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Public-Private Partnerships for Technology Growth in the Public Sector

Scott E. Grasman, Javier Faulin, and Fernando Lera-López

Abstract—Public-Private Partnerships (PPP) are a mechanism for financing large infrastructure development such as transportation projects, hospitals, schools, and public works facilities. In addition, the benefits of PPP stretch well into the realm of engineering management. Most notably, PPPs provide the opportunity for more efficient project management, proficient risk mitigation, and enhanced technological innovation. This paper provides a general description of the typical PPP process and how this process can be used to improve management of technology in the public sector.

Index Terms—Project Management, Public-Private Partnerships, Research and Development Management, Risk Analysis, Technological Innovation

I. INTRODUCTION

PUBLIC-Private Partnerships (PPP) have been defined to refer to contractual agreements formed between a public agency and private sector entity, and allow for greater private sector participation in the deployment of infrastructure. Historically, private sector participation has been limited to separate planning, design or construction contracts. However, expanding the private sector role allows the public agencies to tap private sector technical, management and financial expertise in order to improve performance related to cost and schedule certainty, innovative technology applications, specialized expertise, or access to private capital. While the mechanism for financing large infrastructure development projects such as transportation networks, hospitals, schools, and public works facilities is quite mature, the understanding related to other realms of engineering management are not well-known and not often considered in the PPP process. Most notably, PPPs provide the opportunity for more efficient project management, proficient risk mitigation, and enhanced technological innovation. Thus, this paper provides a general description of the PPP process and how this process can be

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used to improve technology growth in the public sector.

There are a variety of PPP agreements that encompass the spectrum of public-private participation. Excluding agreements related to “finance-only” options, the PPP arrangements shown in Figure 1 highlight the typical terminology used to describe relationships.

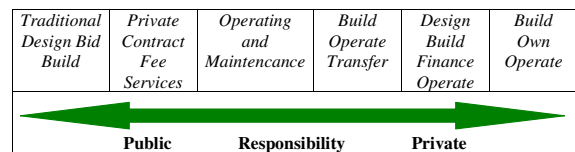


Fig. 1. PPP Options and Relative Degree of Responsibility

Responsibilities range from simple transfer of in-house tasks, to leasing and operating, to complete private ownership. Table I provides a brief definition of the arrangements

TABLE I
DEFINITIONS AND EXAMPLES OF PPP ARRANGEMENTS

Type	Definition
Traditional Design Bid Build	<ul style="list-style-type: none"> The private firm designs and builds according to pre-defined performance (and cost) specifications. Design Build is often not considered a PPP.
Contract Fee Services	<ul style="list-style-type: none"> Transfer of separate planning, design or construction contracts on a fee for service basis
Operating and Maintenance	<ul style="list-style-type: none"> Operation and maintenance of a publicly-owned asset is transferred to a private operator. O&M are often considered contract fee services unless lease or purchase agreements require improvements to existing assets.
Build Operate Transfer (BOT)	<ul style="list-style-type: none"> The private firm designs, finances, builds, and operates a project and then transfers back to the public sector after a fixed period of time. BOT includes Build-Own-Operate Transfer and Build-Lease-Operate-Transfer Agreements
Design Build Finance Operate (DBFO)	<ul style="list-style-type: none"> The private firm designs, finances, builds, and operates an asset under a long-term lease agreement. The asset is transferred back to the public sector at the end of the lease.
Build Own Operate (BOO)	<ul style="list-style-type: none"> The private firm designs, finances, builds, and operates a project in perpetuity.
Other Innovative PPPs	<ul style="list-style-type: none"> Unique PPP approaches that do not necessarily correspond to the different above categories

As the level of private responsibility increases, so does the opportunity to positively influence the management of a project. Private firms have the experience, expertise, and incentive to successfully implement highly innovative systems,

while achieving desired performance attributes and risk characterizations. This ability makes the concept of PPP extremely desirable to the public sector.

II. OVERVIEW OF PUBLIC-PRIVATE PARTNERSHIPS

There has been much global interest related to PPPs. Supporting organizations have arisen on local, regional, national, and multinational scales. Public and private entities have taken on the challenges, particularly associated with the financial and legal processes associated with PPP and how properly managing these aspects can be leveraged to provide services that otherwise may not have been feasible. A number of sources detail PPP issues and activity, e.g., Davies and Eustice [1], new approaches, e.g., Brewer and Johnson [2], and practical guides, e.g., Carty [3]. Table II highlights some application sectors and examples.

TABLE II
PPP APPLICATION AREAS

Sector	Examples
Healthcare	Hospitals, Assisted Living Facilities
Leisure	Parks & Recreation, Sports Complexes
Public Works	Housing, Schools & Science Centers, Energy-Related Services, Water & Waste Treatment, Recycling
Services	Hotels, Information Systems, Shopping Malls
Transportation	Airports, Light/Heavy Railways, Ports, Highways, Bridges, Tunnels

Other entities, particularly on the private or non-profit side, have approached how PPP arrangements can be used to provide *better* services by utilizing the expertise of the private sector. PPPs can not only overcome significant financial constraints and allow infrastructure to be developed, but also provide a stronger value proposition to the public sector by realizing projects with improved project management and reduced risk, *often* with lower costs [4]. Also, drawing from the expertise of multiple stakeholders often leads to innovative approaches to system design, implementation, and operation.

A number of efforts have addressed the general needs and benefits, governance and capacity-building, financial and legal processes, and project management and risk mitigation aspects of PPPs. Further, efforts are being made to go beyond the traditional scope of PPP in order to encourage technical innovation.

A. Governance and Capacity Building

Reflecting the interest in PPP as tools for development, the United Nations Economic Commission for Europe (UNECE) established an alliance of public and private sectors in order to engage governments interested in applying PPPs and to offer advice and support. Originally known as the PPP Alliance, the alliance has recently fallen under the auspices of the Committee on Economic Cooperation and Integration (CECI). Working closely with other bodies, CECI aims to create an environment for PPPs throughout the European region. The role of the UNECE/CECI in infrastructure development,

innovation and competitiveness has been delineated in Hamilton [5]. The main objective is to increase the expertise of governments to identify, negotiate, manage and implement successful projects through exchange of knowledge and experiences, including experts from public and private sectors, particularly in the identification and testing of best practices [6]. Activities have resulted in a guidebook for promoting good governance in PPPs [7], which provides seven principles: 1) Policy – linking policies to clearly defined goals and objective, 2) Capacity-Building – providing the support and collaboration at a local/regional level, 3) Legal Framework – allowing flexible in legal processes, 4) Risk Sharing – allocating suitable risk burdens, 5) PPP Procurement – ensuring clear and transparent processes, 6) Putting People First – considering the benefits to and impacts on all stakeholder, and 7) Environment and Social Concern – balancing sustainability and responsibility. Figure 2 depicts the interfaces between these principles.

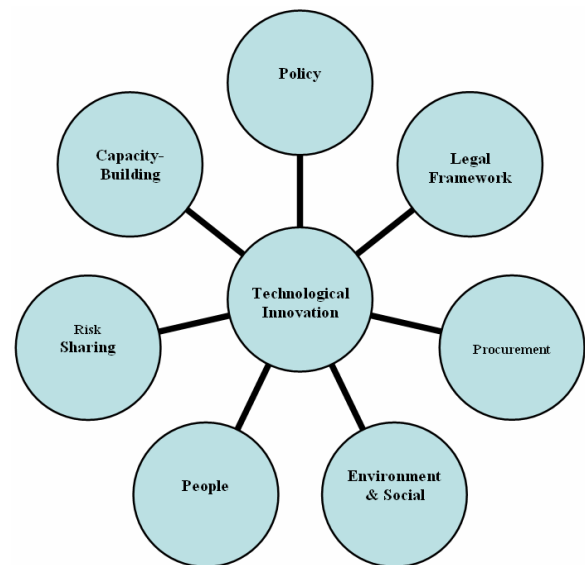


Fig. 2. Seven Principles to Good Governance in PPP

All of these principles are conducive to encouraging technological innovation through the use of effective and successful engineering management. The guidebook on good governance and others, e.g., [8], are useful, not only for detailing lessons learned and best practices related to governance, but also to provide a framework for capacity-building activities and a basis for innovative problem-solving. The guides contain best practices, studies, and innovative tools that can be used in capacity-building programs and training.

While international networks are being created to draw on the experiences and knowledge of experts in each area of PPP, the level of PPP maturity differs significantly from region to region based on the complexity of projects and the amount of involvement. As either the complexity of partnerships or the involvement in partnerships increase, the level of maturity generally increases. Figure 3 shows a generic PPP market maturity curve.

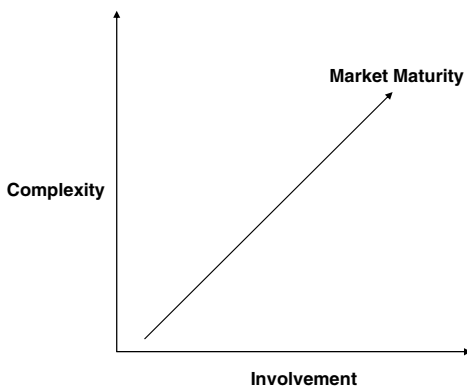


Fig. 3. PPP Complexity and Involvement
(Adapted from Deloitte USA LLP)

In mature markets, technological innovation is plentiful and can lead to significantly more efficient project management, proficient risk mitigation, and enhanced technology growth. Specific opportunities are discussed in a later section.

B. Financial and Legal Processes

Private Finance Initiative (PFI) is defined as arrangements for the public sector to contract services in order to take advantage of private sector expertise and managerial skills with the incentive of private financial risk. PFI could be considered to be more restrictive than PPP in the sense that it primarily addresses financial and legal processes, however, the aims of the two are similar, and will be used synonymously in this context. In addition, both provide opportunities for encouraging technological innovation through collaborative partnerships. An excellent discussion of ways to address the investment challenges and to strengthen partnerships is provided in [9] and [10].

In order for these financial and legal agreements to be feasible, there must be a value proposition for both the public and private partners. In most cases, the public partner receives value from releasing control of the project, thus receiving the expertise of the public partner, while the private partner receives financial incentive for completing the project. In addition, both partners *should* receive value from collaborative efforts related to streamlining strategies for project, risk, and technology and innovation management. However, without expanding beyond financial and legal frameworks, these benefits are likely to be unrealized.

C. Project Management and Risk Mitigation

In PPPs, effective project management and risk mitigation can be realized by properly allocating activities and risks to both the public and private sector. Based on the type of PPP arrangement, the relative risk allocation differs. As the responsibility of the private sector increases, so does the amount of risk that needs to be managed by the private sector. As shown in Figure 4, project management risks related to schedule and budget are generally transferred to the private sector.

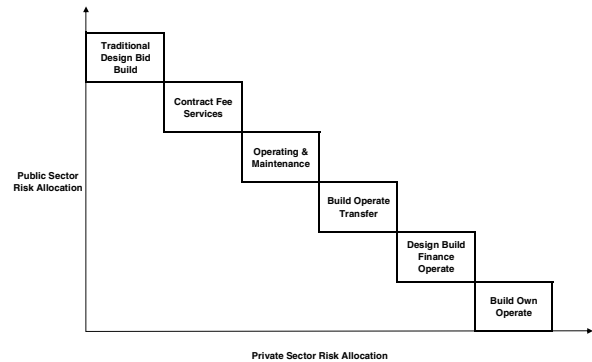


Fig. 4 Relative Risk Allocation by PPP Arrangement

However, risks should be allocated to the sector that is best able to absorb the risks. For example, the public sector may have the ability to pool risks from multiple projects that a single private firm would not have the ability to do. By doing so, not only are the risks likely to be better mitigated, but the associated costs and project delays may be decreased as well.

III. OPPORTUNITIES FOR INNOVATION

In traditional procurement systems, and most PPP processes, there is generally little incentive provided for technological innovation. Private partners that wish to provide advanced technology often do so at the risk of not being a financially-competitive bidder. Therefore, to encourage innovation, the public sector must recognize the value and reward those projects that have additional public benefit due to enhanced project management, risk mitigation, and technology innovation.

Creating an environment conducive to technological growth is critical to the long-term success of public sector projects. In this regard, PPPs can provide for the development of financing mechanisms capable of rewarding such efforts. However, without proper recognition in awarding process, technological innovation will be left in the wayside. Therefore, perhaps the greatest opportunity to provide significant benefit to the private sector lies in the *potential* for PPPs to encourage technological innovation, which is not present in traditional systems.

A number of strategies could be taken in order to increase the value of technological innovation and to create an environment for advancement. On one hand, private sector financing options for innovative ideas may exist through the use of venture capitalists. However, in most cases, the expected return on investment will steer the technology toward the consumer markets and these innovations are unlikely to enter the public sector in the near term. On the other hand, the public sector strives to improve technologies for a variety of applications though work at governmental labs. Again, these improved technologies will not enter the public sector in the near term.

In order to bring technological innovation to the public sector, PPPs can be used to allow collaboration. Policies need to be implemented that allow private firms to develop

technology that can be delivered to the public sector. Ideas for such policies are discussed in [11] and [12]. As mentioned, the public sector must first recognize the value of and reward technological innovation. To accomplish this, the public sector must 1) provide financial support to private firms that have innovations in order to get them into the hands of early market users, and 2) re-evaluate the procurement process in order to reward technology and innovation.

In the first case, public agencies can provide financial support, including direct funding, loan guarantees, supplements, and other mechanisms that allow technology to reach the marketplace. For example, when the technology curve is too steep to allow for significant penetration, supplements may allow the technology to be competitively introduced. Situations where the cost of the technology is prohibitive require the public sector to provide direct funding or loan guarantees that will assist in attaining additional financing from the private sector in order to continue research and development efforts.

In the second case, the public sector must recognize the benefits and the “value for money” offered by technology and innovation. Here, the public sector can take advantage of the flexible financing options available through PPP just as has been done to gain benefits related to project management and risk mitigation. For example, the length of an agreement could be lengthened, the revenues associated with the asset could be increased, or the public sector could share additional risks that balance the additional effort of the private firm.

IV. EXAMPLE: ENVIRONMENTAL AWARENESS

A very visible example of the need for innovation is related to environmental awareness in the public sector [13]. While many recognize the need for improved environmental technology, the technology curve often constrains its use in the public sector, especially when advances lead to financially non-competitive bids. In this area, policy is being developed both within and without the PPP framework and at a national and multinational level. The previously mentioned guidebook on good governance [7] includes a principle on the environment, national governments or agencies have published reports on environmental practices in PPP [14], and independent organizations have proposed strategies for environmental inclusion in the PPP process [15]. As an example, policies to ensure the state-of-the-art environmental innovation and strategic environmental assessment in transportation projects are also being developed [16-18].

V. SUMMARY AND CONCLUSIONS

Public-Private Partnerships (PPP) are generally considered to be a mechanism for financing large infrastructure development such as transportation projects, hospitals, schools, and public works facilities. However, the benefits of PPP stretch well into the realm of engineering management. Most notably, PPPs provide the opportunity for more efficient project management, proficient risk mitigation, and enhanced

technical innovation. Creating an environment conducive to technical advancements is critical to the long-term success of public sector projects. In this regard, PPP can provide for the development of financing mechanisms capable of rewarding such efforts. However, without proper support for early market research and development and recognition in awarding process, the public sector will be slow to adapt to technological advances. A number of opportunities exist to find the proper balance between public and private involvement, both from a governance and technical point-of-view. Increasing the capacity to leverage these opportunities will lead to beneficial use of technological innovation in the public sector.

The Public Sector should pursue two main policies to support technological innovation, both of which are attainable through PPP. First, the Public Sector should provide financial support to private firms that have innovations and want to introduce them into the market. It has been pointed out that this policy is very common in the European countries where private firms are strongly supported by national, regional and local governments that provide incentives for innovating and developing new concepts. Second, the Public Sector must address the issues related to the value for money and the public sector comparator (which is not cited in this paper). Again, the question remains related to how to manage the risks and uncertainty implied in technological innovation.

REFERENCES

- [1] P. Davies, and K. Eustice, K., “Delivering the PPP Promise: A Review of PPP Issues and Activity”, PWC, November 2005.
- [2] P. K. Brewer and L. Johnson, “Partnering in Practice: New Approaches to PPP Delivery”, PWC, 2004.
- [3] A. Carty, *A Practical Guide to PPP in Europe*. Partnerships UK, 2006.
- [4] National Council for PPP, available at: <http://ncppp.org/>.
- [5] G. Hamilton, “Promoting PPPs for Infrastructure Development, Innovation and Competitiveness: The Role of the UNECE” in *Law in Transition*, editors G. Sanders and M. Nussbaumer, EBRD, 2007.
- [6] UNECE Economic Cooperation and Integration Division, available at: <http://www.unece.org/ceci/ppp.html>.
- [7] *Guide to Promoting Good Governance in Public Private Partnerships*, UNECE, October 2007.
- [8] *Guidelines for Infrastructure Development through BOT Projects*, UNIDO, 1996.
- [9] *PFI: meeting the investment challenge*, MH Treasury, UK, 2003.
- [10] *PFI: strengthening long-term partnerships*, MH Treasury, UK, 2006.
- [11] *Financing Innovative Development*, UNECE, 2007.
- [12] *Creating a Conducive Environment for Higher Competitiveness and Effective National Innovation Systems*, UNECE, 2007.
- [13] *Report of the Commission on Environmental Markets and Economic Performance*, UK Department of Environment.
- [14] *Green Public Private Partnerships*, UK Office of the Deputy Prime Minister, July 2002.
- [15] J. Hill and J. Collins, “PFI: Meeting the Sustainability Challenge”, Green Alliance, 2004.
- [16] *THE SEA Manual – A Sourcebook on Strategic Environmental Assessment of Transport Infrastructure Plans and Programmes*, BEACON: Building, Environmental Assessment, CONsensus Project, European Commission, October 2005.
- [17] *SEP-15 Program*, U.S. Department of Transportation, available at: <http://www.fhwa.dot.gov/PPP/sep15.htm>.
- [18] Replogle, M., Environmental Defense communications, available at: <http://environmentaldefense.org/go/transportation>, 2008.