Public-Private Partnerships and Smart Cities

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Recent technological developments on urban infrastructure are reshaping the way we manage, finance and regulate public infrastructure. Existing Public Private Partnership (PPP) models need a significant restructuring, to be able to provide an adequate response to the smart infrastructure challenges.

Introduction

The world is changing and revolutionising the models by which we manage and operate urban infrastructure, whether it is transportation, water, energy or communications. Along with the digitalisation of infrastructure and the emergence of smart cities, there is a worldwide trend of increasing the involvement of the private sector in the financing and direct operation of urban infrastructure and public services (Rouhani et al., 2016; Iossa and Martimort, 2015; Roumboutsos, 2015). Large transportation investments such as metro systems, commuter rail or bus-rapid-transit are being developed with the active involvement of the private sector (Chen et al., 2016; Berechman et al., 2006; Fiorio et al., 2013). The same can be observed in water supply systems and waste management or energy production/distribution (Carpintero and Petersen, 2016; Kanakoudis and Tsitsifli2014).

Infrastructure needs to become smarter. This urgency is claimed by all main stakeholders: users, operators, regulators, and governments. Users today are much more demanding towards extracting real time information from the infrastructure, to help them decide and optimise their personal choices. This is particularly relevant in the transportation sector, where users want to know how long the journey will take with existing traffic conditions, what the alternative routes are, and how much the travel will cost. It is also relevant in the energy sector, where the potentially different applicable tariffs can steer consumption patterns towards more economically rational ones. The same applies to the water sector. For operators, the need for more information about infrastructure is due to several reasons: i) to understand existing usage of capacity and help them (when applicable) to more effectively plan the services; ii) to have more information on existing asset conditions, allowing for more effective maintenance activity planning, thus decreasing the overall life cycle costs and increasing the value of investments; iii) to develop target actions able to influence consumer/user behaviours towards more cost-effective ones. Regulators need more data to support their regulatory activity. Most of the regulation today is based on administrative reporting from operators and users, making the exercise of regulation a reactive process. To be able to have active regulation, capable of influencing and changing undesirable behaviours, regulators need to have access to more and better data, as well as more sophisticated big data analysis models. Last but not least, governments need to have more informed decisions. It is necessary to have more complete and reliable data towards existing patterns and asset conditions, to be able to have a more informed decision regarding planning of infrastructure investments and regulatory changes.

PPPs and smart cities

Traditional PPP approach

PPPs emerged as a panacea for solving infrastructure gaps. Based on the theoretical principle that private sector expertise can increase efficiency and reduce cost in public services, in reality, PPPs were most commonly used as a mechanism to leverage private financing to compensate a loss in public financing.

The model provides several benefits, but the reality shows that there is a significant value at risk, with potential losses, particularly taking into account the negative effects of ex-post renegotiations (for more on PPPs successes and failures, please see Cruz and Marques, 2012; Sarmento and Renneboog, 2016; Button, 2016).

The PPP model has been based on a relatively stable and known rationale. For a certain project, the private sector calculates the required CAPEX (capital expenditure) and OPEX (operational expenditure), which is facilitated by the existence, in most cases, of several existing similar sys-

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tems, and forecasts the revenue (or uses the forecasts provided by the government). Measuring the level of risk of the project (e.g. country, project and financial risk), the private sector decides on the expected return.

The design, structuring and assessment of a PPP is based on a forecast of costs and revenues plus a risk assessment to determine a risk-adjusted return on investment. This is often known as a "base case", which takes the form of an Excel file with all projected CAPEX, OPEX, revenues and/or any public subsidies. The benefits of involving the private sector are reducing the CAPEX and OPEX. Although the private cost of capital is normally higher than public borrowing, the efficiency in construction is expected to decrease the overall CAPEX. Based on these forecasts one can calculate the project's Net Present Value (NPV) and Internal Rate of Return (IRR), the two most commonly used decision parameters. But the application of PPP is now evolving from traditional infrastructure, with a low level of innovation, towards more innovative and technological infrastructure based solutions.

Types of PPPs in "smart cities"

To illustrate how PPPs are being used, or not, in different levels of technological innovation, we have created three classes for PPP development: "Business as usual" PPPs; "Incremental innovation" PPPs; and, "Ground-breaking innovation" PPPs.

- "Business as usual" PPPs refer to those typical BOT projects or concessions for the operation of the systems. They generally involve long term contracts, (20 years or more depending on the levels of investment), and involve significant private sector financing.
- "Incremental innovation" PPPs concern those PPPs developed for partial subsystems, such as ticketing systems, or the operation of electric fleets. These are technological upgrades to existing systems, but do not represent a restructuring of the backbone of the system nor do they provide a disruptive approach. Their purpose is to upgrade the service, maintaining existing business models and structure.
- "Ground-breaking innovation" PPPs are those disruptive improvements, building new business models and entirely restructuring existing mobility structure.

The classification "Business as usual" PPPs does not mean that there is not any type of innovation in those projects. One would expect that innovations regarding smart sensing of infrastructure (e.g. in tunnels, pavements or bridges) or signalling and management of metro and rail operations, is incorporated as they may represent a gain in efficiency. But the receipt is essentially prescriptive, meaning that the public sector determines, and specifies, the level of technological incorporation, the systems/subsystems used, and where innovation should be integrated (e.g. Hohoot Metro Line 1, Mongolia).

The emergence of what we designate "Incremental innovation" PPPs aims at establishing PPPs for specific sets of subsystems, for example, ticketing systems, vehicles, communication and control (e.g. Athens Bus Ticketing System or Electric Bus System in Bangalore). The use of PPPs has been more linked to heavy infrastructure development, such as roads, water systems, airports, dams, etc. Over the last decade, there has been a growing trend towards increasing the use of PPPs in "soft systems", such as ICT systems. Some of these systems are intrinsically connected with the operation of heavy infrastructure, but, whenever possible, the trend has been to vertically unbundle. An example of this unbundling is separating signalling and communication from construction and management of rail infrastructure or separating ticketing systems from the operation and management of buses or metro systems (e.g. Athens in Greece or Belgrade in Serbia).

Cases of "Ground-breaking innovation PPPs" are scarce and more linked to isolated exploratory pilot actions that, if successfully tested, can later become a "business model". It resumes to the possibility of testing "proof of concepts".

To accelerate the development of "smart" "Business as usual" PPPs, the model must evolve toward a quality of service model. Which will raise a set of other different issues, such as how to evaluate proposals and compare different bids.

Innovative PPP concepts

As mentioned, "Ground-breaking innovation PPPs" are still very scarce and linked essentially to pilot cases. The pilot cases, by definition, are developed within a controlled environment with several protections provided by public authorities and regulatory authorities, that, if successfully tested, do not necessarily mean optimal performance in the real business environment, nor that they are "bankable". Bankable "Ground-breaking innovation PPPs" are able to attach private equity and commercial loans, compatible with the level of risk of the project.

There are still few examples of PPPs developed in autonomous vehicles, big data analytics or any other type of disruptive technologies, to perform a truly comparative analysis of new vs. standard PPP models. In fact, these innovative PPP models are still at a conceptual and rather uncertain level. In fact, a current challenge for researchers is to provide guidelines for what can be future PPP models.

The new PPP approach will have to deal with significant risks particularly regarding planning, production, demand, financing and legal & regulatory issues. The structure of the risk-sharing agreement has always been a critical question for PPP development, and critics have highlighted the uneven and inefficient risk allocation of PPP projects. In a smart cities context, this challenge will increase, because the risks are higher. To avoid inefficient risk pricing, governments should avoid a full risk transfer

approach, and retain some risks, such as legal and regulatory, on the public side. Financial risk can be mitigated by separating financing from PPP operation. The financing can be awarded through an independent competitive tender, avoiding any risk contamination from a riskier operation. This could have a potentially positive effect on the cost of capital.

To establish a true partnership, and share potential benefits, the public sector could have an equity stake in these new innovative PPP projects, as also suggested by the HM Treasury (2012) regarding the UK second PFI wave.

Conclusions

The medium- and long- term vision for the infrastructure sector, and ultimately for cities, will bring a radical change in the way we have been building and managing existing infrastructure assets. Although the overall levels of efficiency in water, transportation, energy and other infrastructure-based sectors has historically been improving, it has not been possible to have a highly cost-effective system. Costs remain high, and there is a strong political temptation to cut infrastructure spending, particularly when economic growth is low and public finances have strong constraints. The results are deteriorating infrastructure and lower quality of service.

One of the main drivers to decrease operating costs in the infrastructure sector (and raise capital for financing infrastructure development plans) has been to involve the private sector, but the potential for savings will not be much higher. Only a technological shift both in the management of the infrastructure itself (through smart monitoring), lowering life cycle costs, and on the demand side guiding and influencing smarter usage patterns, can provide a potentially large impact on efficiency levels.

But the risks of this new perspective are considerable. Traditional PPPs have been founded on the concept that the transfer of risk to the private sector improves the value of money of infrastructure spending. But the risks have to be "manageable", meaning, there has to be a certain degree of predictability so that the private sector can assess and calculate risks (and risk premiums). Most ground-breaking innovations in the infrastructure sector are not predictable. Applying traditional PPPs will mean that most projects will not be bankable given their extremely high level of risk.

A new flexible and truly shared partnership will be required to be able to attract the private sector towards smart infrastructure investments. It is unlikely that the typical contract-based concession will be adequate, because the level of contractual incompleteness will only increase when dealing with technological ground-breaking innovations. Mixed companies or project-specific third entities will most likely be adopted to allow a better incorporation of uncertainty.

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