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ORIGINAL ARTICLE

The Challenge and the Role of Japanese Civil Engineering Consulting Firm for Infrastructure Development in Developing Countries －Based on Small-Hydropower Projects as Case Studies－

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***Abstract*:** Asia is experiencing a period of remarkable economic growth. In order for the lagging provision of infrastructure to keep pace, each country in the region has been left little choice but to rely upon private funding through PPP. In the field of energy, which accounts for around half of infrastructure demand, the introduction of renewable energy sources marks an area of considerable activity in each country. In particular, and in part due to the creation and operation of Feed-In-Tariff systems, there is currently a rush among both domestic and foreign investors in the development of small-hydropower projects, due to their capacity to provide a region with a stable base load power source.

This research will first provide an overview of the infrastructure market in Asia. The subject of the research is then the field of energy, due to it comprising 50% of infrastructure demand, and in particular the area of small-hydropower projects, which have been made a high policy priority in each country. Based upon actual case studies of Japanese Civil Engineering Consulting Firm active in Asia, we will seek to collate the risks and possible responses at each stage of the process - investigation, planning, design, EPC and O&M - and to identify the roles that Japan Civil Engineering Consulting Firm should play in infrastructure PPP projects in Asia, an area expected to show continued expansion into the future.

Keywords: Japanese Civil Engineering Consulting Firm (Japanese CECF), Public-Private Partnership in Infrastructure (PPPI), Small-hydropower project

1. INTRODUCTION

Asia is experiencing a period of remarkable economic growth, with an expected 8.3 trillion dollar (approx. 750 billion dollars per year) demand for infrastructure between 2010 and 2020. In order for the lagging provision of infrastructure to keep pace with this demand, each country in the region has been left little choice but to rely upon private funds through PPP (Public-Private partnership). In the field of energy, which accounts for around half of infrastructure demand, the introduction of renewable energy sources marks an area of considerable activity in each country. In particular, and in part due to the creation and operation of Feed-In-Tariff (FIT) systems, there is currently a rush among both domestic and foreign investors in the development of small-hydropower projects, due to their capacity to provide a region with a stable base load power source.

On the other hand, on-site at those small-hydropower projects undergoing rapid development and led by local companies, a variety of risks are starting to come to light, including policy,

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business and technological varieties. The cause of many of these is failure to employ suitable engineering during each phase, from investigation, planning and design through to EPC and O&M.

Japan has more than 100 years of practical experience in the field of hydro power, while under some of the harshest environmental conditions in the world, and this provides us with all the experience and know-how required to resolve the above issues. Alongside a clear contribution to the field of ODA (Official Development Assistance), it can be stated that Japan should be proactively transmitting and providing this knowledge to the Asia region in the field of privately led PPP.

This research will first provide an overview of the infrastructure market in Asia. We will then research the field of energy, due to it comprising 50% of infrastructure demand, and in particular the area of small-hydropower projects, which have been made a high policy priority in each country. Based upon actual case studies of Japanese Civil Engineering Consulting Firm (CECF) active in Asia, we will seek to collate the risks and possible responses at each stage of the process - investigation, planning, design, EPC and O&M - and to identify the roles that Japanese CECF should play in infrastructure PPP projects in Asia, an area expected to show continued expansion into the future.

2. THE INFRASTRUCTURE MARKET IN ASIA

Global investment in infrastructure is predicted to become a massive market by 2020, on average 1.9 trillion dollars per year. Furthermore, when looking at the field of PPP projects, which is coming to comprise such a large segment of global infrastructure investment, we can see that economic infrastructure, including roads, railways, water, airports and ports, comprise the largest part of the projects. The GDP of Asia is also maintaining growth ahead of the global growth rate, and it is predicted that the GDP of Asia will account for 50% of the GDP of the entire world by 2050. According to calculations performed by the Asian Development Bank (ADB), the infrastructure demand in Asia will reach 8.3 trillion dollars (approx. 750 billion dollars per year) in the period between 2010 and 2020. Reports indicate that this demand breaks down into 50% for energy, 30% for transportation, close to 10% for communications and 5% for water supply and sewer systems (Fig.1).

In response to this massive demand for investment in infrastructure, national funds from each country can only go so far. The total of private investment and implementation of ODA in the same region has reached 24 billion dollars per year, but in order to fill the remaining gap with the investment requirement of 750 billion dollars per year, it is vital that further investment be called into the region. In particular, bringing in a further level of private investment is absolutely vital to the development of the region.

The field of energy comprises around half of infrastructure demand, and has already seen large scale IPP projects relating to coal and natural gas. With the tides shifting toward environmental conservation and prevention of global warming, however, each country is also becoming more active in the introduction of renewable sources of energy.

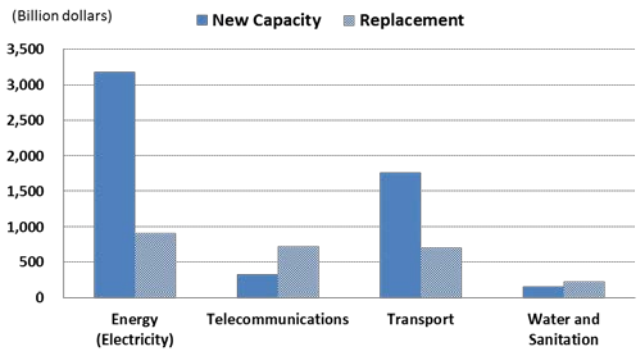

Fig. 1 Infrastructure Investment Demand in Asia by Project Field (2010 - 2020)

In particular, it is hoped that small-hydropower projects - which are unaffected by price fluctuations in primary energy - can provide a stable base load power source for a region. Countries such as the Philippines and Indonesia have placed a policy priority on the development of such projects through the introduction of a FIT system.

3. THE RISKS BECOMING APPARENT FOR SMALL-HYDROPOWER PROJECTS IN ASIA

The larger part of the Asia region has a monsoon climate, with many areas that are perfectly suited both by climate and topography for run-of-river small-hydropower. To provide an overview of the small-hydropower projects proceeding in these regions, the majority of them fall into the range of an output of 10MW or less, construction costs of 1 to 3 billion yen, and a project development period of 3 to 5 years. This kind of scale means that even local investors have plenty of possibility to make an investment, and there is currently a rush among both domestic and foreign investors in the development of small-hydropower projects, aided by the creation and operation of FIT systems.

On the other hand, on-site at small-hydropower projects undergoing rapid development and led by local companies, a variety of risks are starting to come to light. It is no exaggeration to say that anything that can go wrong has gone wrong, including political and policy risks such as changes in official systems and delays in completing required procedures, commercial risks such as delays in acquisition of land or consent from indigenous people and failure to acquire capital, and technological risks such as delays or increased costs during construction and malfunctions or accidents causing an increase in maintenance expenses after operations begin. While limiting initial costs for the investigation, planning, design and EPC and borrowing capital at a high rate of interest from a commercial bank can lead to a project getting off the ground, issues such as insufficient planned river flow volume, flaws in the civil engineering leading to sedimentation and sediment removal issues or slope collapses, serious malfunctions with turbine generators and restrictions on the volume of supplied electricity due to insufficient facilities for the transmission and distribution of the electricity, have served to create a permanent downward spiral, in which solutions for an issue are only considered once that issue has actually occurred. As a result, the planned volume of electricity cannot be sold, the capital is unable to be repaid, and projects are often seen being sold off or forced to cease operation completely. The cause of many of these is failure to employ suitable engineering during each phase, from investigation, planning and design through to EPC and O&M.

According to a supervisor from a Japanese corporation operating in the Philippines and Indonesia, with whom we have had contact via the proposal formation process for small-hydropower projects, the following are the kind of problems occurring on-site.

[Investigation, Planning, Design Phase]

- River flow volume, topographical surveys and basic geological and foundation investigations are performed simply and at low cost, leading to extremely poor and imprecise results.
- Due to planning and design being performed based on imprecise investigation results, revisions to the plans and designs have to be made during actual construction.
- The decision concerning whether or not to proceed with the project is made using an economic evaluation based on imprecise calculations of income and expenditure.

[EPC Phase]

- The extremely rough construction plan means that construction often has to be corrected on-site, and the costs and time required by the

construction greatly exceed the original plan.

- Without performing sufficient investigation into turbine generator specifications, and without performing sufficient commissioning by specialists, within 1 to 2 years of starting operation the full range of problems with the turbines starts to occur.
- As those running the project do not have the knowledge required to properly inspect the turbines when they are delivered, they tend to be at the mercy of the manufacturer, leaving who is to blame unclear when problems do occur.

[O&M Phase]

- As there is a lack of experienced O&M technicians, rate of operation after coming online remains at the lowest levels, and income from the sale of the electricity never reaches planned levels.
- As system repairs are required far sooner and on a far larger scale that the original plan allowed for, maintenance costs also greatly exceed planned values.
- There have been numerous cases of failure to achieve the budget plan even after operation comes online, and once the operating body can no longer provide compensation the project ceases to operate, which then leads to it being sold off.

It can therefore be clearly stated that on-site at small-hydropower projects in developing countries, having the project led by a local company that provides most of the investment comes with significant risks. It is the role of CECF to provide management that will minimize these risks as much as possible and turn such projects profitable, and indeed, this is the key point in realizing a sustainable business model for small-hydropower in Asia.

4. MERITS OF THE INVOLVEMENT OF A JAPANESE CECF

Japanese weather is influenced by the East Asian monsoon, and the country features some of the harshest terrain in the world, including rugged mountains and copious flooding. Amid these conditions, the Japanese have more than 100 years of experience in the field of hydro power, and possess all the experience and know-how required to resolve the above issues. Therefore, alongside a clear contribution to the field of ODA, Japan should be proactively providing this knowledge to the Asian region in the field of privately led PPP. This would involve the participation in the project of a Japanese CECF from the initial developmental stages of investigation and planning, allowing for the provision of a design that takes the entire lifecycle of the site into account and engineering services at the CM, PM, EPC and O&M stages. Furthermore, as well as the provision of highly reliable engineering, having financially stable Japanese corporations involved in the funding for the project will allow low-interest investment and loans to be obtained from Japanese governmental and private financial organizations, such as JICA and JBIC, all capable of powerful financing, allowing for provision of a scheme that offers greater merits when it comes to project budget. Fig. 2 shows an example scheme of the involvement of a Japanese CECF in a small-hydropower project.

5. THE ROLE THAT JAPANESE CECF SHOULD PLAY IN INFRASTRUCTURE PPP PROJECTS

Small-hydropower projects are comprised of civil engineering, mechanical and electrical facilities. This means that the example risks presented in section 3 are not exclusive to small-hydropower projects, and should have many similarities with other infrastructure projects, including water supply and

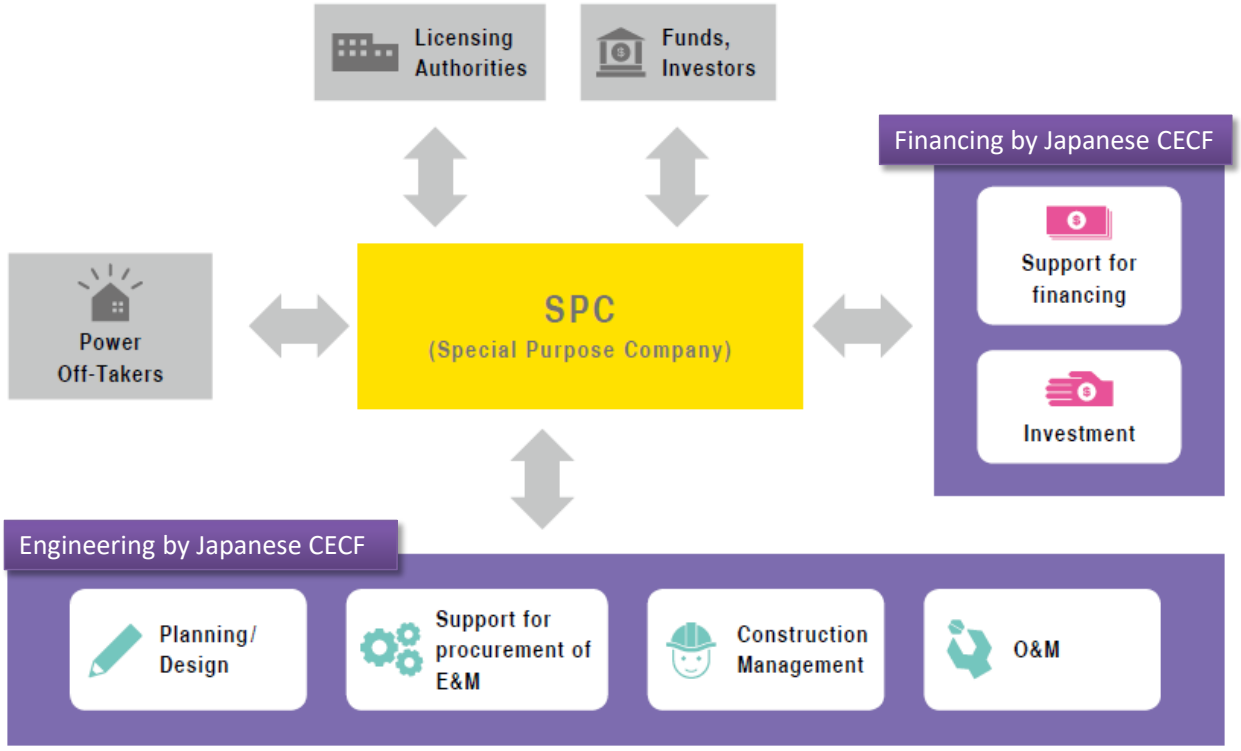

Fig.2 An Example Scheme of the Involvement of a Japanese CECF in a Small-hydropower Project

sewer systems, transportation, and information communications.

The risks of an infrastructure project that proceeds on a PPP scheme (PPPI: PPP in Infrastructure) can be broadly classified into “risks resulting from political or policy based actions”, “risks resulting from commercial actions”, and “risks resulting from natural phenomena”. Generally, each of these risks should be handled as far as possible by the body with the most control over them, and in that case it would be best for the local side (local partner) to take the lead in handling “risks resulting from political or policy based actions”.

CECF should therefore use their highly reliable engineering and resulting capital acquisition abilities to apply their resources to the risk management of “risks resulting from business actions” and “risks resulting from natural phenomena”. This involves using the organization’s management resources of talented people (personnel), products or services (technology), capital (finance) and information /personnel connections to respond to risks.

In order to achieve stable infrastructure and business, the key requirement is a thorough understanding of their own resources and effective usage of external resources, managing the project toward completion.

With reference to the case studies of small-hydropower projects as pin-pointed by this research, the resources that CECF should have available can be arranged as shown in table1. To put this another way, these can be considered “the roles that CECF should play” in PPPI projects. What is important here, beyond the obvious maximization by the CECF of their own personnel, technology, finance, and information and personnel connections, is that they are also responsible for finding “trustworthy local partners” with the capacity to reduce the “risks resulting from political or policy based actions”. It is therefore no exaggeration to state that the key to success for PPPI projects with the participation of Japanese CECF is “securing

Table1 Resources that CECF Should Possess (For Small-hydropower Projects)

Item	Elements
Talented People (Personnel)	Personnel with the following management skills and know-how ・Project creation & planning ・Project financing ・Project management (risk management, contract management) ・Project operation
Products or Services (Technology)	The following technologies for investigation, planning, design, CM, EPC, and O&M etc. ・Civil engineering and construction technologies ・Electrical technology ・Mechanical technology
Capital (Finance)	・The capital power to make an investment ・Capital acquisition abilities (information, trust, persuasion)
Information/ Personnel Connections	・Securing of a local base ・Securing trustworthy local partners ・Securing complimentary partners (domestic and overseas)

trustworthy local partners".

6. CONCLUSION

This research first collated the continually increasing infrastructure demand in Asia, and among the lack of public budget demonstrated the importance of providing infrastructure through PPP. We then turned our attention to the field of energy, which accounts for 50% of infrastructure demand, and from that field selected small-hydropower projects as a case study since they receive high policy priority in each country. Based on examples of Japanese CECF working in Asia, we collated the risks present in each phase - investigation, planning, design, construction and acquisition and O&M. Furthermore, indicating the merits of the participation of Japanese CECF in order to avoid these risks, we proposed their highly reliable engineering and capital acquisition abilities, and presented those roles in the scheme of a project. Based on this, we then commented upon the roles that Japanese CECF should play as PPPI projects continue to expand across Asia.

In order to contribute to the spread and expansion of PPPI projects in the future, the most important issue is the continued development of the kind of personal who can complete the roles outlined herein.

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