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Chapter 10: Public-private partnership models for enhancing built environment sustainability

10.1. Introduction

The sustainability of the built environment is one of the crucial issues faced by humanity. In the endeavor to enhance the sustainability of the built environment, the partnership between the public sector and the private sector has developed gradually over the years, with an increasing interest from scholars and practitioners alike (Paleti et al., 2024; Singireddy et al., 2024; Koppolu et al., 2023). However, despite the increasing emphasis on and wide practice of public-private partnership in this area, the existing theoretical studies lack holistic and exploratory research and tend to be based on single theories instead of comprehensive ones. By reviewing the subsets of 'sustainability' and 'built environment,' the paper suggests that built environment sustainability is characterized by the merging of public and private projects in the built environment, in the development process that covers the whole project life cycle through the private sector organizing and financing the creation of new assets or operating and managing existing assets to meet public needs, through the integration of public partners that contribute to political, social, ecological, and community wellness. This definition implies that sustainable development will happen only under the condition of both public and private benefits and could cover all areas of the built environment. These, in turn, imply that public-private partnership models for the financing, development, operation, and maintenance of the built environment will respond in a more adaptive manner to functions that meet public needs and generate public benefits within public built environment projects.

10.1.1. Overview of Public-Private Partnership Dynamics

A common pejorative criticism of the construction industry and of project organization is to ask what the industry has done to enhance its professionalism and to tackle long-standing and enduring problems, such as ever-increasing industry inefficiency, waste, and the adversarial climate that historically plagues large construction projects. This last problem is one that has not bedeviled all project sectors; in particular, the power project sector of the 1970s and 1980s, with its high proportion of pioneers, entrepreneurs, and large numbers of international contracts and contractors, had much less of a problem than the process-plant sector, and indeed, the construction industry as a whole. Consequently, it is necessary to examine what is meant by improved sector performance, its guardian, sustainability, and to question how the industry is adapting to evolving client organization structures and procurement practices. This chapter examines the process through which procurement-based problems that have bedeviled the construction industry are being resolved through the application of public-private partnerships within a growing number of national economies and within many of the world's developing countries. Preliminary analysis suggests that these procurement models potentially allow for financially sustainable public infrastructures to be delivered cost-effectively and with the minimum of life-cycle costs while, at the same time, the move towards asset procurement and building performance also begins to allow environmental agencies, client organizations, and all stakeholders involved to assess whether or not these shared resources are being sustainably managed. As such, this innovative procurement concept has the potential to deliver a more professional, more sustainable, and environmentally aware construction environment.

10.2. Understanding Public-Private Partnerships

Public-private partnerships are contractual arrangements between the public and private sectors that allow for more private sector participation than traditional public sector procurement contracts. The fundamental differences between PPPs and traditional procurement are that the private sector plays a more significant role in the development, financing, or operation of a facility, infrastructure, or service; the private partner typically assumes more operational and financial risks; and the existence of long-term contracts. Ultimately, a PPP is a joint venture between the public and private sectors, each of whom has different objectives and motivations in pursuing a partnership. A private contractor or consortium formulates a bid to construct and operate a project in exchange for long-term revenues. However, the public sector can also be involved in the project on behalf of taxpayers and could also be represented by user representatives such as consumer groups (Jeevani Singireddy, 2022; Sneha Singireddy, 2023; Paleti et al., 2024).

Public-private partnerships are a form of doing public business by involving private sector institutions. The term partnership refers to the contractual form that it takes under an appropriate risk allocation. It seeks to bring together the financial, managerial, and technical capabilities of the private sector and the competitive efficiency of the private sector to provide public infrastructure and related services to achieve development objectives. While the company's financial and operational strengths can be transferred to the project, it can also provide financing to help meet funding needs. Conversely, the government provides risk-sharing, revenue guarantees, and credit support. Governments could also offer tax credits or grants, public equity investment, or land grants, including real estate rights. The public-private partnership is an agreement between a government sector and a private sector partner to deliver a service as specified in a service contract, and it fulfills a public need. It typically involves a transfer of operations, management, investments, or a combination of these from the government sector to a private sector company or consortium.

10.2.1. Definition and Key Concepts

Sustainability tends to embrace three issues: environmental conservation, economic satisfaction, and social well-being. Recognizing these needs, it is essential to stress the importance of dealing with sustainability as it concerns all three issues. The synergistic interaction among these three topics finds its ideal framework in what is termed the ‘three-legged stool’ of sustainability. In the context of the built environment, planning the use and management of resources to provide fulfilling lives by achieving sustainability must seek to integrate planning, design, engineering, construction, and management in a holistic process. Serious consideration should be devoted to reducing the environmental impact of industrially produced products as well as the built environment. Creating a more efficient and ethical supply chain requires a high degree of interdisciplinary activity in any public and private activity designed to improve the sustainability performance of the built environment.

One common definition of a PPP is a long-term, contractual partnership between a public sector authority and a private party for the provision of public services, where both parties share the value and risk of that partnership. Long-term contracts are an important feature of PPPs for the provision of public infrastructure and services. In many cases, rather than being based on build and operate, they are based on a life-cycle approach. Properly structured PPPs align the incentives of all the parties involved, including the service users; the problem is that not all PPPs are properly structured. Some critics of PPPs suggest that a typical characteristic of PPP contracts is a significant emphasis on output-based specifications, which considerably reduces the flexibility of the public

sector client and the assembled project team to implement any future in-service changes that could provide the initiative with additional value.

Fig 10 . 1 : Public–private partnership as a driver of sustainable development

10.2.2. Historical Context and Evolution

Environmental sustainability is not an entirely new concept. In both ancient and medieval times, development ideas incorporated elements of environmental protection and utility by encouraging conservation and recycling. The link between the built environment and human settlement has been well documented in ancient Greece and Rome. Nations historically have had an affinity and respect for their natural environment and a recognition of the economic importance of the environment. However, it was only in the twentieth century that people began to realize the severity of the environmental problems faced due to human actions and started using the term 'sustainability'. The

study and practice of sustainable development have been ongoing for more than two decades already. In many ways, environmentalism is also a legacy of the modern age. As a global issue, environmental problems are not restricted to contemporary society. Ecosystem meltdown can be seen in a historical context as an inevitable consequence of the increase in the scale of human intervention in nature. Periodically, the scale of the disaster has compelled communities to cobble together some version of a global emergency response. The two world wars and, more recently, the Cold War were events that, in their own way, distracted nations from the path that was eventually resumed when peace broke out. Environmentalism shares something with these warning signs in the sense of being a reaction to a perceived state of crisis. Their presence tells us something about how environmental problems are viewed by different generations. The two world wars and the Cold War antedate the alliances that meet to fight famine.

10.3. The Built Environment and Sustainability

In the last decade of the 20th century, words such as environmentalism, sustainability, climate change, energy conservation, and energy efficiency received worldwide attention. Within those considerations, urban areas were highlighted as destined to play a key role in global trends. Nowadays, nearly half of the world's population – over 3 billion people – live in cities. This percentage is expected to increase in the future, with urban areas anticipated to accommodate over two-thirds of the world's population by 2050. It is also observed that a significant portion of the human population is quite dispersed along the ocean, occupying building concentrations with a strong competitive, cultural, and historical presence in the coastal zone, constituting ultra-specialized areas, that is, with evolved or excellent levels, and therefore highly vulnerable.

To keep in mind that one more generation is to be guaranteed as existent until today, architects and engineers should seriously consider three principles: (1) sustainable development that meets the equilibrium between economic progress, social development, and environmental quality, guaranteeing the needs of the present without compromising future generations; (2) universal accessibility that meets the needs of all user categories, that is, compatible with diverse human abilities; and (3) electromagnetic field immunity that protects users from exposure to pollution. Of course, this subject is not a new one and, in fact, brings back many classic rules of the old construction masters. However, during the last decades, there has sometimes been a lack of care given to this matter, or even an underestimation of the real perils of the situation today and their related consequences.

10.3.1. Defining the Built Environment

The built environment comprises all man-made or modified structures and spaces, which can include anything from buildings, infrastructure, and utility-scale renewable energy facilities to residential-scale rooftop photovoltaic systems. The collectively constructed, finished environment is assembled into such a diversity of spaces and scales that it can be subdivided into various disciplines of study, each uniquely structured to deliver the techniques needed to design, develop, modify, and operate the built environment. Furthermore, each component of the built environment represents a different function or utility to support and advance the well-being of the urban communities that surround them. Together, the built environment and the urban communities serve as the foundations for complex urban systems that transcend the famous label. The built environment and urbanizing population represent societal contributions that are expected to bring about a more prosperous, healthy, and sustainable lifestyle while effectively protecting the expanding world economy and the natural and, arguably, the planned, balanced evolution of resource use that underpins it.

10.3.2. Importance of Sustainability in Urban Development

Sustainable urban development focuses on employing urban space and infrastructure to meet the needs of the present without compromising the ability of future generations to meet their own needs (Jeevani Singireddy, 2022; Sneha Singireddy, 2023; Paleti et al., 2024). There are two main dimensions of urban development. The first is efficiency in meeting the basic requirements of clean air, water, food, energy, health, education, and shelter, the so-called "resource functions" of cities. The second dimension focuses on the impact of urbanization on the environment, taking into account the natural water circulation and purification through infiltrative wastewater systems, the potential of cities to generate food through urban agriculture and recirculation of resources in the urban context, the possibilities for energy and housing with the best possible energy performance, a beneficial microclimate, etc. This balanced approach to urban development must be integrated and should cover all sectors of integration for sustainable urban development.

The sustainable urban resource management strategies involving water supply, sanitation, electricity, and energy might compete, and the required education might not allow for the coordination and integration in the required concern for the total built environment. The different values attached to urban development benefits at the local, regional, national, and international levels, in combination with the present increasing international market-oriented urban policy governance, have been discovered as one of the main causes for not realizing sustainable urban development. Historically grown urban patterns and inadequate allocation of urban land for private and common use make

it difficult to achieve sustainable development goals even when the realization of these goals would be profitable. This is the realm where public intervention may be indispensable.

10.4. Models of Public-Private Partnerships

The P4 and E4 partnerships described above are part of the growing number of PPP models in the marketplace that are demonstrating the ability to help governments meet a variety of strategic goals in new ways. These goals might include providing goods or services directly, promoting economic development, fostering public health, ensuring public safety, protecting the environment, or preserving and maintaining significant cultural or historical heritage, as well as creating opportunities for disadvantaged segments of society. Fully committing to the most sustainable form of facilities development possible is often at the heart of these partnerships.

The new PPP models that are being developed are based on a wide variety of different structures that interface with the private sector in different ways, and on a wide variety of different legal and regulatory frameworks and practices. The relationship between the public and private partners is as different as the types of goods and services being provided, the policy goals that are being promoted, the technical complexity of the challenges to be overcome, and the institutional capabilities required. These deals span a spectrum from straightforward, short-term or service-based contracts used in a competitive, regulated market where the government pays for specific goods and services on behalf of defined constituencies; to much longer-term, vertically integrated deals for new assets in complex, highly regulated markets where many complex conditions or explicit performance requirements may exist, all of which need to be rigorously managed to safeguard the public interest, and which may need to be renegotiated over time to ensure adaptability.

10.4.1. Types of PPP Models

One of the biggest challenges faced by governments throughout the world is the need to balance funding constraints with the renewal of aging built assets. Put simply, public funds often are not available to meet the needs of schools, hospitals, housing, roads, bridges, and other public assets, but the facilities often are in need of significant upgrades. Within the built asset field, governments are increasingly looking to private companies to develop and manage public infrastructure and buildings. In business vernacular, this has come to be known as a Public-Private Partnership (PPP) in which the public sector and private sector share the resources and the delivery of services.

There are, broadly speaking, six main models of PPPs employed in the infrastructure and built asset sector: 1. The traditional – it refers to low-risk sectors where the building has a single operation such as a highway or a telecommunications network and there is no permanent connection or obligation between the public and private sectors. Once the construction phase is completed and service operations are initiated, government support is limited to normal regulation and oversight. 2. Design and build – in which the private sector builds the facility, but does not operate the facility. The public sector maintains operational responsibility. 3. Mixed concession – which includes the construction and operation of a facility for a defined number of years, after which the ownership of the facility is transferred to the public sector. 4. Leasing contracts – allowing the public sector to maintain control and ownership of the land on which a built asset stands while leasing the properties to private companies to develop buildings. At the end of the lease, the public government can decide either to extend the lease, transfer the asset to a new third party, or use the building for their own operation. 5. Long-term lease, operation, and maintenance – under which design, construction, and long-term operation and maintenance of the facility is under the private sector, and ownership rights are retained by the public sector. 6. Mixed ownership – which refers to situations where government shares ownership and control with the private company.

10.4.2. Comparative Analysis of Models

This section provides a comparative analysis of the models. First of all, the differences in institutional design and power variation mechanisms are explicitly unfolded. The purpose is to find out how specifically the various co-regulatory models cope with the complexity of working on how to direct market behavior, why special governance arrangements are made, and in what respect public and private parties have to support a joint approach. Then the identified design features are used to deduce potential strengths and drawbacks of the models tested.

One of the most striking differences is to be found in the way of linking the negotiation model and the appeal principle. If the ground rule is 'he who does not want to know—it is his own fault', it seems more likely that public regulators are willing to consider at least some elements of an independent, private part in the regulation process. In other words, with a demanding professional crowd, the only alternative is to take. The 'appeal principle' has a variable carrying capacity. It cannot stand alone, independent of other power variation mechanisms. Without any clearly formulated objectives, without guaranteeing transparency and effectiveness, without guaranteeing meaningfulness and voice of the parties concerned, without mechanisms of sanctions, simultaneously with the need for autonomy in a certain phase of the discussions and independence of decision

and control as well, the co-regulation partners and, specifically, the regulator are at best in interdependence, a matter of a 'glass half full'.

10.5. Case Studies of Successful PPPs

In this section, we discuss some successful models of PPPs in addressing sustainability challenges in the built environment, explaining their unique features, value propositions, and challenges. The cases are examples of the public working with the private, non-profit, or community sector to combine the skills, strengths, and resources of different parties to originate, develop, and implement sustainability solutions in the built environment sector. It is heartening to see how strong collaborations can bring about improvement beyond individual capabilities and resources, raising the overall sustainability profile of the built environment across the world. These cases focus more on how challenges can be addressed through PPPs, coalescing a set of actors that are stakeholders in the industry.

Governments play a unique role with funding structures that typically favor the short term when far greater benefits can arise over longer periods. By creating a mutual project where each party takes on risks and gains associated with their field of activity, PPPs can be successful. In the presented examples, public bodies remain at the center of the project as a principal with a multitude of market players. Governments rely on service providers, large infrastructure companies, property developers, and entrepreneurs for innovation. There are numerous ways to work together, with the government setting the rules of the game. These are the core PPP principles governing performance policy: risk balancing, long-term partnership, improved operational effectiveness, an emphasis on final results, use of market capabilities and private funding, and innovation. The presented PPPs all aim to achieve additional benefits beyond generating budgetary savings through innovative financing while ensuring value for money to the community.

10.5.1. International Examples

The Centre for Sustainable Cities noted that new tools in built environment planning and construction are needed to control greenhouse gas emissions and create sustainable cities. Part of the Build-up initiative's work is to promote the Land Administration and Management Model and support activities for national target setting, legislation, regulations, action planning, education, and training. Financing of these activities can be partly from national or local budgets or partly or entirely from other sources, such as public-private partnerships. The classic LAM Model is as follows, which is followed in most developed countries and applied in developing countries with projects funded by

international support: a country finances a land reform, a new mapping and land cadastre archive that is kept updated, and a survey of property boundaries.

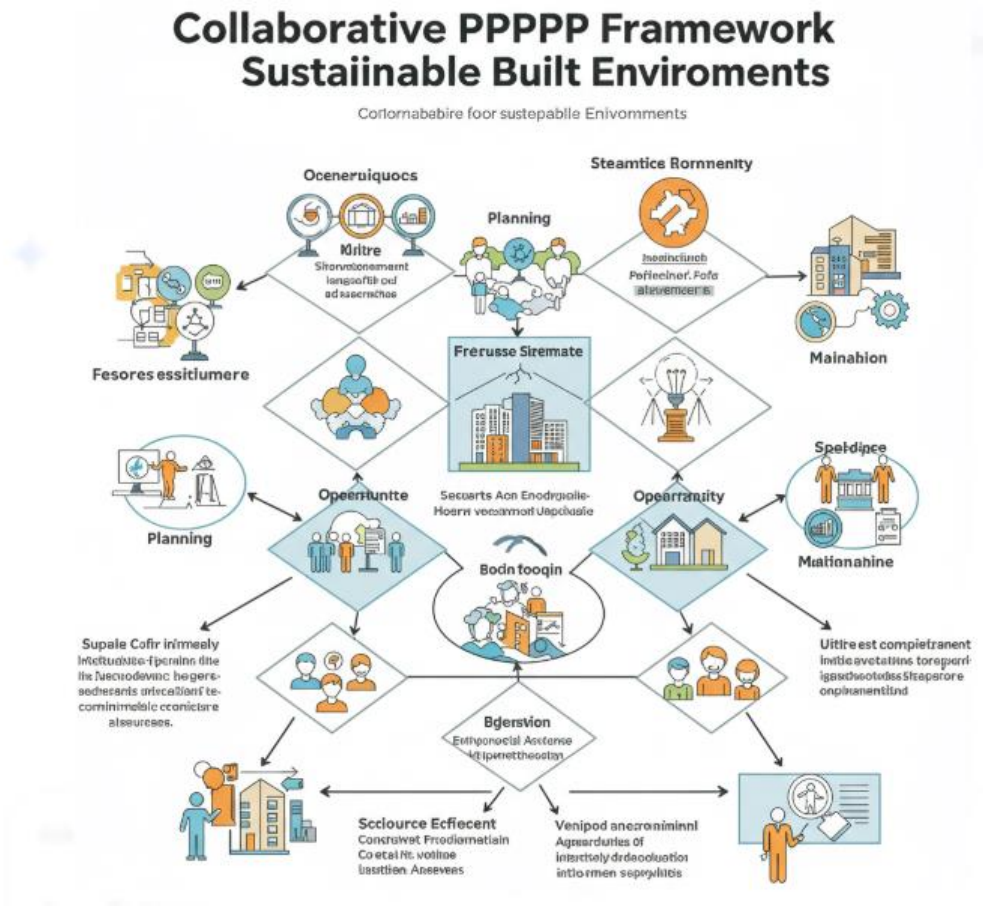

Fig 10 . 2 : Collaborative PPP Framework for Sustainable Built Environments

The LAM Model PMI assumes that the private sector invests the costs of the land reform and the office buildings and running for it instead of originally non-existent or expensive administrative equipment used by the government. Among the motives of the private partner are profit considerations as the infrastructure is designed to be self-financing, i.e., it sweeps its costs after a predefined number of years. Benefits to the private partner are therefore expected to be significant and include a good share in the benefits of the LAM.

10.5.2. Local Initiatives and Success Stories

Increasingly, American cities, counties, and entities are recognizing the benefits of pursuing ecological and social goals at the local level. In creating sustainable built environments, local and regional entities are recognized as often best positioned to quickly and effectively blend the strengths of stakeholders and to take unique problems and environmental and social conditions into account. This approach involves the assessment of local sustainability conditions, leveraging current best practices and resources to implement and monitor action, focusing on simple, measurable, and achievable goals, and identifying willing partners. Exploring these partnerships provides insight into the power of a locally focused action network, household engagement, and program design. The scope of projects can be adapted to the strength and resources of the partners and linked to sustainability plans and climate action initiatives, recognizing and learning from the unique conditions that characterize the community. Moreover, projects can easily be added to the existing community support. Small projects can enhance social considerations, economic development, and business in localities, and recognize and promote strong practices in residential, commercial, and public buildings.

Local initiatives are pragmatic, ushered in with a common purpose supported by a diverse set of leaders. They involve clear channels of consultation, concise action, and results sharing that arise in industries, fuel imaginative marketing and outreach activities, and are measurable. They gain the resources and financing of the various public and private programs available, and they can push each project to the next step, from conception to implementation, monitoring, repositioning, and redevelopment. These initiatives are beneficial for federal programs and incentives to prepare drivers of residential and commercial activities.

10.6. Challenges in Implementing PPPs

To develop sustainable urbanization and improve urban regeneration projects, the PPP approach is proposed as the solution. The goal of the PPP is to maximize benefits from synergistic relations between the public and private sectors engaged in the provision and use of facilities in the urban area. Despite the perceived merits of PPPs in enhancing sustainable development, the approach is not free from problems and issues with its implementation. Indeed, the partnership approach is a critical issue in the private and public sector relationship, and it is still at an early stage of development. It faces challenges, including the redefinition of the roles and responsibilities of each party involved in a development partnership, trust and risk-sharing in the relationship, long-term commitment and development decisions, conflicts of interest, and management and regulatory capacities.

Drawing on the assessment of the necessity of PPP models for the renovation of the existing built environment, this research does not just focus on the models' common strengths and opportunities. Before formulating PPP models, mapping potential risks and challenges is fundamental in choosing the best solutions. For now, the existing chapters laid the base for this, and now it is time to put forward challenges in the implementation of PPP models that should be later addressed with the use of implementation tools. The main aim is to examine research issues and challenges for practitioners that need to be addressed for PPPs to provide improved performance and expand their reach.

10.6.1. Regulatory and Legal Barriers

Public-Private Partnership work is, in many countries, severely hampered by rigid public procurement rules. The stringent, complex, and vague procurement processes pose a significant hurdle to getting PPP work off the ground. This is often justified as member states are expected to comply with explicit or implicit procurement rules that are meant to prevent corruption and unfair advantages, aim to secure equal access to government tenders for all companies across all member states, and to ensure that taxpayers' money is spent in the most efficient way. PPP, typically in the maturity of the agreement, entails the contracting of the supply, maintenance, and operation of public infrastructure, often lasting decades. The frontloading of the contracting is used to justify a rigorous procedure designed since then, in particular, which is known for its complexity.

Increasing the complexity of the procedure with a pre-qualification stage with lengthy documents tailored for a specific concession project may lead to companies looking for similarities in the projects rather than to the ability, competence, or commercial viability of the concession agreement, because the projects looked for during the pre-qualification process are often based on atypical project characteristics cherry-picked from previous projects. Due to the long duration of a PPP, from determination of the public sector need through to the satisfaction and closing of the contract, the terms and conditions of the concession agreement may be revised long after the public procurement is closed.

10.6.2. Financial Risks and Uncertainties

Most PPPs tend to require a long duration of investment financing. As a result, financial risks remain the most significant risks that impede a successful PPP. This is because the share of initial investment is high and the return on investment may need time, e.g., more than 20 years, especially for social infrastructures like toll roads or public buildings. Moreover, social infrastructure markets have social characteristics, and PPP projects have risks not only associated with construction but also with support during a long

project period. Structure and traffic risks for public infrastructure payment risks for operators have an adverse effect on the effectiveness of PPP projects. If the scope of the project is small, the clarity about the issue is low, or long-term cash flow is uncertain, investment in a project may also become speculative. Consequently, such risks and uncertainty will raise the financial costs, which are just as important as the actual cost of finance in PPP projects.

Because of these important reasons, many governments provide subsidies or support for the foundation and operation of PPP projects. Also, government and project consortiums raise long-term capital by issuing project finance bonds for project companies to protect against uncertainties of construction and revenue. However, this means that governments shoulder part of the uncertain risk. If the cost of money after government support increases due to the business structure and characteristics of project costs, a higher sum must be paid. High costs also discourage participation from pursuing PPPs. This means that a discussion of the possibility of future risks in the various PPP models to which these characteristics correspond is crucial.

10.6.3. Stakeholder Engagement Issues

This represents a critical factor in PPP projects, particularly in relation to ensuring that varying and often conflicting decision-making norms are addressed to permit appropriate preference structures to be established, within which value for money PPP procurement decisions can be made. A specific issue, as more countries embrace citizen-driven decision-making, is how to engage in 'meaningful' and affordable 'engagement.' The latter is an important issue as many public sector organizations are currently suffering economic problems and are much more focused on cost-cutting than on stakeholder engagement. This is particularly so in the infrastructure areas where their concern over meeting the increasing demand for new infrastructure - particularly in areas such as transportation - increases in severity. This is particularly important given the large-scale contribution this sector makes to both capital and revenue budget requirements, with considerable 'forgone' resources potentially being realized. Many stakeholder expectations thus proved unrealistic, and 'undue' influence was often found to be brought to bear. Stakeholders - community groups particularly - need to become more savvy as defenders rather than 'advocates' for their communities.

10.7. Strategies for Enhancing Sustainability through PPPs

Over the decades, the built environment has emerged as a key sector with an ability to influence society's pursuit of sustainable development. Therefore, it is crucial to develop and adopt new governance arrangements that facilitate environmental sustainability,

especially in the built environment. Maturity developments and pressures to lessen government financial burdens have led to more private sector involvement in delivering public goods and services. It is now acknowledged that public-private partnerships are a model for enhancing built environment sustainability, such as enhancing cost efficiency, investment quality, and environmental quality.

In the context of transportation, the most comprehensive analytical method to identify relevant evaluation criteria for PPPs that enhance sustainability is the Sustainable Decision Framework, which is based on transportation research. They concluded that investment, operating, and demand management strategies through PPPs may affect sustainability, although investment decisions are, to some extent, broader, affecting the socio-political and institutional framework. Their methodological approach and findings could be useful in establishing generic evaluation frameworks to assess the effectiveness of PPPs. This addresses the recognition of the more widespread use of public-private partnerships in building and operating transport infrastructure. The literature is replete with different models of PPPs to enhance built environment sustainability, but few present criteria to evaluate such models from the perspective of creating a culture of development responsive to environmental imperatives. This is the motivation for this research.

10.7.1. Innovative Financing Mechanisms

Real estate provides the essential framework holding together our business environment and civilization. The intensity of resource depletion or environmental overload by the built environment sector and its buildings demands a rapid global undertaking to confront these phenomena and incorporate sustainability principles in all future buildings as an obligation of means.

However, in meeting these requirements, it is not enough to rely on public spending allocations and on regulatory mechanisms, particularly in the present recessionary context. The challenge is crucial for the private sector, as most of the facilities needed to fulfill these objectives are currently or will be in the private portfolio. In the face of these forces and challenges, innovative financing and delivery models for the built environment are required to meet sustainability objectives. The essence of these mechanisms pertains to the urge to divert private savings towards investment in buildings and leverage the existing stock.

The significant public and private sector implications of the above necessity bring forward the possibility of merging public and private policy programs in the building sector in order to promote and support dedicated investment in sustainable real estate and remodel. The contemplated pull/push model, which will engage individuals desiring

such a move with public instruments, can be complex but still beneficial for public/private partnerships in a large variety of cases. Moral suasion, as well as the leverage of market incentives, has important roles to perform in the sustainability arena. Forget the fiscal pressures. Public/private sector cooperation, at each level, will play a key role in helping to facilitate the green building revolution.

10.7.2. Technology Integration in PPP Projects

Terms and Goals The integration of advanced technology into PPP projects, for instance, to maximize life-cycle performance, enhance bid incentives, and drive competition, can ensure quality and sustainability for the delivered infrastructure. Many advanced technologies can be related directly to better quality, reduced O&M costs, and increased energy efficiency; for example, continuous monitoring, decentralized control, sensor-equipped materials, smart or self-healing materials, advanced dimensioning and geometry scanning, non-destructive inspection, and construction robots. With a range of advanced technologies available, the degree and extent of their integration into PPP projects are evaluated in this chapter. The framework we propose here aims to enhance the sustainability profile of a project and mitigate the negative consequences of integrating new technologies. The goal is to put advanced technologies at the service of society and the environment. Its objective is to help governments, budget-constrained SPVs, and joint ventures of the private and public sectors identify the underlying principles and value-creation drivers for value-generating and value-sustaining PPP projects. These projects are difficult to complete due to challenges such as long gestation periods, budget overruns, underperformance, and delivery delays. The market and societal need for innovation is not exclusive to PPPs, nor is the framework applicable to this delivery option only, but the public interest is at the heart of these projects. The whole process is carried out under the umbrella of the principles of integrated project delivery as a means of enhancing value creation and sharing contributions.

10.7.3. Community Involvement and Social Equity

Over the years, the demands made upon the built environment have been many and varied, leading to the pressure upon its development and use to be sustainably responsible. As it is largely the responsibility of the private sector to respond to these demands, the involvement of the community in the development process might have the impact of advancing the criteria for sustainable development. The dissemination of information about the prevailing and impending threats to the global ecosystem eventually impacts the public and policymakers. With public enlightenment, both the

policy implications of these themes are more likely to be seen, and in subtle ways, individual and social behaviors are modified so that life is better integrated with and less damaging to the systems of life that support the biosphere.

Prior to the installation of solid pollution control measures, air, land, and water have been accepted as national garbage dumps by many nations. The formation of governments, unions, and professional organizations, for instance, is an indicator that the public is concerned that at present, brick and mortar structures seem to render an environment in hitherto unseen fashion, which could have inconsiderate consequences. Personal contrivances, like the wearing of clothing masks for the control of air pollution, reflect the individual realization of the importance of a clean environment. The public and nongovernmental organizations have expressed concern over the degradation of the global environment and of necessary measures to protect air, land, and water.

10.8. Evaluating the Impact of PPPs on Sustainability

Coping with societal and environmental issues in an efficient way is an increasingly important task of governments. From the institutional economics view, governments are seen as inherently inefficient. As a result, the question arises whether firms are a far superior alternative. Given the strong position of governments in the political structure, however, private firms are not a suitable alternative at all. This inevitably brings the discussion to the combination of both - public-private partnership. Public-private partnerships have been positioned as a contracting and governance mode and have been categorized as separate from both the public sector and private sectors. Over this short period, they have proven themselves. Ample evidence suggests that public-private partnerships provide better quality services at lower costs or produce services at much lower levels of inefficiencies.

Public-private partnerships encompass various legal entities and financing modes, in which the effective management of risk is central. In doing so, they are seen as particularly relevant for long-term service contracts and for complex and large projects. What is more, public-private partnerships are being established in various service sectors, including the built environment. With less control over transport assets, local governments nowadays make use of public-private partnerships rather than just looking for managerial instruments to cope with services like public transport, parking garages, and street lighting. Nowadays, the focus has somewhat switched with respect to the relevance of public-private partnerships for the built environment in serving society-related demands such as economic growth and maintenance of the quality of place. Services in the built environment are the intermediate (co-)production of capital and consumption goods pivotal for efforts to fight off competitive position decline of cities and regions. Services in the built environment thus also serve as a kind of production

factor for business, turning urban space into a productive place through the provision of incentives for firm and firm location behavior and business creation. What is more, the (re-)provision and/or adaptation of built environmental services are significant challenges in safeguarding human well-being. This accounts for the provision and the (re-)processes in built environment services such as hospitals and elderly care institutions, while for fully residential-oriented businesses, the quality of the living environment by residential bodies slowly but continuously seems to be of rising importance. So, services in the built environment are both of low value added and high service impact oriented, and have to be provided by local and regional governmental organizations paving the way for the involvement of private firms within the sphere of governmental tasks.

10.8.1. Metrics for Assessment

A key development step for public-private partnership (PPP) models to enhance the sustainability of the built environment is to set some assessment benchmarks or metrics. Benchmarking of PPP models can be undertaken from two institutional perspectives: (1) state level - government and (2) firm level - contracting firms or parties involved in public-private partnership projects. At the state level, the metrics for assessment are: the extent of public and private sector responsibilities, guidelines for risk-sharing arrangements, clarity in addressing market failure imperfections, and maximizing development in previously neglected locations. Benchmarking from the firm or industry level is more complex as it requires the examination of contractual PPP arrangements including the extent and nature of project governance agreements. These include medium-term policy uncertainty, concessional equity, construction cost risk, and non-recourse debt finance.

Getting the public-private partnership model right is critical for the enhancement of built environment sustainability. Suggested core metrics for assessment are: risk, provision of guarantees, partnership procurement expertise, level of completion risk, stimulator of private sector incentives, competitive tension, and public benefits maximization. A salient issue is how these recommendations can be implemented within the context of developing and transition countries as these economies face a unique set of development constraints. An enhanced public-private partnership model can address some of these fundamental development and transition challenges by facilitating greater private and foreign direct investment partnerships within the built environment.

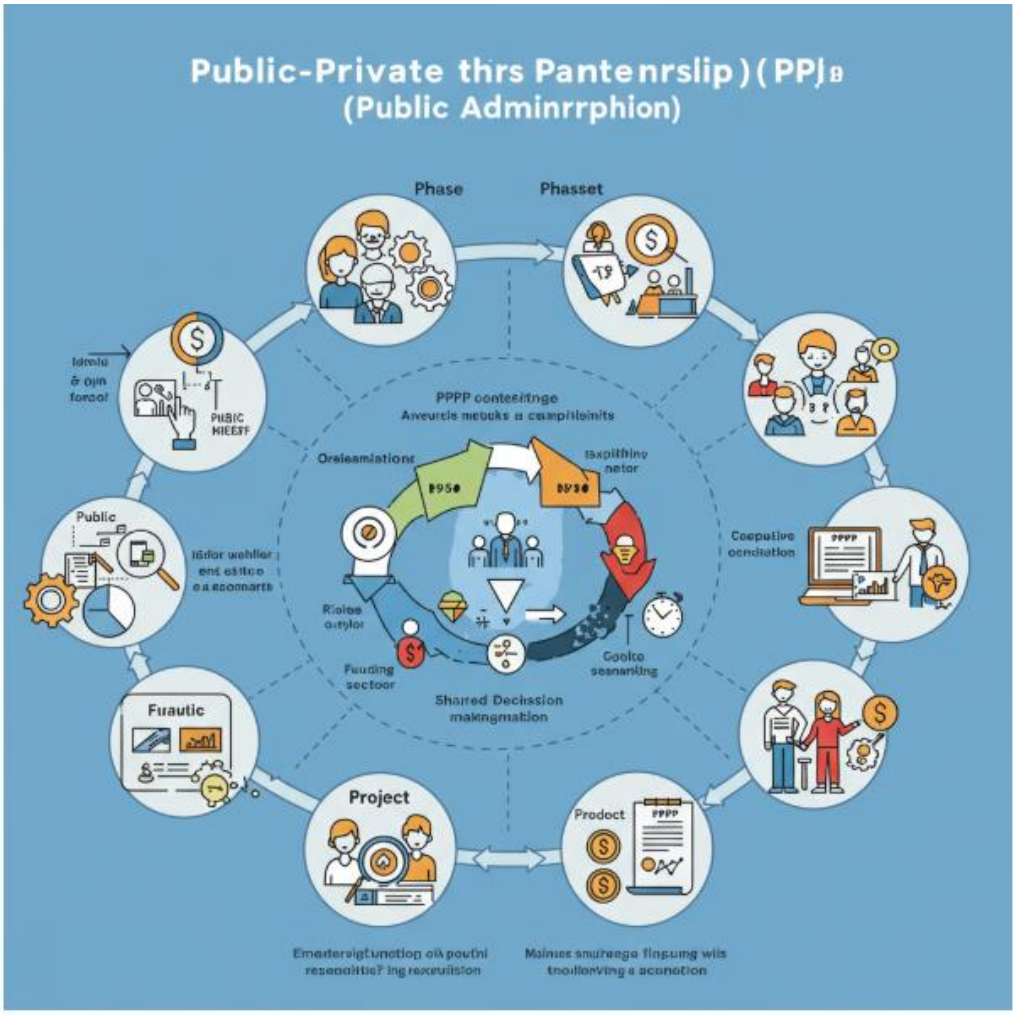

Fig 10 . 3 : Public–private partnership in Public Administration discipline

10.8.2. Long-term Sustainability Outcomes

Long-term sustainability benefits are defined as being directly associated with the ecological and social attributes of the built environment and that are supported by the enduring attention of society and government to sustainable issues over the life of these developed assets. An additional long-term sustainability benefit is the use by society of sustainable building products and materials, as well as the careful operation and maintenance of both new and existing assets over the extended period of their useful life. Improved community quality of life over the long term is also a perceived long-term sustainability outcome from the developed assets of the built environment.

As long-term investment and built environment industry decisions are made intermittently and infrequently in the context of continuing government attention, the current culture of low long-term portfolio turnover industry attention in the form of stop-start market signals, short-term, near-sighted project validation methods driven by short-term, efficient delivery, and short-term asset measurement and discounted valuation methods, stand in stark contrast with the focus and disciplined attention needed to ensure long-term sustainability benefits resulting from these recurring, significant, and lasting asset decisions. Indeed, the current environment may lead to very different long-term sustainability results than those to which society aspires. Enhanced private industry vision, broader interpretation of the public and private interest in developed assets, increased societal commitment to long-term built environment sustainability, and new public-private partnerships that capitalize on the strengths of the two sectors could help focus increased attention and discipline on long-term sustainability goals.

10.9. Future Trends in PPPs and Sustainability

The increasing awareness of the environmental and social impact is changing the construction industry. New and effective methods are adopted to shift the traditional way of doing things to sustainable approaches. The literature is full of theoretical arguments and case studies illustrating that sustainability-based approaches have many merits and advantages, and that many projects are better off from being sustainable. It is still recognized that such approaches are not without their problems. This paper's focus has been the widening of project sponsors making available funding, and reducing the ever-increasing demands on public financing for building construction and maintenance projects, accelerating financing and delivery times, providing the support of private sector expertise to deliver and manage building infrastructure while improving value, reducing costs, and contributing to a sustainable environment.

However, the delivery method is evolving, the changing funding methodologies are dynamic, and the funding options are changing. The pressure for sustainable development is increasing, and enhanced infrastructure facility performance and private sector innovation must be at the forefront of the research to produce the best solutions to the infrastructure challenges. The aim must be the delivery of the best fit-for-purpose facility that is constructed, operational, and can be utilized to ensure that all key stakeholder requirements are met. Evaluation methods need to be made available to inform and determine the best fit-for-purpose choices of delivery mechanisms. The fundamental principles of long-term benefits and minimum wastage, along with the distribution of risk and opportunity between the public and private sector, remain the case. Opening dialogues with the capital and policy decision-makers to develop and

effect new project financing alternatives offers a series of challenges that invite research and exploration.

10.9.1. Emerging Technologies

Technologies designed to provide more sustainable solutions to certain built environment challenges are emerging. While numerous technologies that could potentially address these challenges exist, few have been commercialized and reached market readiness. Attributes, such as the novelty and apparent value of the benefits they offer, affect the ease or difficulty with which emerging technologies can be implemented. Early-stage investments in these emerging technologies have yielded new business opportunities for technology vendors, investors, and end users. Such technologies have the potential to improve building performance and/or make urban environments more sustainable in terms of their use of resources, and influence the quality of life for occupants, operators, and society. Their successful exploitation ranges from 'greening' existing buildings to making new built structures fit for purpose in a sustainable way. This chapter elaborates on emerging technologies and some of the business models by which vendors and end users share the economic benefits they generate for delivering sustainable built environment solutions. Examples of approaches that are being evaluated and used, such as buyback of gained energy and utility incentives for technology use and demand response programs, as well as local mandatory appliance performance programs, are described. After providing a concise summary of tools available for measuring the financial implications of technology use, the value of energy efficiency, financial disclosure for real estate investors and funds and a Green Lease of Life are discussed. The importance of understanding the economics of sustainability is stressed, creating awareness of this issue by improving institutional education and investor knowledge. Finally, the chapter points out the need to adapt the business models to new technology introductions and ends by outlining the key factors to be considered in the evaluation of risk and appropriate technology valuation models.

10.9.2. Policy Recommendations for Enhanced Collaboration

The study on built environment sustainability has provided several outcomes that are converging. These concluded that for sustainability to occur within the built environment, policy and strategy, enforcement, adoption, culture, and regulatory frameworks interact with each other, as do the skills and their demand that stem to a large extent from both. These three sets of interrelated variables are highlighted in the process of interaction and formation of public-private partnerships. Furthermore, the study identified that for the PPP in the UK to function in the sustainability of its built

environment, the participation of stakeholders is required and must be optimally facilitated by either social or government-enterprise partnerships. This is an interesting finding coming out of the comparative analysis because stakeholder participation took place in all six countries surveyed. Moreover, it was concluded that those countries with a significant number of participants, such as the UK, USA, Canada, France, and Australia, demonstrated high rating indices.

The combination of the experience of the UK, USA, France, and Germany has since shown to others, including Canada, Italy, Portugal, and Japan, that they have always demonstrated an interest in contributing. Thus, a qualitative review of the experience of other countries undertaking PPPs for sustainability in their built environment showed that all had high rating criteria and indices. Therefore, if policymakers and built environment stakeholders are to achieve the principles of sustainability, they need to rid themselves of the notion that there is only one recipe for the actors to operate under a PPP. The recipe for facilitating PPP in the UK is that policymakers and built environment stakeholders must develop the ability to amend or add to the PPP recipe the principle of change of policies, appropriate socio-economic conditions, empowerment, and evolving stakeholders' support.

10.10. Conclusion

For well over a decade, the public-private partnership (PPP) has been advanced as an organizational model that serves to overcome the capital and capability constraints of governments, delivering public infrastructure faster, more reliably, and at a lower cost than traditional provision. In the scientific research of the effectiveness of the PPP and empirical studies in certain strategic aspects, such as innovation and other attributes, the PPP has also been found to be at least as effective, if not more so, than its traditional alternative in certain sectors and types of projects. So, drawing on the case study that illustrates the reasons for the success of the PPP in delivering the built environment sustainably, it is considered that it provides actionable operational dimensions that offer strategic value to both creators and end users, including international and national engineering and construction concerns. Nevertheless, it is also acknowledged that current PPP research has concentrated on negotiating inputs and that gaps exist and require an empirical understanding of the socially critical output-related performance attributes and avenues. Such research could involve using the planning and definition-process schema developed to promote built environment sustainability through the sponsored delivery model to also measure and manage the actual delivered deliverable during the development life-cycle stages of the megaproject.

The shared thesis of this chapter is the design of an operational organizational model between PPP principles and infrastructure and building projects. Profit-led and complex

policy objectives provide a stark critique with regard to the adequacy of current knowledge concerning the PPP organizational miscalibrations pertaining to the delivery of the built environment, thereby not supporting the need to align best practices with perceived strategic intent. The PPP model is empirically tested and validated through a case study of a regulatory system-led public-driven client-led building project delivery model and PPP failures other than the expected norm, the procurement and sponsor capacity skills shortage thesis. It was initially surmised from the literature review that the PPP and the partnered-extractor hybrid PPP approach would provide an appropriate delivery model for the stated business case stage.

In conclusion, this case study-based investigation into the possibility of using and hence improving the general public works sponsorship and risk and development life-cycle governance model to facilitate the government delivery of PPP projects within the building and infrastructure sectors realized that neglecting the content of the source decision significantly increased the difficulty and personal cost of actual delivery. However, by taking care to rationalize the decision filter, the sourcing process reduces risk, improves predictability, and saves transaction costs associated with delivery by providing a governance trajectory. The case study thus provides a measure of fit and generalizability of the main research objective, although it is accepted that it does not provide evidence of either the effect of a focus on policy, though updating industry codes and components are considered to be enablers, or scale. It is empowering because it seeks to improve on the general theory of governance by mirroring the successful experiences to date of the PPP, in providing guidance, foresight, and outcomes to deliver PPP-like success results to government, requesting a similar approach to governance, rationalizing delivery, but still filling an identifiable and addressed public need.

10.10.1. Final Thoughts and Future Directions

The chapter succeeded in setting forth a rather holistic conceptualization and operationalization of public-private partnership (PPP) models specifically dedicated to the implementation and operation of urban infrastructure services and systems. Five different PPP models, according to their salient organizational, human, and technological parameters, were derived, making the provision of a broad range of increasingly desired urban services and functions a public-private effort. It is worth noting that while these models have been formulated based on non-encompassing but relatively well-reflected characteristics of the urban built environment, it may well be assumed that they are not necessarily specific to it. Simply put, these models can be used as templates for the development of PPP models largely dedicated to other sectors of economic, social, environmental, and cultural activity.

Lastly, this chapter aimed at another important target: increasing PPP implementation by focusing both the academic and policy-making worlds towards shifting the discourse, which since the very start of the PPP process has been dominated by an almost exclusive singular ideal model of state-private sector relationship, as well as channeling research and debate towards developing the optimum models most effectively responding to the challenge urbanization poses: accommodating human needs in an environmentally friendly way. The PPP model subsequently developed should, therefore, be viewed as a stepping stone; one reflecting practical PPP operating modes being implemented worldwide, one that, even in the absence of a substantial body of widely recognized relevant knowledge, can be constantly improved, built upon, and upgraded, primarily for the benefit of city dwellers.

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