

ORIGINAL ARTICLE

Enhancing the efficiency of infrastructure projects to improve access to finance

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ABSTRACT

While there has been much discussion about the large infrastructure needs in Asia and the Pacific, less attention has been paid to public expenditure efficiency in infrastructure services delivery. New constructions are not the only solution, especially when governments have limited capital to invest. Globally, new infrastructure projects face delays and cost overruns, leading to an inefficient use of public resources. The root causes include the lack of transparency in project selection, the lack of project preparation, the silo approach by public entities in assessing feasibility studies, and the lack of public sector capacity to fully develop a bankable pipeline of projects. To tackle these issues, governments need a smarter investment approach and to do so, enhancing public service efficiency is very crucial. The paper suggests a “whole life cycle” (WLC) approach as the main strategic solution for the discussed issues and challenges. We expand the definition of WLC to include the entire life cycle of the infrastructure asset from need identification to its disposal. The stages comprise planning, preparation, procurement, design, construction, operation and maintenance, and disposal. This is because we believe any efficient or inefficient decision throughout such a wide life cycle influences the quality of public services. Hence, in this holistic approach, infrastructure life cycle consists of four phases: planning, preparation, procurement, and implementation. Governments could enhance public efficiency and thus improve access to finance throughout the WLC by several solutions. These are (i) preparing infrastructure master plan and pipelines and long-term budgeting during the planning phase; (ii) establishing framework and guidelines and improving governance during preparation phase; (iii) promoting standardization, transparency, open government, and contractual consistency during the procurement phase; and finally (iv) continued role of government and total asset management during the implementation phase. In addition to these phase-specific means, key WLC solutions include proper use of technology, capacity building, and private participation in general and public-private partnership (PPP) in particular

Keywords: *efficiency; infrastructure; finance; public sector; PPP; whole life cycle; planning; preparation; procurement; implementation; disposal; PIMA; public services*

1. Introduction

While there has been much discussion about the large infrastructure needs in Asia and the Pacific, less attention has been paid to public expenditure efficiency in infrastructure services delivery (Henckel *et al.*, 2017). This is an important omission, as there are empirical evidences that infrastructure projects are often subject to corrupt practices, favoritism, delays, and cost overruns. For instance, cost overruns range between 96 percent of infrastructure investment for dams and 24 percent for roads. Averaging 28 percent of infrastructure investment, cost overruns clearly indicate potential efficiency gain (Flyvbjerg *et al.*, 2016). In addition, according to Agarwal *et al.* (2016), large capital projects typically take 20 percent longer to finish and cost up to 80 percent more than expected. Dealing with such issues is important to not only get more done with existing resources and use taxpayers' money more efficiently but also to make infrastructure projects more attractive to private investors. Therefore, enhancing public efficiency should be considered a prerequisite for countries to improve their access to infrastructure finance (Yescombe and Farquharson, 2018).

Avoiding investing in projects that bridge to nowhere is a very powerful way to reduce the cost of infrastructure. Woetzel *et al.* (2017) estimate that US\$200 billion per year could be saved annually globally by choosing the best combination of projects and eliminating wasteful ones. Closing the infrastructure investment gap is not easy, but it is both necessary and possible. Several solutions have been discussed and implemented by governments to enhance the efficiency of infrastructure projects and thus to close such a gap. The results indicate that countries could deliver the same quality and quantity of infrastructure services with fewer resources by increasing the efficiency of infrastructure delivery. Several solutions could be proposed to obtain efficiency gains in all aspects of infrastructure life cycle by improving project identification and planning, streamlining preparation and procurement, and optimizing infrastructure implementation.

To enhance the efficiency of infrastructure projects, it is vital to have a life cycle approach. While most think of only cost overruns during the construction stage, the costs during the planning, preparation, and procurement stages as well as the management and operation of the infrastructure assets after construction can escalate considerably, too. On one hand, the planning stage can lead to inefficiencies through the lack of transparency and standards in the selection of projects. To enhance efficiency in this stage, it is important for countries to take a portfolio view of projects, considering the performance of the entire system, rather than focusing on individual projects. In addition, efficient

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preparation and procurement are necessary to bring value for money.

Weak maintenance of existing assets is a root cause of inefficiency during the life cycle of infrastructures, which according to Bonifaz and Itakura (2014) could add 32 percent to project costs. To overcome these challenges, in addition to the common solutions, countries could embrace the manifold opportunities presented by technology in how they plan, deliver, and operate their infrastructure systems and networks. For instance, rather than focusing on the capital efficiency of individual projects, by using new technologies, a program could encourage government departments and leaders in the industry to take a higher-level portfolio view of projects, prioritizing the whole life of the asset as well as the performance of the entire system.

This paper explores different types of public efficiency and the necessity of a whole life cycle approach. The main section expands on the key causes of inefficiency in infrastructure projects during the planning, preparation, procurement, and implementation phases. Multiple strategies and solutions are presented to enhance the efficiency of infrastructure throughout the infrastructure life cycle. Specifically aiming at issues and solution towards investigating efficiency enhancement, the paper will expand on the following questions:

- Why should governments emphasize on a whole life cycle approach?
- How can governments identify opportunities for different types of efficiency gains at each project phase?
- What kinds of new technologies are relevant at different project phases to enhance efficiencies?

2. Background of public efficiency

Efficiency is about the relation between inputs, outputs, and outcomes. In 1957, Farrell introduced an efficiency measurement method for economic policymakers (Farrell, 1957). As Clark *et al.* (2016) discussed, efficiency is the key to a smarter investment that delivers more for less with better public services. Efficiency is not just about reducing public spending but also about the entire process of turning public money to the desired outcome for society. It includes both technical efficiency (i.e., how the outputs are produced from the inputs) and allocative efficiency (i.e., is the desired outcome produced). To enhance technical efficiency, the government may provide the inputs at a cheaper price or produce more outputs. However, allocative efficiency is about achieving more desired outcomes by taking the right way of doing things and improving the policies (Fourie and Burger, 2000). Governments are better in terms of technical efficiency than allocative efficiency. Therefore, it is crucial to improve the framework, policies, and methods throughout the whole life of infrastructures to enhance allocative efficiency and, as a result, to improve public service delivery and access to finance.

Public efficiency, defined as the outcome of public sector activities relative to the resources employed (Afonso *et al.*, 2005), is a continuous and holistic process. The literature on public expenditure shows that public spending could be much smaller and more efficient than it is today. This is more critical at the initial stages of the project life cycle. For instance, sound and efficient decisions during the planning phase will enable governments to protect the outcome of the asset later in its entire life. Conversely, improper decisions at any stage of the life cycle will deteriorate the performance of the asset for the rest of its life cycle. For example, an inefficient investment

decision will waste the resources employed during preparation, procurement, and implementation. Therefore, efficiency is tightly connected with the infrastructure whole life cycle and efficiency gains are derived from acting seamlessly throughout the project cycle and learning at the same time. **Figure 1** summarizes the different phases of the infrastructure life cycle and their associated tasks and decisions. The public efficiency during each phase will affect efficiency during the following phases.

3. Proposed approach

From the public sector's perspective, infrastructure life cycle spans the entire life of an asset from initial planning through the disposal of the asset. The stages comprise planning, preparation, procurement, design, construction, operation and maintenance, and disposal. When it comes to efficiency, all of these stages need to be considered, both economically and environmentally. For instance, focusing too much on minimizing initial costs (i.e., planning, design, and construction costs) and not paying enough attention to the asset utilization phase can lead to higher life cycle costs. To do so, it is vital to adopt methodologies that use a life cycle perspective to evaluate both environmental and economic impacts, such as life cycle assessment (LCA), which examines environmental impacts, and life cycle cost analysis (LCCA), which examines economic impacts (Norris, 2001; Petrillo *et al.*, 2016). While the asset life cycle normally refers to the design, construction, and operation of the infrastructure, we expand this definition to include the entire life cycle of the asset from need identification to its disposal. This is because we believe that any efficient or inefficient decision throughout such a wide life cycle influences the quality of public services. Hence, in this holistic approach, an infrastructure life cycle consists of four phases: planning, preparation, procurement, and implementation (**Figure 1**). It is noteworthy that the implementation phase itself spans the conventional definition of life cycle by including design, construction, and operation. While the first three phases (i.e., planning, preparation, and procurement) fall mostly under the government's responsibility, the implementation phase could be managed by either the public or private sector, or as a combination, generally a public-private partnership (PPP). International Monetary Fund (IMF) results suggest that by improving efficiency throughout the WLC, countries could increase the value of their public investment by 30 percent (IMF, 2015).

3.1. Planning phase

The planning phase starts from identifying the needs and ends with the project selection as a good investment decision. The public sector cost would entail the costs in this phase over a lengthy period, which may or may not be measurable. For example, a highway project and different routing options could be under consideration for years. Meanwhile, there could be many policy and institutional changes which may have impacted the building of the road and the associated infrastructures. The economic viability of the highway will change if there have been significant variations in the landscape and demography of the beneficiaries. By the end of this phase, a government should be able to take an "investment decision" on the best option to provide the most economic benefits to the target population according to their needs with minimal costs. Efficiency gains during the selection and prioritization of a particular investment should be irrespective of whether the delivery mode is public procurement or public-private partnership (PPP). Ideally,

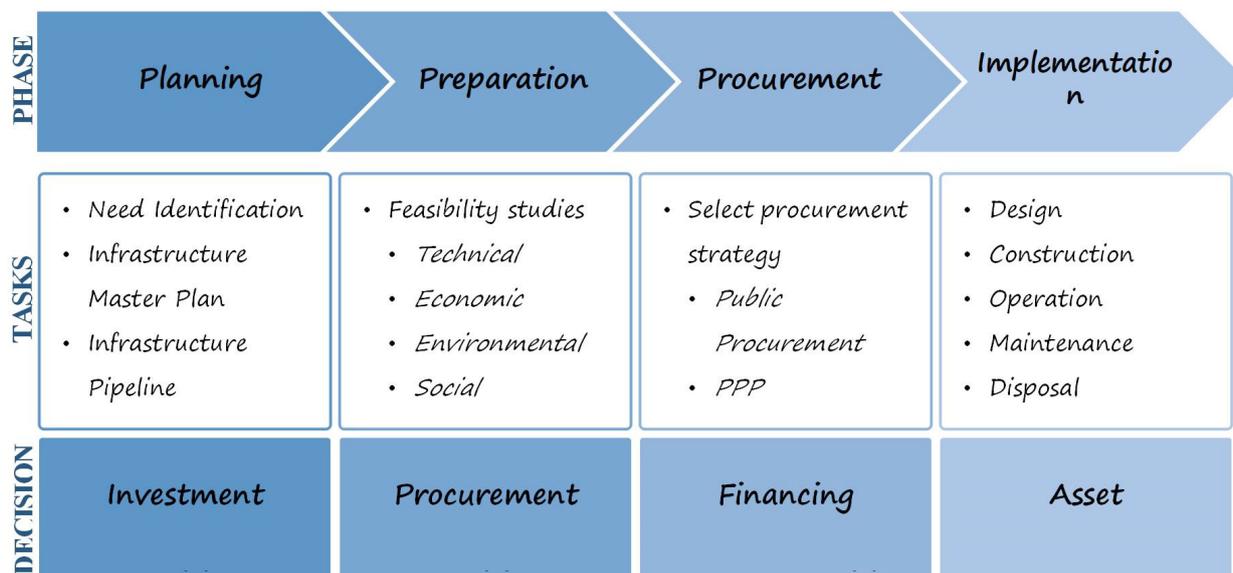


Figure 1. Infrastructure life cycle's phases, tasks, and decisions.

this would be done at the local or sectoral government body, such as the ministry of transport. By shifting the responsibility of the best investment to serve the need decision or “investment decision” to the sectoral ministry, the central ministry would be able to make an informed decision from a portfolio of well-purposed projects. In 2015, IMF developed a tool for assessing infrastructure governance over the entire investment cycle. The Public Investment Management Assessments (PIMAs) tool has been well received by member countries, mainly in emerging markets (EMs) and low-income developing countries (LIDCs). The analysis shows that institutions are better designed for the planning phase (e.g., budget unity, budget comprehensiveness, and national planning) compared with the rest of the asset life cycle. However, these well-designed institutions need to be better implemented in practice.

3.2. Preparation phase

The preparation phase should prepare the project selected as a good investment with full feasibility studies on market, technical, economic, commercial, legal, environmental, and social aspects. These studies require budget and institutional capacities to ensure that the project has engaged the relevant stakeholders in order to cost the project and identify the risks during the WLC. For example, in the highway project, the engineering study should identify the watershed areas affecting the irrigation and drainage of the adjacent farmland. Only then, the farmers as stakeholders can be consulted and a proper mitigation plan can be put in place so as not to affect the environment. Consultations with stakeholders can have a significant impact on the design of the project. By the end of this phase, a government should be able to determine whether involving the private sector would be a good decision to provide one or multiple services during the WLC. For example, the private sector could be involved in construction only, in construction and maintenance, or only as subcontractors for specific services. This decision would be a “procurement decision”, meaning determining the best way to procure the project services. The main part of this decision is to determine if public procurement or PPP is a better method to procure the asset. Several PPP screening tools could be used, among which value for money (VFM) is more common in practice

(World Bank Group, 2016). The present value of whole life cycle costs (WLCC) of a Public Sector Comparator (PSC) is compared with that of a PPP scheme and the method with smaller WLCC will be selected (World Bank Group, 2017; Akbiyikli, 2017). A centralized ministry, such as the ministry of planning, finance or economy, would generally receive many funding requests. Preferably, the central ministry would conduct a process of VFM and fiscal affordability analyses. Based on its own set of public resources' conditions and long-term planning, the best method to procure the asset and service would determine the way forward. This separates the “procurement decision” from “investment decision”.

3.3. Procurement phase

The procurement phase would depend on the government's decision on which procurement strategy it wants to follow. In public procurement, generally each procuring agency has its set rules and regulations. These contracts would be small and would entail individual tenders for each service. The procuring agency will be responsible for all the multiple-contract management, e.g., design, multiple construction contracts for each segment, toll company, drainage area mitigation, resettlement, etc. If the decision is to procure a private company, then a PPP law and related procedures would be followed. While PPP laws may or may not be separate from public procurement laws in common law countries, there would be some operational guidelines which could be different, e.g., in UK, Australia, and India. The procuring agency will be responsible for the overall management of the main concession contract with the private company; however, the private company should manage the multiple subcontracts. During this phase, a “financing strategy decision” should be made to determine the best way to spend the public resources allocated to the chosen investment. The objective will be to maximize benefits to the target population and the return to the government, at the same time minimizing the WLCC of the project. If the project delivery mode is a PPP, then the objective should be purpose maximization (including social, environmental, and financial outcomes) and not profit maximization (which includes only financial benefits). In fact, the most efficient decision in this case is the one that provides a win-win situation by optimizing the public benefits as well as the private proceeds. For example, the same budget allocation to an investment can be structured as a capital grant, loan or guarantee. This would be the “financial strategy decision” and should be taken together by the central ministry, sectoral ministry, and procuring authority. PIMA results suggest that the countries lack appropriate management of PPPs and, in particular, the transparency of the procurement process. Despite available disclosure procedures, PIMAs reveal that procuring authorities have not appropriately implemented the procedures in practice. Therefore, there are many rooms for improvement in this regard.

3.4. Implementation phase

The implementation phase should include design, construction, operation, and maintenance until the end of the infrastructure life (i.e., disposal), leading to “asset management strategy decision”. However, most countries underestimate the operation and maintenance costs and do not provide either budget or institutional support. As a result, the infrastructure asset falls into decline, making it impossible to rehabilitate in a few years. Consequently, cost overruns are focused on only construction and not to the WLC. While capital costs are the most expensive with the most multiplicative effects due to delays, the overall cost to the public sector comes from whole life cycle costs (WLCC) and not just from capital expenditures. By bundling construction with operation

and maintenance, there would be economies of scale and better risk mitigation. For example, if the same contractor is building and operating the highway, it would take heed in designing the highway to minimize the costs arising from the risk of damaging the watershed zones in the right-of-way areas adjacent to the highway. PIMA results indicate that the implementation phase suffers from weak project management as well as asset-monitoring institutions in practice although they have central monitoring mechanisms of project implementation. To fix the weakness, the countries could implement project management guidelines and training, employ monitoring mechanisms, and perform audits.

3.5. Whole life cycle costs (WLCC)

Whole life cycle costs (WLCC) employs the WLC approach by focusing on project costs throughout the infrastructure life cycle, including the costs of planning, preparation, procurement, and implementation. The cash flows before the procurement decision (i.e., the planning and preparation cash flows) are small compared with the WLCC. In addition, these costs are independent of the procurement method. However, a large portion of WLCC (i.e., the procurement and implementation cash flows) are spent after the procurement decision and depend on how well the procurement decision is made. In other words, one smart and efficient way of managing the WLCC is to ensure that the planning and preparation phases are precisely and completely followed, leading to a good procurement decision. This small investment will provide a sound basis for the procurement and implementation phases and could protect the large amount of money that will be spent during implementation. It demonstrates that efficient planning and procurement is necessary. However, it is not sufficient, meaning that it will not necessarily result in efficient procurement and implementation. In summary, being efficient in each phase is a basis for success for the rest of the life cycle (**Figure 2**). This is why planning is the most important phase of the asset life cycle regardless of its small cost.

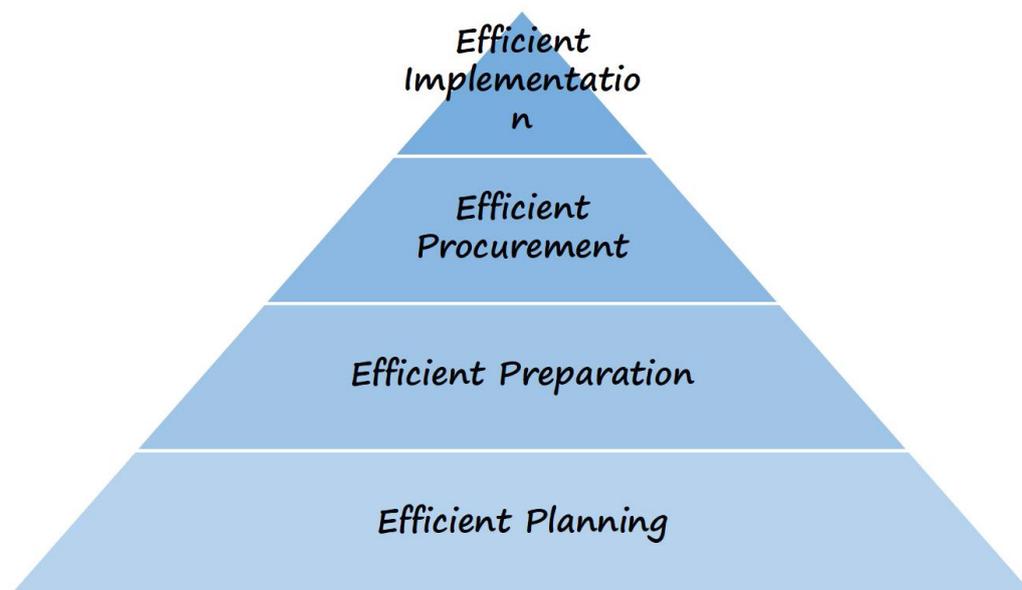


Figure 2. Efficiency as the basis for success.

Infrastructure projects could be procured publicly or by the use of PPP. From the government's perspective, the WLCC and its distribution throughout the asset life cycle are different for different procurement methods. **Figure 3** depicts the cash flows for public procurement, a government-pays PPP, and a user-pays PPP. For public procurement, the majority of the WLCC (i.e., around 95 percent) is incurred during construction and operation. Focusing too much on minimizing initial costs and not paying enough attention to the asset utilization phase can lead to higher life cycle costs. The better the planning, preparation, and procurement practices are performed, the more efficient the implementation tasks will be.

In a government-pays PPP, the majority of the spending is incurred during operation, since construction is done by the private party. Therefore, it is important for the government to consider the WLCC (including the service cost during operation) in the planning and preparation assessments. On the other hand, in a user-pays PPP, in which the project is bankable and no government contribution is needed, the required cash flow from the government's perspective is much lower than public procurement and government-pays PPP. This is because the construction costs are provided by the private partner and the majority of the service costs are covered by user charges. Hence, the user-pays PPP, if the VFM is assessed properly, is the most efficient way of fulfilling public needs since it has the least burden on the government.

4. Findings and discussion

Based on the proposed whole life cycle approach, in this section we discuss the issues and related solutions for different phases, i.e., planning, preparation, procurement, and implementation.

4.1. Planning phase's issues and solutions

The planning phase's issues and solutions are listed in **Table 1**. The issues are related to the governance, the way the government identify and select the project, and the budgeting approach.

4.1.1. Improving governance

Improving public governance could fill up to two-thirds of infrastructure efficiency gap. Both sectoral and national governance improvements are required to connect the fragmented sectoral plans and create national frameworks in which public investment decisions are made clearly and efficiently. In order for this to come true, transparency is necessary. To fight corruption, countries should define transparent procedures for need identification, project selection, and planning. Several methods, tools, and good practices have been developed to help governments fight corruption and deliver better public services that are at the heart of people's lives, such as education, water, health, and the judiciary (Schütte *et al.*, 2016; United Nations Development Programme, 2011; Kohler, 2011). Experience shows that while several countries have standardized technical processes in place, they are not successful in their implementation in practice because of ambiguous and complicated rules and regulations that open rooms for corruption. The idea of e-government could help enhance transparency and governance. In other words, wherever people are involved in the design, delivery, and monitoring of services, better and more services are delivered.

4.1.2. Long-term needs-based infrastructure planning

Defining a comprehensive infrastructure master plan based on the identified public needs over

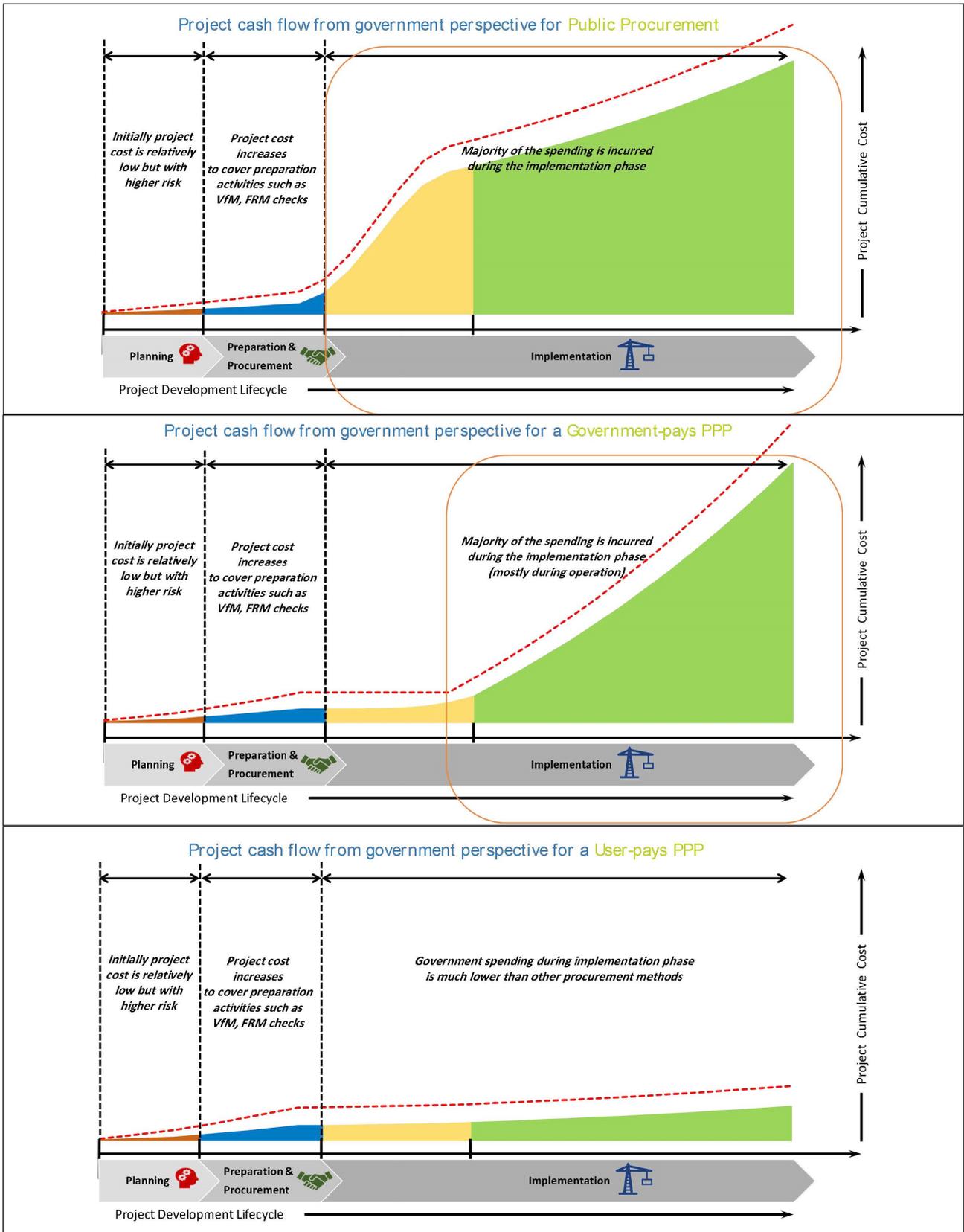


Figure 3. The infrastructure costing by phases for different procurement methods from government’s perspective.

Table 1. Planning phase’s issues, solutions, tools, and references

Issues	Solutions	Tools & References	
Governance			
<ul style="list-style-type: none"> • Corruption • Lack of transparency • Too many people in the value chain • Lack of capacity 	<ul style="list-style-type: none"> • Incentives for public officials, personal penalties • Capacity building 	<ul style="list-style-type: none"> • World Bank PPP reference guide • G20 Initiatives • UK’s Five Case Models • United Nations PPP Readiness Assessment Tool • BRI data company’s PPP transactions data 	
Project Identification and Selection			
<ul style="list-style-type: none"> • Selection of projects based on political concerns and unrealistic needs • Long wish list of (unviable) projects • A large volume of incomplete projects that are not economically needed • Lack of adequate feasibility studies • Lack of balance between urgency and priority • Separate processes for public investment and PPP selection 	<ul style="list-style-type: none"> • Comprehensive long-term needs-based master plan • Improved soft infrastructures • Unsolicited proposal • Infrastructure pipeline • PPP pipeline • Starting from a few pilot projects 		
Budgeting			
<ul style="list-style-type: none"> • No long-term budgeting 	<ul style="list-style-type: none"> • Transparency over multi-annual commitments • Assessing fiscal space for new projects • Establishing capital budget ceilings • Publishing existing ceilings 		

a sufficiently long period in the future will avoid arbitrary project selection. This would entail matching long-term needs with long-term planning in a systematic way to determine which type of infrastructure would be best (Abiad *et al.*, 2017). It is possible that instead of creating a new physical asset, there could be efficiencies in improving soft infrastructure such as the enforcement of regulations. On a portfolio basis, it is better to create a plan across a range of sectors rather than a single sector to ensure an efficient distribution of financial resources across all sectors. In the absence of these plans, the projects will be defined based on political concerns and unrealistic needs. Such projects are more often economically unfeasible, leading to wasteful use of public budget. Unfortunately, countries suffer from a large volume of incomplete projects that are not economically needed and therefore no funding is available to finish them.

4.1.3. Moving away from a “wish list” to a “viable pipeline of investments”

Emphasizing quality over quantity to build an economically viable pipeline will improve efficiency. Ministries are under pressure to produce a long wish list, which is often misunderstood as the actual pipeline of projects. This “wish list” of projects, which is a result of fragmented and unsystematic project selection processes, often lacks basic information on costing, needs analysis, or revenue forecasts. In an environment of limited public resources, most of these investments end up with partial or no successful outcomes. Oftentimes, high-priority projects are allocated to the public procurement list because of easy official development assistance (ODA) funding, whereas low-priority projects that are often commercially unviable are allocated to the PPP list. The status quo continues as the public investment process is separate from the PPP selection process. Investment planning should be holistic and done together based on the government’s priorities. Projects should be screened based on real-time analysis to ensure that they are shortlisted appropriately. If a project is well suited for private financing, then it should be structured in such a way. This will

prioritize public funding for projects which are economically viable but not commercially viable, leaving more commercially suitable projects for the private sector. All in all, forming a pipeline of infrastructure projects, developing an online comprehensive database, and reforming the guidelines and criteria will help governments overcome such an unsystematic selection process.

4.1.4. Aligning costing, budgeting, and planning

Long-term planning requires long-term budgeting. However, generally, budgeting allocation is done on a one- to three-year basis in most countries under a medium-term framework. While capital costs are allocated from the central budget and transferred to the sectoral ministries, operational and maintenance costs are considered expenses under the local public budgeting. This is often the reason for government subsidies allocation in two different streams: one for capital grants and another for operations. This results in the loss of optimization in the use of public funding in the project. Governments are required to enhance multi-year budgeting by improving transparency over multi-annual commitments, assessing fiscal space for new projects, establishing capital budget ceilings, or publishing existing ceilings.

Based on the Economic and Social Survey of Asia and the Pacific, the developing Asia-Pacific region will need US\$840 billion of additional costs annually in the transport sector, US\$454 billion in the energy sector, US\$141 billion in the ICT sector, and US\$114 billion in the water and sanitation sector to fill the infrastructure shortages, maintain existing capital stock, and provide new infrastructure to meet the growing demand (United Nations Economic and Social Commission for Asia and the Pacific, 2019). The survey suggests that a huge amount of these infrastructure savings could be achieved through better planning and coordination, better project selection, and more efficient implementation.

4.2. Preparation phase's challenges

Once the “investment decision” in the previous phase is complete, a project can move to the preparation phase. By the end of this phase, the government should have conducted the value-for-money analysis to determine the best way to procure infrastructure services as a “procurement decision”. The preparation phase's issues and solutions are listed in **Table 2**.

4.2.1. Improving governance

While the strength of public governance is important throughout the WLC, it is more crucial in the initial phases, i.e., planning, preparation, and procurement. Without transparent and strong governance in place, countries could not prepare sound projects for the procurement decision. Limited and selective feasibility studies due to weak governance could end up with uncompleted projects that spoil public resources. Using incentives for public officials and personal penalties; taking anti-corruption practices; developing preparation frameworks, guidelines, and standards; posting information online; encouraging unsolicited proposals; and using external advisors could help improve governance.

4.2.2. Project preparation framework, guidelines, and standards

Simplifying the enabling environment for project preparation makes a better-quality project. The enabling environment constitutes a) comprehensive legal framework applicable to the project; b) appraisal guidelines for feasibility studies, value for money (VFM), fiscal risk management (FRM),

Table 2. Preparation phase’s issues, solutions, tools, and references

Issues	Solutions	Tools & References
Governance & Environment		<ul style="list-style-type: none"> • World Bank PPP reference guide <i>Tools from:</i> <ul style="list-style-type: none"> • Global Infrastructure Facility • ADB (Asia Pacific Project Preparation Facility, AP3F) • Global Infrastructure Hub
<ul style="list-style-type: none"> • Corruption • Lack of transparency • Lack of leadership • Lack of framework, guidelines, and standards • Lack of adequate project preparation budget and skills 	<ul style="list-style-type: none"> • Incentives for public officials, personal penalties • Anti-corruption practices • Preparation framework, guidelines and, standards • Use of external advisors 	
Project Appraisal		
<ul style="list-style-type: none"> • No comprehensive costing • Old costing systems • Exclusion of O&M • Cost overruns and delays 	<ul style="list-style-type: none"> • Comprehensive WLCC 	

and cost-benefit analysis (CBA); and c) environmental, legal, social, gender, disability, disaster risk management, poverty analysis considerations, etc. Governments can also reinforce their stakeholder engagement and consultation policies to determine the best investment design to maximize the utilization of services. However, all these studies take time and resources to prepare. Oftentimes, governments do not have the capacity to appraise the projects and are under time pressure to provide information. This leads to unidentified risks and low returns in the project and ultimately to the misuse of public resources.

4.2.3. Project preparation capacity and budget

The lack of adequate project preparation budget and skills are widespread in developing countries (Hurley *et al.*, 2019). Despite many efforts by governments, oftentimes there are not enough regular budgetary resources to conduct complex appraisal reports. Procuring authorities are competing with many priorities and hiring external advisors becomes an added cost instead of a necessity. Incentives are aligned to increasing the processing speed of a project and not enhancing the strength of the analysis. Evidence shows that, when possible, the use of external advisors can help to improve efficiency. For instance, Coc San, a 29.7-megawatt hydropower project in the Lao Cai province of Vietnam, used the advisory services of InfraCo Asia and began operations in 2016. Before the involvement of InfraCo Asia, insufficient levels of due diligence work, project safeguards, and risks of the project resulted in delays in the early stages of the project because of its lenders’ and investors’ uncomfortable feeling. InfraCo Asia was thus included to provide the development expertise and advisory services to restructure the Coc San project and commission environmental and social impact analysis to World Bank and IFC standards. It resulted in improving the bankability of the project and obtaining US\$23 million of debt financing from SHB (Zen, 2019).

4.2.4. Comprehensive WLCC

Costing needs to be done on the design- and market-based pricing. However, in reality, costing is based on an old system of unit prices with little consideration for new technology, modern materials, engineering designs, international contractors, indexation, etc. Governments are used to public procurement contracts and do not necessarily understand the need for updating the unit costing developed many years ago. The inclusion of operations and maintenance has not been a routine

practice and would entail fundamental policy changes. WLCC would require a deep understanding of the asset and its utilization, which would, in turn, require detailed studies. The plans for many infrastructure projects are based on the estimated capacity, such as traffic loads, or on production forecasts, such as those for oil and gas developments. While governments may pay attention to developing the base case, they put insufficient effort into evaluating alternative scenarios that could affect the success of the asset or require expensive modifications. Thinking harder about the worst-case scenarios during planning would make governments do a better job of ensuring that they have the flexibility to cope with unexpected events. In other words, sensitivity analysis and scenario planning mitigate the risk and enhances the predictability of the project outcomes.

Costing should be dynamic and founded on the on-the-ground information. During the design and construction of projects, countries could reduce capital investment by using the concept of design-to-value (i.e., designing based on understanding and minimizing the elements that drive up costs) and the minimal technical solution (MTS) (i.e., designing to deliver only the necessary value-added requirements).

4.3. Procurement phase's issues and solutions

The “procurement decision” in the previous phase serves as the starting point for this phase. By the end of this phase, a government should have optimized its public funds into the project as a “financing strategy decision”. The procurement phase’s issues and solutions are listed in **Table 3**.

4.3.1 Transparency and disclosure

An open environment with a transparent tendering process will encourage competition. Procurement is susceptible to corruption and rent seeking because of its complexity, long life, large capital outlays, and natural monopoly characteristics. Increasing the levels of transparency can minimize some of these shortcomings often associated with infrastructure sectors. Transparency in procurement at the project level should be aligned with government disclosure practices at all levels. It is also helpful to develop project appraisal guidelines, including cost-benefit and risk analyses.

Table 3. Procurement phase's issues, solutions, tools, and references

Issues	Solutions	Tools & References	
Governance			
<ul style="list-style-type: none"> Lack of transparency and disclosure 	<ul style="list-style-type: none"> Creating an open environment Developing appraisal guidelines (including cost-benefit and risk analyses) 	<ul style="list-style-type: none"> World Bank PPP reference guide EIB APMG PPP Certification Reference Guide World Bank Disclosure Information 	
Market			
<ul style="list-style-type: none"> Lack of effective market assessment Absence of a strong private sector and financial institutions 	<ul style="list-style-type: none"> Effective market consultation Collect and integrate feedback 		
Tendering Process			
<ul style="list-style-type: none"> Lack of clear and standard process Lack of central authorities Lack of sectoral units 	<ul style="list-style-type: none"> Standardized tendering process Forming central and sectoral units 		
Budgeting			
<ul style="list-style-type: none"> Lack of standard and model contracts High transaction costs 	<ul style="list-style-type: none"> Consistency in commonly used contractual provisions Sector-specific contracts 		

4.3.2. Market assessment

An effective market consultation improves project structuring and outcomes by bringing pertinent perspectives to the project at an early stage. Market assessment helps with gauging the landscape for potential contractors, suppliers, and lenders interested in the project. This gives an opportunity to the public sector to collect and integrate feedback into the project structure to maximize the purpose. When it comes to large and complex infrastructure projects, many countries face the absence of a strong private sector and financial institutions both domestically and internationally. This results in the lack of competition, constraining value for money. Market forces work best when there is a full and open competition. To benefit from private participation, the selection process should be performed diligently to assure that a qualified private partner is selected via a competitive process.

4.3.3. Standardization of tendering process

The standardization in the bidding process sets clear expectations. The public procurement environment of a country is the atmosphere in which infrastructure development happens. To deliver efficient infrastructure, the procurement processes and bid management frameworks need to be standardized, transparent, and non-exhausting to bidders. Once the rules of engagement are clear, bidders can adjust to the conditions set by the government. However, in most countries, there is no single authority that can serve as a one-stop-shop, such as a PPP unit, to provide these rules based on an enforceable and transparent legal framework. PIMA results recommend governments to integrate PPP management into the overall PIM framework to enhance the coherency of the entire process.

4.3.4 Consistency in contractual arrangements

Bringing consistency in commonly used contractual provisions safeguards both the public and private sectors. A contract serves as the main document defining the terms and conditions between the procuring authority and the contractor. While some of these conditions are standard and repetitive, some need to be customized for the project. If the government can standardize the mandatory and most frequently used clauses, then it can save transaction costs for both sides. A model contract with some standard drafting for particular legal issues that are likely to be similar across multiple contract types, such as force majeure, termination rights, or dispute resolution, could be a starting point. However, there should be a balance between the standardization and the customization of contracts. In the case of infrastructure projects, there may not be a one-size-fits-all contract that could cover projects in all sectors and levels of complexity. Sector-specific contracts are generally more applicable. Examples of countries that have sector-specific PPP contracts and clauses include India (for railway, ports, and roads), South Korea (for road projects), United Kingdom (for waste projects and schools), and the United States (for roads). India's model concession agreement for ports includes standard definitions, implementation agreement, and port services agreement. The document can be further adapted to specific circumstances.

4.4. Implementation phase

This phase will be based on the “financing strategy decision” in the previous phase. By the end of this phase, governments should have managed the contract and utilized the investment to achieve the value for money envisaged while planning. This should be the result of an “asset management strategy”. The implementation phase's issues and solutions are listed in **Table 4**.

Table 4. Implementation phase's issues, solutions, tools, and references

Issues	Solutions	Tools & References	
Contract Management			
<ul style="list-style-type: none"> • Too much interference and micromanaging • Overspending public resources • Harming private sector's innovation 	<ul style="list-style-type: none"> • Systematic and well-structured contract management approach 	<ul style="list-style-type: none"> • World Bank PPP reference guide • O&M information systems/ database • ERP Systems • Project Management tools • Contract management cases (Japan) 	
Role of Government			
<ul style="list-style-type: none"> • Lack of clear role of government throughout the asset life cycle 	<ul style="list-style-type: none"> • Continued monitoring role of government • Effective dispute resolution mechanisms 		
O&M			
<ul style="list-style-type: none"> • Lack of systematic and periodic operation and maintenance • Operational costs on infrastructure users 	<ul style="list-style-type: none"> • Maintain the existing infrastructure properly 		
Asset Management			
<ul style="list-style-type: none"> • Cost overruns and delays • Ad hoc interventions • Lack of total asset management 	<ul style="list-style-type: none"> • Boost asset utilization • Optimize maintenance planning • Expand demand management 		

Implementation receives the least attention. The fact that the contract has been awarded to a private company generates a state of complacency among public authorities. This is especially true for large and more complex projects where the government has been working extremely hard to get the project to the market. Once the contract is awarded, it is handed over to another unit, if at all. However, this is the phase when public resources are spent, which can have a larger impact on the risk-return profile of the project. More importantly, the results and outcomes are delivered during this time to serve the needs which were identified to begin with. This phase is long and can span multiple political cycles. In the Latin America region, for example, timely implementation can increase efficiency, with savings that could reach up to 0.49 percent of the regional GDP. Additionally, more efficient practices could reduce cost overruns by 26 percent, saving annually more than 0.65 percent of the regional GDP (Suárez-Alemán, *et al.*, 2019).

4.4.1. Contract management strategy

A systematic and well-structured contract management approach is needed for both publicly procured and PPP projects. Traditionally, countries with a history of many public procurement experiences tend to have a large government body and the rigidity to shift to newer, more efficient methods such as PPPs. These governments, therefore, tend to manage PPPs like traditionally procured projects by too much interference and micromanaging. This approach will not only lead to the overspending of public resources but also harming the private sector's innovation, cost management, and efficiency. The procuring authority should have a system to manage the implementation of the infrastructure contract, including establishing a contract management team; involving some contracts management team members in the project, initiating at the procurement stage; and employing implementation manuals and risk mitigation mechanisms. A monitoring and assessment system for tracking the progress and completing the construction works, with relevant information made publicly available, could be dedicated to the project.

4.4.2. Continued role of the government

Irrespective of public or PPP procurement, the government will continue to have a strong role in the implementation of the investment. Some functions which the government will retain, but not limited to, are a) measuring performance and payments, b) appropriating budget and availability of government payments on time, c) managing environmental and social risks, d) overseeing regulation response and enforcement, e) engaging stakeholders during the life cycle, f) continuing land acquisition, and g) providing permits and licenses. The government needs to respond to specific events (e.g., force majeure, material adverse government action, change in the law, and refinancing) that may happen during the asset life cycle. At the same time, dispute resolution mechanisms will be needed to allow the parties to resolve disputes in an efficient and satisfactory way without adverse effects on the project.

4.4.3. Focusing on operations and maintenance

The lack of systematic and periodic operation and maintenance will not only increase the cost to infrastructure providers but also impose operational costs on infrastructure users. Once the infrastructure is built, the public sector often takes for granted that the infrastructure will continually provide services at the expected level of quality. However, infrastructure non-linearly deteriorates over time in such a way that is not visible until the moment when routine maintenance can no longer avoid the damage. At such point, an even more expensive rehabilitation is required. For instance, deteriorated roads cause vehicle depreciation, increased travel times, higher gas consumption, and more accidents. In addition, the lack of power infrastructure maintenance increases electricity losses, power tripping, system instability, breakdowns, and fires (Rioja, 2016). The lack of maintenance can also lead to humanitarian catastrophes. A recent example of that is the collapse of a bridge in Genoa, Italy, that cost 43 lives. Preliminary investigation results suggest that the cause of the collapse was the corrosion of its steel stays. According to the private operator, the maintenance costs for bridges in the region were four times higher than average (Glanz *et al.*, 2018). Therefore, instead of pushing for new infrastructures as the only way to improve the delivery of services, it is better to maintain the existing infrastructures properly.

From the political perspective, however, the construction of new infrastructures is more attractive than maintenance. Limited resources, poor execution capacity, corruption, favoritism, and rent-seeking opportunities during the bidding process are among the main reasons for ignoring maintenance. Even the media, especially in non-developed countries, place a lower value on maintenance projects until tragedies occur, before calling attention to deferred maintenance (Maraña *et al.*, 2017). Setting aside the required funds and performing regular maintenance prevent extra costs. For instance, in the United States, every \$1 spent on preventive maintenance saves \$4–\$10 in future repairs (Kahn and Levinson, 2011). Africa spent \$45 billion on rebuilding and rehabilitation in the mid-1990s because of not investing \$12 billion in periodic maintenance of roads during the 1980s (de Richecour and Heggie, 1995). In addition, in the case of Peru, evidence shows that the country spent seven times more bringing deteriorated roads back into operation than it would have spent for the regular maintenance of the roads between 1992 and 2005 (Serebrisky *et al.*, 2017). Hence, to eliminate fiscal rule limitations, it is suggested to classify maintenance as an investment expenditure instead of current expenditure. It can allow for greater participation in the budget, increase financing sources, and ensure the continuity of maintenance.

4.4.4. Moving towards Total Asset Management

There is an urgent need to move away from ad hoc interventions to put out emergency fires and move towards “Total Asset Management”. Total asset management as a concept is much broader and includes contract management, performance management, financial management, and the handover of assets. To get the most benefit from existing capacity, governments should boost asset utilization, optimize maintenance planning, and expand the use of demand management techniques to reduce the need for additional infrastructure, all of which could also justify private participation in infrastructure development.

4.5. Capturing financial inefficiency

A better approach to achieve financial efficiency would be to maximize purpose and not profit. Normally, governments have many ways to enter into a contractual relationship. The relationship requires fortitude to make certain the best way to structure the government support in the project. While a government’s objective will be to maximize returns for the users, a private company will focus on its own returns. The overall project can benefit from moving towards “purpose maximization”. The imbalance between risks and rewards for all stakeholders involved makes the procurement of infrastructure difficult. The issues and solutions related to financial inefficiency are listed in **Table 5**.

4.5.1. Optimizing government support

The challenge is to optimize financing options that will maximize the benefits and the economic internal net present value (eNPV) to governments and minimize the public money spent. Sometimes, governments may seek to financially support a project to make it bankable and affordable to the users. Government support can be in many ways, such as direct payments in the form of capital grants, availability payments or indirect payments in form of subsidy, tax incentives, guarantees, and regulations. It would be in the interest of governments to determine the right financial structure of the payments, just as the bidders develop their own financial model. While the project should have one financial model at the time of financial close, during the procurement phase, the public sector needs to optimize its own economic and financial analyses. Therefore, a financial model is required

Table 5. Financial inefficiency’s issues and solutions

Issues	Solutions
Government Support	
<ul style="list-style-type: none"> • Lack of proper financial model • Weak assessment of financial and risk structures 	<ul style="list-style-type: none"> • Proper financial model to optimize government supports • Monitoring long-term commitments and contingent liabilities
Long-term Fiscal Affordability	
<ul style="list-style-type: none"> • Promising too much without understanding the consequences • Too much burden for the government in the future 	<ul style="list-style-type: none"> • Improving transparency over multi-annual commitments • Better assessment of the fiscal space for new projects
Changes	
<ul style="list-style-type: none"> • Unexpected difficulties do arise once contracts are underway 	<ul style="list-style-type: none"> • Renegotiation strategy and continuous monitoring • Contract variation strategy
Debt Changes	
<ul style="list-style-type: none"> • Change of terms and conditions of debt 	<ul style="list-style-type: none"> • Refinancing gain-sharing arrangements

to work as the basis for financing options in which a win-win balance will be found between the prospective net present value (NPV) of the private partner and the eNPV to the government (World Bank Group, 2016). Without a proper financial model, no sensitivity analysis can be performed to optimize resource usage and enhance efficiency. The lack of such decision framework will result in a weak assessment of financial and risk structures.

4.5.2. Safeguarding long-term fiscal affordability

Public resource optimization will go hand-in-hand with fiscal responsibility. Governments should be aware and monitor total liabilities (both direct and contingent) in the long term from all infrastructure projects. Promising too much without understanding the consequences may result in too much burden/commitment for the government in the future. This will be a critical constraint to efficiency, especially for countries with volatile exchange rates and inflation levels. In addition, to enhance multi-year budgeting, IMF results propose country-specific measures, including improving transparency over multi-annual commitments, better assessment of the fiscal space for new projects, establishing capital budget ceilings, or publishing existing ceilings. Many countries have started to adopt fiscal responsibility laws, which provide guidelines to the authorities on availability and limitations. Infrastructure investments are capital-intensive, which means that governments must spend money. The governments' strategy should be to determine the best way to spend the resources. Based on a 2017 IMF report, around 14 countries have fiscal rules in Asia and the Pacific region¹ (Lledó *et al.*, 2017).

4.5.3. Renegotiations

Changes during contract life should be expected and managed. One of the lessons learned from past long-term contracts is that there is no such contract as a “static” agreement that withstands the pressure of change. Despite good intentions and iron-clad contracts, unexpected difficulties do arise once contracts are underway. As a result, renegotiations are a growing trend in international business.

Most successful renegotiations have been due to the principle that both parties take the contract as an outline and negotiate in good faith. Both sides have a renegotiation strategy and monitor the agreement continuously. While contract renegotiations have been successful in some cases, they have resulted in time and cost overruns during project implementation in several instances (Acerete *et al.*, 2010). The main reasons for renegotiations include faulty contract design, defective regulation, demand overestimation, inflexible contracts, and changing construction risks. In Portugal, the renegotiation of PPP transport project contracts resulted in high repayment by the public sector for a long period in order to offset cost (Sarmiento and Renneboog, 2014). In Spain and Latin America, renegotiations resulted in tariff adjustments, revisions of cost components, adjustments of the annual fee paid by the operator to the government, extension of concession contracts, and increases in the future costs of service for the users (Guasch *et al.*, 2014). In addition, about 70 percent of PPPs in Asia are renegotiated because of currency risk, most of which resulted in increased subsidies and financial compensation for the private partners (Reside and Mendoza, 2010).

¹ Australia, Hong Kong, China, India, Indonesia, Japan, Malaysia, Maldives, Mongolia, New Zealand, Pakistan, Russian Federation, Singapore, and Sri Lanka have specific rules on fiscal responsibility to control their budget and debt in order not to exceed certain levels.

4.5.4. Refinancing

Refinancing will occur when the terms and conditions of the debt are revised. The revisions oftentimes result in potential savings on the debt payments from a new agreement. Generally, contracts have a refinancing gain-sharing arrangement between the parties, affecting the financing efficiency of the governments.

4.5.5. Contract variations

Any variation which results in the reassessment of public resource allocation should ensure the retention of value for money and financial efficiency. A variation is a change to a contract. A variation to a contract could include, but not be limited to, a change to the service level or type, product, delivery, time frame, personnel, contractor, or price. As a contract constitutes a legal agreement between the parties, there are both legal and cost considerations to be considered prior to executing any change.

4.6. International practices

4.6.1. Governance, institutions, and regulations

Reforming institutional arrangements enhances public efficiency. OECD countries have employed several approaches to reform institutional arrangements and enhance public efficiency. Examples include increasing devolution and decentralization, strengthening human resource management (HRM) structure and arrangements, changing budget practices and procedures, and introducing results-oriented approaches to budgeting and management (Curristine *et al.*, 2007). Among them, evidences show that decentralization and appropriate human resource management may improve efficiency. In addition, OECD countries have decided to increase the use of performance information in the budget processes with the aim of moving the focus of decision-makers away from the inputs towards measurable outcomes. It requires a comprehensive and long-term planning framework for the entire government and incentives to motivate civil servants and politicians to change their behavior.

Simplifying procedures and regulations supports efficiency. To enhance public efficiency, China has taken several measures to use simpler, more straightforward procedures and balanced market regulation for easier market access, fair competition, and greater consumer safety. The decisions include delegating more than 200 administrative approvals to local governments since 2013 and dropping more than 20 central government certifications and evaluation requirements (Zhang and Hu, 2017).

Tracking and recording public efficiency is a fundamental basis for efficiency improvement. For example, the UK Office for National Statistics publishes statistics on the productivity of public services. Analysis of the case studies and evidences on both technical and allocative efficiency for the UK suggest that the key broad drivers of public sector efficiency improvement include the use of markets and competition, service redesign and alternative delivery mechanisms, organization and workforce drivers, technology, data and targeting, and hard budget constraints and spending flexibility. It shows, for example, that placing hard budget constraints can increase efficiency. It concludes that, in particular, service redesign, the use of markets and competition, and the use of new technology and data can significantly improve efficiency (Aldridge *et al.*, 2016).

One way to assess whether public funds are spent economically, efficiently, and effectively in compliance with the existing rules and regulations is to establish well-functioning supreme audit institutions (SAIs) as the lead public sector audit organization in the country. SAIs can contribute to public efficiency improvement by confirming that services are being delivered efficiently and suggesting ways in which the government can operate better. However, in many countries, SAIs lack the independence, resources, and skills to perform the high-quality audit required by governments, parliaments, citizens, the media, and the development partners. OECD (2014) presented several good practices in supporting SAIs.

4.6.2. Benchmarking

Benchmarking against comparable countries is necessary to ensure that a country is on the right track in its attempts for efficiency improvement. Experience shows that a minimum level of quality in several public factors (e.g., governance, regulations, and institutions) is required to deliver quality services. Recently, Suárez-Alemán *et al.* (2019) reported that regulatory quality, government effectiveness, rule of law, and the control of corruption are highly correlated with infrastructure efficiency. These results show the potential efficiency gain by strengthening these factors. Countries should take a balanced approach to simultaneously improve their several weaknesses. Correcting one aspect (e.g., transparency) without reforming others (e.g., rule of law, planning frameworks, and control of corruption) may not help a lot. On the way to increase infrastructure efficiency, countries could learn from the best practices. To do so, benchmarking against comparable countries is necessary. It is crucial to identify homogenous peer groups with as similar as possible income level, population, and density and benchmark the corrective practices.

4.6.3. Open government

Effective collaboration with citizens and civil society is the main part of the solution to build effective, transparent, and accountable institutions and thus to improve public service delivery. In other words, reforms for an open government are a great way of unlocking the ideas and capacity of citizens and civil society. Recent experiences in Asia, in particular, demonstrate the significant role of citizens in improving public service delivery. Examples include Pakistan's Citizen Satisfaction to create a standardized feedback loop for governance and service delivery, Afghanistan's Community-Based Monitoring of Schools to increase transparency and accountability and enhance the quality of education services, and health-sector initiatives in Sri Lanka to create a transparent policy that provides safe and affordable medicines for all. In Indonesia, under the Pencereh Nusantara program, the government and the civil society institutionalized a system in remote and underdeveloped areas to solicit the citizen's feedback to improve the efficiency of the public health programs. The results of the three-year implementation show significant improvements in public health services. As a result, the Indonesia's Ministry of Health decided to scale up the program to the national level. In the Philippines, Construction Sector Transparency Initiative (CoST) estimated that around 30 to 50 percent of the infrastructure budget gets lost in leakages. Citizen Participatory Audit program has therefore established citizen feedback and service delivery in flood control, health facilities, solid waste management, and building schools. As a result, the Philippines Commission of Audit reported significant savings due to the implementation of the program. Mongolia has defined the Check My Services program to evaluate public services based on the citizen scorecard program. Forty thousand requests in 84 public services resulted in improving several public services.

4.6.4. Digitalization

Asia's digital revolution is even changing the way the region's governments operate. Digitalization helps governments have greater access to timely and accurate data. The use of digital technology can improve service delivery, tax compliance, and the efficiency of government spending. In India, the Aadhaar identification system is the world's largest biometric identification system, which provides a unique 12-digit ID number for 1.2 billion residents. Linking the system to various social programs, including subsidies on liquefied petroleum gas, helps prevent claims from ghost beneficiaries or multiple claims and helps bypass dealers. The Philippines's Listahanan digital registry program covers 75 percent of the population and serves as a gateway for as many as 52 social programs, ranging from cash transfers to emergency assistance. In Indonesia, digital social registries have also helped increase the coverage of conditional cash transfer programs. The Government of Bangladesh uses smart water meters to monitor water quality. In Bhutan, the government has standardized project appraisal and selection for public investment using an e-tool. In Singapore, Malaysia, Vietnam, Indonesia, and Thailand, e-filing, e-payments, and e-customs initiatives in tax administration are common (Gaspar and Rhee, 2018).

5. Conclusion

The status quo cannot continue. Focusing on only new construction and not enough on maintaining existing infrastructure is not sustainable. Generally, 20 percent of infrastructure inefficiency is related to the challenges during project planning and identification. The public sector needs to think smart and not more. Smart means a working efficiency with what the government has. With a fixed pot of money, what should the government do? Difficult questions should be addressed, such as that commercially suitable projects should not be financed using public funds. What changes need to be made in order to facilitate private sector participation in the project? Instead of asking what the private sector can do, governments need to ask what they need to do. They need to put the public procuring authority in the driver seat and bring in the private sector as the co-pilot, and they need to put in place transparent, clear, and consistent procedures so that the private sector can do what contractually they are supposed to do. Governments need to change the government's strategy by demanding purpose maximization instead of profit maximization and change the regulations and bidding arrangements to seek the private sector's support to capitalize on impact investments. Governments also need to bring in the stakeholders to understand what purpose means, not just for today but also for the future. They need to adopt all four pillars of efficiency. Public efficiency, infrastructure efficiency, financial efficiency, and asset management efficiency are parts of the same tree. One cannot be achieved without the other. In order for a successful public infrastructure program to thrive, all pillars need to withstand the rigors of time. Last but not least, the use of technology is emerging as a strong solution. ICT can be a problem solver, reduce transaction costs, and increase information sharing and transparency of public services. With anything new, comes many pitfalls. Governments need to prepare and embrace information technology, while managing information technology solutions.

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