on PPP management, and essentially run the project itself. In order for a major Japanese construction company to enter this kind of international PPP market, we think that it will be indispensable to have a PPP consultant function, either by itself or via partnership with another consultant, who can manage PPP.

Fig5 shows the possible roles and functions described above when consulting on PPP projects, which will only continue to expand in Asia in the future. JCECFs provide services under contract with their customers—the Japanese government, special-purpose companies (SPCs), investors, EPC contractors, and so on. In developing countries, JCECFs are seen as international consultants, and thus their services need to be improved to add more value, such as using advanced technology and value engineering (VE) together with cost competitiveness. From an efficiency perspective, it is not practical for a JCECF to accomplish this alone. In each phase, from design and

planning to O&M, the ability for JCECFs to supervise, offer guidance, and generally collaborate with local consultants, contractors, and operating companies will be extremely important.

Generally, in construction projects and plant engineering projects, the cost and schedule uncertainty for the project is greater in the upstream phase, and thus requires more sophisticated management techniques. Therefore, as we can see in Fig5, it would be best to have JCECFs leading the project across all phases, including design, planning, FS project development, etc., rather than local consultants. In the EPC and O&M phases, we believe that it would be best to focus on management, such as with SV etc., and collaborate with contractors and operating companies.

The authors of this paper have worked as JCECFs under the roles shown in Fig5 for small hydropower projects in the Philippines and Indonesia.^{8,9,10} There, under the concept of offering “O&M-oriented Consulting Services”, we have already established a JCECF-devised “PPP Project Management System (PPP-PMS)”³.

6. Criteria Required for JCECFs to Expand Overseas

Given the changes in establishment processes and roles of International consultants and JCECFs that we have laid out by this point, we will now try to summarize the challenges and requirement involved in helping JCECFs to expand beyond their conventional market and into overseas ones (for developing countries).

First of all, we need to come to terms with the fact that even though the upper tier of International consultants has seen their overseas sales rapidly expand from approximately 5x to 50x over the past 15 years, JCECFs' sales have remained stagnant at around 2x. The reasons for International consultants' rapid growth lie in the fact that their domestic markets are small, so they have been forced to expand overseas, and now the

firms that have triumphed among fierce domestic competition, including merging with former competitors to achieve a certain level of scale, are poised and ready to put their battle-hardened skills to work in the greater global market. But in Japan, where there is still a considerably-sized domestic market, it seems that JCECFs have not been subject to the same pressures that spurred their International counterparts to refine their strategies and competitiveness.

So why are JCECF oversea sales in the developing country infrastructure market not growing accordingly, despite the fact that investments in Japanese construction projects have shrunk and it is becoming harder just to maintain their current size, let alone grow, in their home country? We believe that the following three reasons are the primary causes:

- 1) Executive inability to adapt to new business opportunities
- 2) Insufficient project management human resources
- 3) A decline in competitiveness among engineers

We believe that the problem of executive inability to adapt to new business opportunities lies primarily with their other problems of market strategy, corporate alliance strategy, and resources strategy (such as funds and human resources). How many JCECFs do you think currently exist that have executive levels who actively pick up on global market trends, formulate business portfolios from a medium to long-term perspective, build network-type alliances with various partners, and continue to acquire, nurture and deploy their resources, primarily their human resources? We often hear that JCECFs cannot find work overseas because they do not have a project manager (PM), but we believe acquiring and cultivating PMs and engineers and sending them to growth markets is also something that needs to be handled at the executive level.

The problem of insufficient project management human resources, which we consider to be the most important, is perhaps the most critical of all the above

factors pertaining to the JCECF industry's establishment processes, institutional design, and market environment differences. Regardless of how good Japanese companies' advanced technologies and experience may be, adapting it to customers' needs and managing various aspects of projects such as quality, cost, and construction time in order to add value to their technology is the role that a JCECF PM needs to play.

As for the third point, that our engineers' competitiveness has declined, we must face up to the fact that the number of Japanese engineers who provide value in international markets is decreasing. You can say that the experience and know-how of engineers who are now 60 or older possess valuable engineering prowess born from overseeing many different projects from beginning to end, but that in turn implies that younger generations of engineers, perhaps due to vertical organization and subdivision, further ICT conversion, or other factors, are generally unable to see the big picture surrounding a project's entirety unless they have exceptionally high awareness, and thus most of them are only capable of handling low-value mechanical work. Executives, PMs, and engineers alike need to recognize that only partially-optimized engineers like these cannot compete in the global market, and thus need to start taking steps towards cultivating engineers who can fight on the frontlines both in Japan and beyond. That, we believe, is where the real transformation will begin.

7. Conclusion

In this paper, we looked back on how the JCECF industry began, and found that the market environment that formed due to Japan's unique "Two actors project execution system" is a major factor impeding JCECFs' international competitiveness. We also showed that training project management human resources is the most important requirement to help JCECFs expand internationally.

In order for high-quality infrastructure, like the kind the Japanese government advocates, to be deployed in the large and growing Asian infrastructure market, it will need to be accompanied by “O&M-oriented Consulting Services” that maximize the infrastructure's performance and minimize its lifecycle cost (LCC). To accomplish that, infrastructure projects will need people who can work as coordinators and commanders overseeing entire projects from the project development stage onward, and we think that this is a role that JCECFs can and should fill.

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