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Enhanced key success indicators of a risk management framework for public-private partnerships smart city projects

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ABSTRACT

Purpose of the study: Public-private partnerships (PPPs) contractual agreements between a private sector organisation and a government entity to jointly provide infrastructures and services are critical to address urban infrastructure and services gaps. Embedding Information Communication Technologies(ICT) into PPPs urban projects—smart cities is also considered critical. These partnerships are risk-inherent, requiring a risk management framework that can serve as a tool to guarantee successful smart city project delivery. What constitutes successful PPP smart city projects remains contentious since previous studies have not adequately identified the indicators for measuring and managing their success. Therefore, this study rides on the extension of previous studies and seeks to enhance key success indicators of a risk management framework for managing and measuring successful PPP smart city projects.

Design/methodology/approach: A literature review was conducted to extend the guiding criteria of success indicators provided in previous studies to arrive at the enhanced key success indicators of a risk management framework. Smart city dimensions and criteria were deduced from literature and embedded in the framework. The enhanced key success indicators were also embedded in the framework and tested empirically through a quantitative approach. A descriptive analysis was performed to determine their application in managing and measuring contemporary PPP smart city projects.

Findings: The responses to the survey confirmed the Enhanced Key Success Indicators of a Risk Management Framework for PPP Smart City Projects.

Recommendations/value: To manage and measure successful PPP smart city projects, stakeholders should pay attention to project budget/cost, project schedule, intelligent communication technologies(digitalisation of the city), and risk management.

Managerial implications: These Enhanced Key Success Indicators and their guiding criteria could contribute to addressing the gaps between current and premium practices of managing risks and measuring successful PPP smart city initiatives to address cities' infrastructures and services challenges.

Keywords:

Enhanced Key Success Indicators; Public-Private Partnerships; Smart-Cities; Project Management; and Risks Management Framework.

JEL Classification: O22; O18; L32; Q55

1. INTRODUCTION

The risk management field is emerging in many disciplines worldwide as a result of an increased number of failed or distressed PPP smart city projects. These distressed projects have been allied to deficient risk management practices. Singh and Lano (2014) affirmed that risk management failure causes PPP projects to fail. For instance, the Hydropower PPP project in Uganda at Bujagali had a cost overrun of $50m due to the geotechnical risks that occurred and inadequate risk management practices in addressing the risks (Yescombe, 2017). The Ghana-STX Building PPP Project, a $10 billion housing project, failed due to political risk, unstructured financial planning, and other failure factors (Okereke, 2017). The Mbombela PPP Smart Water project in South Africa also failed partially in the early stages of the concession due to risk management failure (Yescombe, 2017). Otairu *et al.* (2014) affirmed that poor risk management practices have caused streams of scandals and poor performance in PPP smart city projects. Therefore, it appears that a haphazard risk management approach causes PPP smart city project failures. A haphazard approach to risk management in PPP smart city projects can be deduced from the absence of an effective risk management framework. As such, Young (2018) concluded that organisations should strive to embed an effective risk management framework into their processes for addressing risks in a structured manner to ensure project success. However, what constitutes a distressed, failed, or successful PPP smart city project remains a bold contention among stakeholders (Osei-Kyei *et al.,* 2017). For instance, governments often assess project success or failure based on the government's political purpose and governance strength of the smart city project rather than using utilitarian physiognomies (Hodge & Greve, 2016). Given this context, using enhanced key success indicators for managing and measuring successful PPP smart city projects is critical to resolving the above-mentioned contention. As such, it has triggered increased research in the last decade in the area of key success indicators for managing and measuring successful PPPs and smart cities. These researches include new key performance indicators for a smart sustainable city (Hara *et al.* 2016), lifecycle performance measurement of PPPs (Bao *et al.,* 2018), performance indicators of PPPs in Bangladesh, an implication for developing countries (Hossain *et al.,* 2018); key success indicators for PPP Projects (Liang & Jia, 2018); critical success criteria for PPPs (Osei-Kyei *et al.,* (2017); key performance indicators for PPP projects (Yuan *et al.,* 2012). The above-mentioned normative pieces of literature unleash knowledge about the indicators for managing and measuring successful projects, yet these indicators and their guiding criteria seem inadequate, causing smart city projects to fail. Thus far, enhancing these indicators and their guiding criteria is crucial for delivering successful PPP smart city projects.

Therefore, the objective of this review paper is to enhance the success indicators of a risk management framework for PPPs, as well as expand their scope and guiding criteria to function as a mechanism to better manage and measure successful PPP smart city projects. Additionally, the study aims at determining and embedding the dimensions and criteria of smart city projects into the enhanced key success indicators of a risk management framework for successful PPP smart city project delivery. As such, the research questions are: what are the enhanced key success indicators of a risk management framework, and what are their guiding criteria? What is the relevance and current practice of these enhanced key success indicators in public and private sector organisations in delivering smart city projects? A literature review is dealt with to address the research questions, which can be used to derive the potential enhanced key success indicators (EKSI) of the risk management framework, as well as the dimensions and criteria of smart cities. The EKSI, dimensions, and criteria of smart cities will be subjected to empirical testing to confirm their relevance and practice in PPP smart city projects. The literature on the above-mentioned concepts is briefly discussed in the next section.

2. LITERATURE REVIEW

The next section provides the state-of-the-art literature regarding the dimensions of smart cities, key success indicators and their guiding criteria, and risk management framework.

2.1 Definitions and concepts of dimensions of smart city projects

The concept of a smart city encapsulates the integration of intelligent communication technologies (ICT), digitalisation, internet of things, big data management, and other electronic management facets into the soft and hard infrastructure of cities for efficient urban operations and services while meeting the socio-cultural, economic, and environmental needs of present and future generations (International Telecommunication Union, 2015). The smart city concept compresses embedding physical, digital, and human systems into delivering a sustainable, prosperous, and inclusive future for citizens (ESPRESSO, 2022). The ICT criteria that can be embedded into infrastructure and services have been discussed profoundly in Section 2.4.7 of this study. However, they are not limited to the Internet of Things (IoT), artificial intelligence, big data management (BDM), cloud computing, and mobile computing. An efficient smart city can be achieved by creating digitalised infrastructure and service delivery through smart city dimensions. The smart city dimension involves any sector of the urban economy in which ICTs can be integrated for efficient project delivery and operation. The smart city dimensions include a smart grid for energy efficiency and distribution, smart roads and buildings, digitised city infrastructure and material flows, smart ports, intelligent transportation systems, smart traffic management, smart-available charging stations for electric cars, smart healthcare, smart wastewater treatment and distribution, smart education, smart technology, smart security, and privacy, smart citizens and governance (Heaton & Parlikad, 2020; Apanaviciene *et al.,* 2020). The above-mentioned dimensions ensure the integration of ICTs in delivering and operating the city's projects. The smart city dimensions can be implemented through project delivery by adapting a PPP modality such as design, finance, build, own, operate, and transfer (DFBOOT). The smart city dimensions in terms of PPP project delivery are not risk-free; hence, they should be subjected to the enhanced key success indicators of the risk management framework for managing and measuring the success of PPP smart city projects. As such, the conceptual expositions of the enhanced key success indicators are briefly discussed in the next section.

2.2 Definitions and conceptual expositions of enhanced key success indicators

KSIs are qualitative and quantitative indicators that are used to manage and measure how PPP projects' objectives have been achieved. According to Yescombe (2017), PPPs can be regarded as an agreement between a government and private sector entity to jointly provide socio-economic infrastructure and services, where risks are shared or allocated to the party that has the best capacity to manage them. Parties struggle to manage risks in PPPs, which has caused some PPP smart city projects to fail. As such, PPP smart city projects' success or failure has been contentious among stakeholders due to inadequate success indicators and the haphazard approach to managing risks as well as measuring successful projects (Koops *et al.,* 2017). Therefore, enhanced KSIs have emerged as a contemporary discourse when it comes to managing and measuring successful PPP smart city projects. For instance, Liang and Jia (2018) recommended that KSIs should be regarded as instruments for evaluating the success of projects. Yuan *et al.* (2012) affirmed that PPP smart city projects are risk-inherent; therefore, to guarantee a successful project delivery, indicators should be used to deal with their risks and measure their success, respectively. As such, KSIs could be considered critical in supporting organisations to concentrate on the project milestones and deliverables without the risk of cognitive bias in project delivery. Therefore, using the proposed enhanced KSIs to deal with risks and measure successful projects could contribute towards advancing organisational processes to safeguard PPP smart city project success. Therefore, the next section provides the theoretical framework for determining the enhanced KSIs of a risk management framework and their guiding criteria for PPP smart city projects.

2.3 Theoretical foundation of a risk management framework

A framework represents central ideas and concepts from theories, key findings from research, policy statements, and other professional standards that guide project implementation (Shikalepo, 2020). A risk management framework can be considered as an integrated organisational process asset, enterprise environmental factors, tools, techniques, strategies, policies, philosophies, principles, inputs, and outputs for managing risks in PPP smart city projects. As such, a risk management framework should be deep-seated in the organisations' management processes to safeguard successful project delivery. Defining the components of risk management is critical for developing a risk management framework. As such, a classical risk management framework should include risk governance, risk culture, and a risk management process (Young, 2018). The components of a risk management framework consist of risk management processes, risk management principles, risk governance, values, and culture (Kruger *et al.,* 2020; Jackson, 2015). Chapman (2011) and Meyer *et al.* (2017) argued that critical components of a typical risk management framework include risk management standards, guides, and axioms. To identify the enhanced KSIs of a risk management framework, the next section discusses each of the above-mentioned components.

2.3.1 Risk management governance

The project governing committee should steer risks to support the overall strategic objectives of the organisation (King IV, 2016). Effective risk governance depends on the three lines of defence for a successful PPP smart city project delivery. Young (2020) affirmed that effective implementation of internal policies, structures, and control measures for addressing the project risks largely depends on the three lines of defence. Smart business management is the first line of defence, smart risk management is the second line of defence, and smart internal audit is the third line of defence. Briefly, smart risk owners that comprise frontline staff are the first line of defence entrusted with the responsibility of directing, identifying, assessing, mitigating, and controlling risk exposures associated with the smart city project quality, cost, schedule, scope, and resources (Mabwe *et al.,* 2017). Young (2020) affirmed that when the responsibility of identifying and addressing risks is entrusted in the hands of the first line of defence, the project can be delivered within the prescribed risk appetite statements. The second line of defence focuses on risk compliance measures regarding regulations, standards, risks, reliability, safety and resilience, quality control and assurance, and the fiscal and non-fiscal discipline of the organisation to safeguard successful PPP smart city project delivery (Mabwe *et al.,* 2017). The second line of defence monitors the risk policies, risk appetite statements, and mitigation measures that the first line of defence must implement. Bin-Ibrahim (2016) mentioned that the third line of defence is a pillar of organisational resilience and independent internal audit that controls (a risk-based approach) operational activities to prevent financial losses. The Chartered Institute of Internal Auditors (CIIA), 2017) reports that the third line of defence should audit, evaluate, and examine the quality of the risk management processes system and report directly to the top management for risk-informed decisions. Thus far, auditing and reporting should be inseparable parts of the risk management process to ensure the effectiveness of the risk responses in PPP smart city projects. The project governing committee should exhibit headship and commitment to providing resources to complete every task of the work breakdown structures (The International Standard Organisation (ISO 31000, 2018). Berssaneti and Carvalho (2014) expatiated that providing resources just in time (JIT) is critical to ensure success since, without resources, the task in the work breakdown structures cannot be completed, consequently causing project delays, cost overrun, and failure. The project governing body should determine how to manage the project costs, schedule, and scope to guarantee the success of the smart city project. Corina (2013) indicated that estimating the project cost suitably influences project success, as under-costing can halt the project's progress and subsequently cause project failure. Bloch *et al. (*2012) expatiated that project duration overrun alone causes at least 11 percent of overall project failures. Singh and Lano (2014) contended that the project scope statement is a hypercritical factor that also stimulates successful PPP smart city projects. However, an inaccurate scope statement of work, poor requirement collection, functional and technical requirements, specifications, and forecasting can trigger smart city project budget undercast to cause project failure since there is no proper basis for cost estimation. Therefore, the project team should use the stakeholder register, project charter, enterprise environmental factors, and organisational process assets as inputs, as well as expert judgment, meetings, interviews, and observations as tools and techniques to collect project requirements to avoid scope creep and guarantee successful project delivery. The project governing body should safeguard the sustainability of the PPP smart city project (King IV, 2016). When public-private organisations fail to apply the concept of sustainability by implementing smart projects in any of the smart city dimensions, the projects are likely to contribute to unsustainable production and consumption, destruction of biodiversity—environmental risks, high carbon emission, climate change, insecurity, and weak society. Hence, such organisations could face regulators' sanctions or end-users spurning the smart city project. Therefore, top management should promote the concept of sustainability when developing and implementing smart cities, thus prioritising people and the environment first while guaranteeing economic benefits. As such, it prevents jeopardising the ability of future generations or the next government to meet their needs after implementing the smart city project. Therefore, it can be deduced risk management, quality, resource availability, cost, schedules, scope, project sustainability, and ICT are key indicators for managing and measuring successful PPP smart city projects. However, to guarantee successful risk management in PPP smart city projects, risk management culture plays a significant role, as discussed in the next section.

2.3.2 Risk management culture

One of the crucial components of a risk management framework is a risk management culture. It determines how risk is perceived and responded to in an organisation (Jackson, 2015). A risk management culture is a constituent of a risk management framework (Young, 2015). According to Meiring (2016), the dominant attitudes, shared beliefs, and values that influence how people perceive, understand, describe, prioritise, and manage risks can be described as risk culture. An organisation's mature risk culture embraces total quality management (TQM), and ICTs for competitiveness, reliability, usability, serviceability, and maintainability of smart cities. As such, quality and ICTs can be used as criteria for determining and accepting successful PPP smart city projects. Therefore, risk management culture should be an enterprise-wide activity embedded in the organisation's facets for implementing PPP smart city projects. An organisation that embeds mature risk culture and ICTs into PPP projects promises effective risk management, added value, and measuring of successful smart city projects. To reinforce effective risk management in PPP smart city projects, the next section discusses the risk management process steps as a component of the risk management framework

2.3.3 Risk Management process-steps

One of the key components of a typical risk management framework for managing PPP smart city projects is the risk management process. The risk management process is an orderly application of the procedures involved in establishing the risk management context, identifying, analysing and evaluating, prioritising, treating, monitoring, controlling, auditing, reviewing, and communicating the risks (ISO 31000, 2018). The risk management process sequentially involves risk management planning, risk identification, assessment and evaluation, prioritisation, risk response, monitoring, controlling, communicating feedback, and risk financing for efficient delivery of PPP smart city projects (Vasvári, 2015; Awuah & Young, 2021). Based on the foregoing definitions and explanations, it is noticeable that there is a shared view concerning the risk management process steps for managing PPP smart city projects. Therefore, each of these steps is discussed in a consolidated manner in the next section to derive the enhanced indicators for managing and measuring successful PPP smart city projects.

a) Strategic planning of risk management activities

Strategic risk management planning aims to establish the risk management context, allocate the budget for the risk management activities, describe the techniques and tools for managing the risks, the time and resources for the risk management activities, and establish the risk management philosophy, objectives, and a blueprint for monitoring, evaluating, auditing, and controlling the risks. It involves identifying and aligning both internal and external environmental factors (IEEFs) with the organisation’s objectives and mission for successful project delivery. The risk management planning activities should be aligned with the organisation’s mission, vision, values, goals, and objectives to ensure that the risk management objectives do not conflict with the corporate goals (The Committee of Sponsoring Organisations of the Treadway Commission—COSO (2013). Throughout the risk management planning, analytical techniques, expert judgment, and top management meetings should be used as tools to identify strategic risks and their potential impact on the strategic value of the PPP smart city project. In strategic risk management planning, the top management should state the risk management objectives, risk appetite statement, risk thresholds, protocols, policies, procedures, guidelines, and boundaries for finding, addressing, and reporting on the risks connected with the PPP smart city project. As such, the top management should ensure the availability of resources for conducting risk management activities. The strategic risk management activities must be within the confinements of the national and international PPP legal framework to avoid litigations and project failure.

b) Risk identification

The second step in the risk management process is risk identification. It involves the procedure of involving experienced staff, expert judgment, data gathering, data analysis, and meetings as tools to generate a series of PPP smart city project risks and include them in the project risks register. Risk identification is a rolling wave activity of detecting and recording a series of upsides and downsides of risks by interacting with people and analysing systems and documents (Chapman, 2011). Additionally, the sources of risk and their possible consequences on project objectives should be identified to generate a complete list of risk exposures to be mitigated (Young, 2018). As such, the risks' impact on the PPP smart city project scope, cost, quality, schedule, and resources should be identified, recorded, and managed to promote successful PPP smart city project delivery. For instance, identifying and managing risks such as cyber-attacks and ICT system failure could prevent project delays, hence facilitating successful PPP smart city project delivery. The next and third step, after risk identification, is risk assessment and analyses, as discussed in the next section.

c) Assessing, evaluating, and analysing the risks

Determining the probability of risk occurrences and their eventual consequences on any of the smart city project deliverables depends on risk assessment. It involves the process of examining the quality and quantity of the risk impact if it does occur, on any of the smart city project objectives (Chapman, 2011). For instance, a qualitative risk analysis can be useful in prognosticating poor quality of work, reworking, delay in project completion, and cost overrun could emanate from poor contractor performance, hence, project failure. Similarly, a quantitative risk analysis could be useful in predicting that a three-week project delay could cause a 3 percent cost overrun, a potential cause of project failure, as additional funding could be a major challenge (Awuah & Young 2021). As such, project schedule, quality, and cost should be recognised as enhanced key indicators that could help to manage and measure successful PPP smart city projects.

d) Prioritising risk

Risk prioritisation is the fourth step in the risk management process; it involves ranking the risks founded and their assessed impact on the PPP smart city project objectives. Risks that have a high impact should be considered first when allocating resources to enhance or treat them based on the risk appetite statements. As it ensures that high-risk events could be estopped from occurring or contained to minimise their impact if they do occur (Young, 2018). Risk prioritisation is critical to PPPs' success since it helps organisations to rank and use their resources, material, human, financial, and time judiciously, following their risk appetite level. Therefore, it can be deduced that a project schedule and resource availability are indicators for managing and determining successful projects.

e) Risk response or treatment strategies

Determining risk response options and actions to enhance upside and reduce downside risks in PPP smart city projects can be regarded as risk responses-strategies. Awuah and Young (2021) mentioned that some of the key risk response strategies for downside risks include, but are not limited to, avoiding the risks, eliminating the causes of the risks, changing the project plan to protect the objectives, transferring the risk, absorbing or accept the risk, reduce the risk, reject the risks, use contingency plans, workaround, use independent verifications and validations. Government guarantees, warranties, performance bonds, insurance policies, and sharing of revenue risks are general risk reduction strategies that can be adapted in PPP smart city projects. For upside risks, some of the risk response strategies include exploiting risks and enhancing opportunities (Chapman, 2011). According to Young (2018), risk response strategies can be reactive or proactive. It is reactive when risk control measures are put in place after an incident has occurred, quite different from emergency response. It is also proactive, where risk control measures are put in place to deal with the incidents before they occur. Chapman (2011) indicated that risk control measures should be proactive and well-timed to gain sufficient leverage to suppress the negative events before they materialise and become irrepressible. The negative events could be revenue loss due to cyber-attacks, ICT failure, cost overruns, and project delays as a result of poor contractor performance. Monitoring, evaluation, controls, auditing, reviews, and reports can assist in preventing or reducing the impact of revenue loss, cost overrun, and other unstainable activities as dicussed in the next section.

f) Monitoring, evaluation, auditing, and reporting on risk response strategies

Risk treatment measures can be miscarried to the detriment of the project management activities. Therefore monitoring, evaluating, controlling, auditing, and reviewing the risk treatment strategies for quality assurance is hypercritical in the risk management process. Awuah and Young (2021) mentioned that monitoring, evaluation, and auditing help to avoid resource shortage, schedule and cost overrun, and poor quality. Berssaneti & Carvalho (2014) contended that monitoring and auditing risk response strategies promote quality assurance in the risk management process, guaranteeing that; resources are provided just in time (JIT), and the project not exceeding the expected duration and cost. Therefore, it can be deduced that monitoring and auditing the risk response strategies promote remedial actions against project delay, cost overrun, resource shortage risks, and poor performance.

g) Communicate and consult

Risk communication involves exchanging risk intelligence amongst the appropriate stakeholders through permitted communication channels for risk-informed decisions (Zhang *et al.,* 2020). Risk consulting comprises obtaining opinions and feedback of information from internal and external experts and risk owners regarding risk treatment approaches for informed decision-making (ISO 31000, 2018). Risk communication allows the variance in the risk response strategies for project cost, scope, schedule, and quality to be communicated promptly for corrective and preventive actions for a successful PPP smart city project delivery.

h) Risk financing

Risk financing is one of the bold steps toward a comprehensive risk management process for PPP smart city project delivery. Poole (2014) explained that risk financing ensures the acquisition and expending of funds for risk management activities to safeguard the project delivery. Awuah and Young (2021) confirmed that there should be funds to secure insurance policies against force majeure risks such as earthquakes, which is critical against holistic financial losses and project failure. Therefore, it is imperative to consider risk financing (funds to support risk management activities) as a critical indicator for managing and measuring successful PPP smart city projects. Given the above expositions, it can be deduced that the risk management process is a distinct and all-important component of a typical risk management framework for enhancing, managing, and measuring successful PPP smart city projects.

2.3.4 Risk management principles

The application of risk management axioms to support the risk management process steps is critical for successful PPP smart city project delivery. As such, the risk management should be: an integrated function, structured and comprehensive, bespoke, inclusive, dynamic, and sustainable. In addition, the best available information should be used and continuously improved to support successful project delivery (ISO 31000, 2018). The three lines of defence of an organisation should apply these principles to identify and treat risks associated with the project scope, cost, schedule, and quality to drive successful project delivery. For instance, the best available organisational process assets (OPAs) should serve as a guide in formulating the budget and schedules to ensure that sufficient funds are acquired for the project. Dealing with risks associated with the project budget, schedule, scope, quality, and technological issues requires promoting a mature risk culture by applying the risk management principles, tailoring, integrating, and comprehensively conducting the risk management activities in a structured manner across every facet of the organisation. Additionally, the project steering committee should apply these principles and lead ethically with pro-activeness to guarantee project sustainability (The Institute of Directors in Southern Africa, 2016). As such, it can be concluded that the risk management principles reinforce effective risk management in PPP smart city projects.

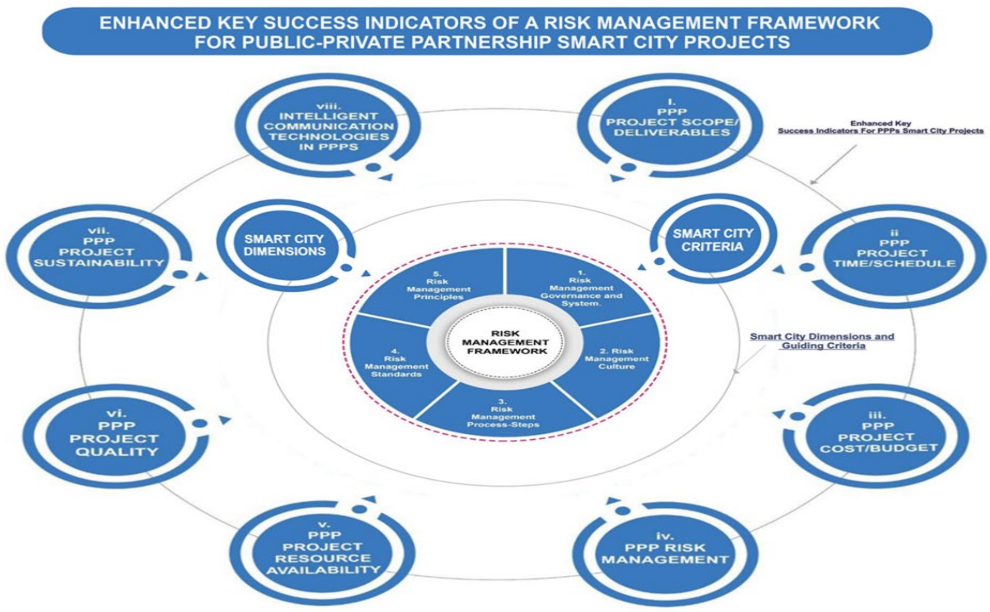
2.3.5 Risk management standards and guide

According to Awuah and Young (2021), implementing a project's specific industry risk management standards and guides reinforces effective risk management. For instance, the ISOs 13720, 2019 addresses risks in smart cities dimensions. To ensure that stakeholders accept the project as good quality and environmentally sustainable, the ISO 14001 and ISO 9001 guidelines should be applied, respectively. As such, risk management standards and guides can be considered as a typical component of a risk management framework that guarantees quality in PPPs smart city projects. In a broader summary, the fundamental components of a typical risk management framework are risk governance and system, risk culture, risk management process, risk management principles, and risk management standards and guides. Furthermore, the following eight (8) EKSIs can be derived from the discussion on the above-mentioned risk management components:

- Finishing the project within the scope of work and deliverables
- Finishing the project within the prescribed schedule or duration
- Completing the project within the allocated budget
- Completing the project following the prescribed quality
- Guaranteeing project sustainability (Sociocultural, Environmental, and Economic)
- Providing resources to complete the project
- Applying Smart or Intelligent Communication Technologies
- Conducting effective risk management activities

The above-mentioned EKSIs, smart city dimensions, and their guiding criteria should be subjected to the risk management framework for managing risks and measuring successful PPP smart city projects, as illustrated in Figure 1.

Figure 1: Enhanced key success indicators of a risk management framework for public-private partnerships smart city projects.



Source: Author's own compilation

Figure 1 illustrates the Enhanced Key Success Indicators of a Risk Management Framework for PPP Smart City Projects. Figure 1 indicates the components of a typical risk management framework, numbered from 1 to 5, namely: 1) risk management governance and system; 2) risk management culture; 3) risk management process steps; 4) risk management standards; and 5) risk management principles. The second outer ring in the risk management framework is the smart city dimensions and guiding criteria, which should be subjected to the risk management framework as discussed in Sections 2.3.1 to 2.3.5 to ensure successful project delivery. The EKSIs are the Roman numerals from i to viii in Figure 1. The EKSI arrows pointing to the risk management framework show that each EKSI should be subjected to the components of the risk management framework. For instance, the project budget or cost should be subjected to the components of the risk management framework to ensure that cost overruns are avoided. In the context of this article, the EKSIs, smart city dimensions, guiding criteria, and a typical risk management framework are inseparable to constitute the Enhanced Key Success Indicators of a Risk Management Framework for PPP Smart City Projects. As such, governments and private sector organisations should consider EKSIs as indispensable for establishing PPP smart city policies and frameworks, guidelines, acts of parliament and bills, PPP smart city procurement processes, and implementing, operating, maintaining, and measuring successful PPP smart city projects. To add value to the success indicators, enhanced criteria for each of the EKSIs are discussed in the next section.

2.4. Enhanced criteria of key success indicators

In terms of PPPs smart city projects, the aforementioned EKSIs and their respective criteria and components are succinctly expounded in this section.

2.4.1 Finishing the project within the scope of work and deliverables

Ogunberu *et al*. (2018) contended that the top management, the project manager, the project technical team, the sponsor, or the client should properly define the PPP smart city project scope to avoid scope creep. To buttress this view, Lampa *et al.* (2017) empirically affirmed that poorly defined scope and risk cause 48 percent of public-private sector project failures. As such, meeting the project owner's requirements and deliverables, functional and technical requirements, output specifications, end-user benefits, project efficiency, and fit for purpose are criteria that form the project scope (Lampa *et al.,* 2017). Villalba-Romero and Liyanage (2016) affirmed that project functional purpose and technical output are criteria for defining the project scope. Therefore, it can be deduced that stakeholders will consider the PPP smart city project as successful when it satisfies the above-mentioned criteria.

2.4.2 Finishing the smart city project within the prescribed schedule or duration

Villalba-Romero and Liyanage (2016) mentioned that completing the PPP smart city project within its planned duration and cost with a sustainable return on investment (S-RoI) encourages stakeholders to accept the project. To avoid project delays and cost overruns to guarantee successful project delivery and profitability, the project schedule should be managed appropriately (The Project Management Institute, 2017). As such, Osei-Kyei *et al.* (2017) affirmed that adhering to the project schedule is a critical indicator for measuring successful PPPs since it reduces disputes and minimises community and political protests. However, a project schedule is not risk-free. As such, when the risks are not adequately managed, it causes project delays, cost overruns, and project failure. For instance, many countries experienced project delays, cost overruns, and project failures during the COVID-19 lockdowns. Therefore, it is imperative to identify and manage the project schedule risks to complete the project on time.

2.4.3 Completing the project within the allocated budget or cost

Project cost over-run, delays, and failures occur as a result of poor project cost management (Lichtenberg, 2016). In addition, unpredicted and unfavourable enterprise environmental factors (EEFs), such as force majeur, high inflation and high exchange interest rates, can surge the project cost, consequentially causing project affordability, value for money, and financial return challenges, leading to project failure. Osei-Kyei *et al.* (2017) affirmed that adherence to the project budget is a critical indicator for measuring project success. Therefore, it is crucial to effectively identify and address the project's EEFs related to economic and financial risks to prevent cost-over-run to guarantee value for money to ensure successful PPP smart city project delivery.

2.4.4 Completing the project in accordance with the prescribed quality

There is a positive correlation between stakeholders' satisfaction and project quality. As such, project quality should be managed by applying industry standards and best practices, processes, procedures, policies, legal, technical, and functional requirements, and appropriate ICT to ensure that the project results in a quality product. Use quality materials that meet global standards for project execution. Quality can be described as the extent to which excellence can be attached to a project (Bao *et al.,* 2018). If a project meets the prescribed deliverables and technical and functional requirements, then the project can be considered to be of good quality. Therefore, accepting the project as a success depends on the greatest satisfaction that stakeholders receive from the project or service rendered. Osei-Kyei *et al.* (2017) confirmed that reliable and quality service operations are critical indicators for measuring successful PPPs. Therefore, project quality should be considered as an indicator for dealing with and measuring a successful PPP smart city project.

2.4.5 Guaranteeing project sustainability

Nawawia *et al*. (2015) sustainability aims to balance the swift progression of human needs and the profligate usage of virgin resources. Smart city sustainability aims to reach project outcomes that guarantee the present economic, environmental, and sociocultural needs of people without putting at risk the needs of future generations (Goyal *et al.,* 2013). The concept of sustainability is analogous to the triple bottom line: profit-making, protection of people (community support and safety), and the planet (3Ps) (Burke, 2011). The profit is aligned with economic risks, the people refer to sociocultural risks, and the planet refers to environmental risks (Kucukvar *et al.,* 2014). Therefore, sustainable PPPs smart city projects promote activities that aim at reducing high carbon emissions and climate change while making societies safe and resilient. Such projects are accepted by stakeholders and considered successful. As such, Shenhar (2011) attested that sustainability is a critical indicator for determining a successful PPP smart city project; however, it is an emerging risk that requires adequate attention to promote a successful PPP smart city project.

2.4.6 Providing resources to complete the PPP smart city project

Completing the PPP smart city project within the prescribed schedule, scope, and budget depends on managing and making financial and non-financial resources available to perform every task of the work breakdown structures (Li *et al*., 2017). Project delays and poor quality can be linked to insufficient resources, which contribute to project failure (Berssaneti & Carvalho, 2014). As such, e-procurement systems should be established to ensure to transparency, accountability, and fairness in awarding contracts to the most a competitive bidder to supply the required resources for successful smart city project delivery. As such, the special purpose vehicle (SPV) will guarantee project quality and within the prescribed deliverables. Thus far, making resources available just in time (JIT) is salient for successful project delivery (Berssaneti & Carvalho (2014). Jamwal *et al.* (2021) mentioned that effective resource utilisation promises maximum output and project success. Furthermore, the use of local content, workforce, and transfer of knowledge, technology, and innovation also play a critical role in smart city project success. Circular, and zero carbon embodied materials should be used in PPP smart city projects to ensure that projects contribute towards sustainable production and consumption, protecting the environment and reducing high greenhouse gas (GHG) emissions and climate change. Such projects avoid public demonstrations and are widely accepted by stakeholders as successful. Therefore, it can be concluded that project resources play a critical role in measuring successful PPP smart city projects.

2.4.7 Applying intelligent communication technology (ICT)

Jamwal *et al.* (2021) and Nel (2020) contended that the progression of technologies within the frame of the Fourth Industrial Revolution (4IR) or industry 4.0 technologies ensures effective resource utilisation for maximum output and enhances the socio-economic sustainability of organisations for successful smart city project delivery. As such, the ICT criteria that can be embedded into infrastructure and services for efficient and responsive cities are the Internet of Things (IoT), artificial intelligence, big data management (BDM), cloud computing, and mobile computing (Saraju *et al.,* 2016; & Li *et al.,* 2019). Gjerde *et al.* (2019) argued that adapting technologies that have criteria such as synchro software, building information modelling (BIM), and Lean technologies for infrastructure projects reduces variabilities and constraints in smart city project design, schedule, and quality, hence, minimises the probability of project delays, structural, and technical failures. Belle (2017) contends that the critical ICT criteria for smart city projects encompass building information modelling (BIM). This digital tool facilitates smart city project management by providing a platform for sharing information, identifying risks, and collaborating on a joint mitigation approach. Digital twinning as a smart city criteria can also be used to verify and store the flows of smart city circular building materials and its financial transactions to ensure that database created is: (a) public, not owned by anybody, (b) decentralised; can be accessed by different people across cities, (c) constantly synchronised to update transactions, and (d) secured by cryptography to make it tamper-proof and hacker-proof for efficient smart city operations (Belle, 2017). Additionally, sensors, geospatial technology including geographic information systems (GIS) and global positioning systems (GPS), big data analytics, artificial intelligence (AI), virtual reality (VR), augmented reality (AR), and blockchain technology are critical criteria for smart cities for recording, tracking, and updating information about smart city infrastructure or initiate maintenance and repair routines to prevent deterioration and structural failures. The 5G network, blockchain, cybersecurity, low power WAN technologies, city-wide Wi-Fi, high-speed internet, smart camera installations, digital displays, and available and easy access to a city's digital information are critical criteria for efficient smart city operation (PriceWaterhouseCoopers 2019). Tolstolesova *et al.* (2021) mentioned that incorporating e-financing and investments, digital financial instruments in PPP smart city projects increases opportunities for attracting financial resources for successful smart city project delivery. As such, it is crucial to adapt ICT into PPP smart city projects to establish real-time communication, technology-based decision-making, and man-machine interaction in project delivery and operations. Thus far, the application of ICTs in the project helps to reduce red tape, project delays, transaction costs, cost overruns, and poor quality to ensure project success. Therefore, it can be deduced that ICTs and their guiding criteria in urban projects play a critical role in managing and measuring successful PPP smart city projects.

2.4.8 Conducting effective risk management

No PPP smart city project is risk-free; as such, the project activities should be subjected to the risk management framework. Any event that has both downsides and upsides impacts on project deliverables can be described as a risk (Johnson & Johnson, 2013). An uncertain event or condition, which, if it occurs, has a positive or negative impact on at least one of the project deliverables, can be considered a risk (The Project Management Institute, 2017). Therefore, to deliver successful PPP smart city projects, it is crucial to deal with the risks linked to the EKSIs. As such, it is imperative to subject the smart city project management phases, initiation, planning, execution, monitoring, controlling, feedback, and closing, to the risk management framework to promote effective risk management in the project. Hence, managing the risk associated with the EKSIs requires that the EKSIs should be subjected to each of the components of a typical risk management framework, as illustrated in Figure 1. As such, Osei-Kyei *et al*. (2017) confirmed that effective risk management is a critical indicator for measuring successful PPPs. Following the above-given expositions, the risk management components, EKSIs, and their derived criteria for managing and measuring successful PPP smart city projects are summarised in Table 1.

Table 1: Risk management components and enhanced key success indicators' guiding criteria

Risk management Components	Enhanced Key Success Indicators	Enhanced Guiding Criteria
• Risk Governance and system • Risk management process-steps • Risk management. Standards	Project Scope	• Determine and adhere to output specifications and deliverables • Determine and adhere to technical and functional requirements • Guarantee project efficiency and usability, meet stakeholders' expectation • End-user benefit and fit for purpose
• Risk Governance • Risk management process-steps	Project time/Schedule	• No delays • No dispute and protests • Optimise forward and backward passes
• Risk Governance • Risk management culture • Risk management process-steps • Risk Management Principles and Standards	Project Cost/Budget	• No project life cycle cost overrun • Use cost-efficient strategy • Guarantee return on investment and profitability • Guarantee affordability and value for money • Manage economic impacts such as inflation, interest rate, and the exchange rate on a budget
• Risk Governance and system • Risk culture • Risk management process-steps	Project Quality	• Adhere to technical and functional specifications • Scope statement of work • Collection requirements • Ensure efficiency, durability, add-value, and fit for purpose • Engage and meet stakeholders' expectations and local content • Acceptable quality from stakeholders' perspective

		• Use quality materials and meet global standard requirements
• Risk management process-steps • Risk management standards • Risk Governance and system • Risk culture • Risk management Principles	Risk management	• Create risk awareness • Describe the risk management tools and techniques • Apply risk management process-steps, standards, guidelines, and principles • Ensure efficient enterprise risk management system (ERMS) • Adopt risk governance and culture • State risk appetite statements, threshold, objectives and philosophies, and parameters for optimal risk allocation and sharing roles and responsibilities • Use government guarantees, warranties, share revenue risks • Align risk management plan with public and private sector organisations' objective, mission, vision, values, and goals • Apply industry standards and best practices, policies, protocols, processes, procedures, legal framework, sustainable and technical requirements, and appropriate technology. • Adapt health and safety measures • Stakeholder engagement, communication and management • Propel political will, optimal risk-return allocation, and sharing, value for money(VfM) • Apply and subject the project management phases: initiation, planning, execution, monitoring and controlling, and closing to the risk management process.
• Risk governance • Risk management process	Project resources	• Ensure transparency and accountability, and fairness in the PPP procurement process, use local content, transfer knowledge, technology, and innovation • Competent and qualified bidders should win the contract • Ensure responsibility, accountability, and quality of resources • Ensure resources are available at all times and just in time • Use recycled, regenerative, smart and green resources
• Risk Governance • Risk management process-steps • Risk management standards • Risk culture • Risk management Principles	Project Sustainability	• Put people first for safety and community support • Ensure positive socio-cultural, economic, and environmental impact • Target improving biodiversity and ecosystem, reducing high carbon emission and climate change • Ensure sustainable return on investment

		• Use circular–green–smart economy activities, increase energy, and innovations in rural-urban engineering and construction projects, transport, health, education, agricultural, and other services PPPs • Ensure sustainable consumption and production and smart agriculture • Ensure the security, safety, and resilience of society
• Risk culture • Risk Governance • Risk management process	Intelligent Communication Technologies ICTs) for PPP Smart cities.	• Artificial intelligence (AI) for smart city PPP projects • Internet of Things (IoT) for smart city PPP projects • Cyber-physical systems for smart City PPP projects • Cyber security • Big data analytics for smart city PPP projects • Digital twining for smart city PPP projects • Sensors for smart city PPP projects • Mobile computing for smart city PPP projects • Cloud or fog computing • Build information modelling (BIM) for smart city PPP projects • Digital tool for smart city PPP projects • Digital twining for smart city PPP projects • Geospatial technology for smart city PPP projects • Geographic information systems (GIS) for smart city PPP projects • Global positioning systems (GPS) for smart city PPP projects • Virtual reality (VR) for smart city PPP projects • Augmented reality (AR) for smart city PPP projects • 5G network for smart city PPP projects • Low-power WAN technologies for smart city PPP projects • City-wide Wi-Fi for smart city PPP projects • High-speed internet for smart city PPP projects • Smart camera installations for smart city PPP projects • Available and easy access to a city's digital information • Lean technologies for smart city PPP projects • e-government activities • e-consortium/SPV activities • e-procurement; using block chain technology • e-sustainable financing

Source: Author's own compilation

Briefly, the next section deals with the research methodology for testing, analysing, and confirming the EKSIs and their applicability in managing and measuring successful PPPs smart city projects

3. METHODOLOGY

A list of generic EKSIs and the components of a risk management framework were identified using a literature review to determine their implementation in PPP smart city projects. The determined indicators form part of the proposed risk management framework. The EKSIs of a risk management framework were subjected to a pre-testing survey using a close-ended and structured questionnaire. Following the literature review, a list of eight EKSIs was derived to design the questionnaire. A quantitative approach and descriptive analysis were used to ascertain the relevance and practice of the EKSIs in PPP smart city projects. The questionnaire was sent to a purposive sample size of ten (10) international PPP, smart city, risk management, and project management experts both in industry and academia in the United Kingdom, U.S.A, South Africa, Ghana, and Nigeria for the pre-testing to ascertain the appropriateness and precision of the EKSIs of the risk management framework. The objective of the pre-testing was to ascertain the adequacy, relevancy, and clarity of the EKSIs and their guiding criteria (Table 1). The 9 experts, representing (90% confidence) returned their questionnaires and affirmed the sufficiency of the EKSIs of a risk management framework with slight changes in some of the narratives regarding the guiding criteria.

3.1 The main survey

The empirical survey was conducted on PPP, smart cities, risk management, and project management experts both in industry and academia across developed and developing countries. These experts had 2-10 years of research or hands-on experience in their field of discipline. A 5-point Likert scale questionnaire was given to the respondents to specify their views according to the following scale: 1=Strongly Disagree (SD), 2=Disagree (D), 3=Indifferent (I), 4=Agree (A), and 5=Strongly Agree (SA). That is, 256 questionnaires were sent to the experts via email to return them within 6 weeks. The respondents from PPP offices, smart urban planners, ICT experts, and independent consultants participated in the survey. The respondents managed PPP smart city projects in the following sectors: smart grid for energy efficiency and distribution, smart buildings, smart ports, smart healthcare system, smart education, smart rail transports, smart toll, and road construction. The survey aimed to determine the importance of the EKSIs and their current applicability in managing and measuring successful PPP smart city projects.

3.2 Analytical techniques

The descriptive statistical analysis, including reliability analysis using Cronbach's alpha coefficient, the Kaiser–Mayer–Olkin (KMO) test, Bartlett's test of sphericity, factor analysis, and mean significance analysis were conducted using the International Business Machine (IBM) 2019 software called Statistical Package for Service Solutions (SPSS). Averages, variances, mean, and standard deviation were used to analyse the primary data using descriptive statistics. The analysed data set (Table 4) affirmed the significance of the EKSIs and their current application in managing and measuring successful PPP smart city projects. Cronbach's alpha value of 0.7 or a coefficient $\geq$ 0.7 was accepted as a reliability test value. The Kaiser–Mayer–Olkin (KMO) test was used to measure the sampling adequacy, as such a high value close to 1.0 was accepted since it indicates that the factor analysis was useful with the research data. Bartlett's test of sphericity was used for measuring sampling adequacy. The decision rule for accepting Bartlett's test value was that for a 95 percent significance level, the p-value should be < 0.05 for the factor analysis to be accepted. In addition, factor loading of each variable greater than ± 0.30 for analysis was accepted.

4. FINDINGS AND DISCUSSION

Out of 256 questionnaires sent to the respondents, 164 were returned complete for the analysis, representing 64 percent, as illustrated in Table 2.

Number	National Symbol	Country	Continent	Regional	Number of Experts
1		Ghana	Africa	West Africa	26
2		South Africa	Africa	Southern Africa	23
3		Nigeria	Africa	West Africa	22
4		Kenya	Africa	East Africa	11
5		Senegal	Africa	West Africa	10
6		Sierra Leon	Africa	West Africa	9
7		United Kingdom (England& Scotland)	Europe	Western Europe	9
8		United States of America	North America	North America	9
9		Switzerland	Europe	Central Europe	8
10		Canada	North America	Canadian Shield	7
11		Norway	Europe	Northern Europe	7
12		Spain	Europe	South-West Europe	7
13		Australia	Australia	Australia	6
14		Germany	Europe	North-Central Europe	6
15		Albania	Europe	Southern Europe	4
Total					**164**

Source: Author's own compilation

The questionnaire-based survey ensured a response of 64 percent (164 out of 256 questionnaires), which was considered adequate for the descriptive data analysis when compared with similar studies by Ameyaw and Chan (2015) and Osei-Kyei *et al.* (2017). Respondents included: senior managers (Chief executive officers); risk managers 25 percent; smart city engineers and planners 16 percent; ICT managers 9 percent; risks, project managers, supervisors, and engineers 14 percent; and beneficiaries and PPP consultants 6 percent. The majority of respondents (indicating 56 percent) had 11 years of experience in PPP smart city projects. Twenty percent of the respondents had more than 10 years of experience in risk management, while 15 percent and 7 percent had 2-5 years and 6-10 years of experience, respectively, in project management. The Cronbach's alpha coefficient for these five Likert scale items was 0.820, which indicated the high reliability of the items in the instrument. Following the above expositions, it can be deduced that participants have a high level of experience in risk management and PPP smart city projects, which presupposes that the responses can be used to derive acceptable conclusions and recommendations.

Table 3: Factor analysis for the KSI of risk management framework

EKSIs	Factor Loadings	Cronbach's Alpha
Complete smart city project within the scope of work	0.862	0.897
Complete smarty project within the schedule/time frame	0.781	
No cost or budget overrun in smart city projects	0.745	
Complete smart city project within the required quality	0.813	
Ensure resource availability for smart city project delivery	0.738	
Ensure project sustainability	0.885	
Adapt ICTs for Urban projects (smart cities)	0.764	
Conduct effective risk management in smart city projects	0.875	
Bartlett's test of sphericity	*r^2= 252.830, df = 6, sig = 0.000*	
Kaiser–Mayer–Olkin measure of sampling adequacy	*0.434*	
Total variance explained (%)	*59.681%*	
		0.794
Risk Management Components		
Risk Governance and System	0.836	
Risk management Culture	0.702	
Risk management Process-steps	0.896	
Risk management standards	0.762	
Risk management Principles	0.875	
Bartlett's test of sphericity	*r^2= 5316.325 df = 703, sig = 0.000*	
Kaiser–Mayer–Olkin measure of sampling adequacy	*0.703*	
Total variance explained (%)	*51.534%*	
Cronbach's Alpha for KSI of a Risk Framework		**1.691**

P < 0.01 *P < 0.05 (**high significance, * significant)

Source: Author's own compilation

Table 3 showed that the EKSIs of a risk management framework had a Cronbach's alpha coefficient of 1.691, that is, 0.897 and 0.794, for the EKSIs and risk management components, respectively, and a total variance of 59.681 percent and 51.534 percent. The KMO and Bartlett's test of sphericity measured 0.434 for EKSIs and 0.703 for risk management components, with $P < 0.001$ for all the indicators. The values for Cronbach's alpha coefficient, the KMO, and Bartlett's test of sphericity suggested that they are good for factor analysis and also reliable, dependable, and applicable in managing and measuring successful PPP smart city projects. Specifically, the factor loading values for the reliability test analysis for each of the EKSIs was at least 0.702. It indicates that most of the EKSIs of a risk management framework for PPP smart city projects have a tendency of relevance and are implementable according to the participant's perspective and experience. That is, participants agreed that the EKSIs are crucial components of the proposed risk framework for measuring successful PPP smart city projects. In addition, the aforementioned experiential evidence supported the aim of one of the secondary objectives of this study, specifically to identify the components of typical EKSIs of a risk management framework for PPP smart city projects. In addition, in-depth statistical analysis, paired sample statistics, and tests of the EKSIs are presented in Table 4 in the next paragraph.

Table 4: Paired sample statistic and test for Eksis relevance and practice in PPP smart cities

EKSIs	**Paired Samples Statistics**						**Paired Samples Test**		
	Relevance and Practice in measuring successful PPPs	Mean rating (μ)	Percentage rating agreeing to Disagreeing	Standard Deviation (σ)	Correlation	Variance (%)	t-test	df	Sig. (2-tailed)
Smart City Project scope of work	Relevance	4.2636	82	0.78163	0.437**	6	1.573	92	0.119
	Practice	4.0455	76	0.7864					
Smart City Project schedule	Relevance	4.6073	91	1.6201	0.381**	21	7.711	92	0.000
	Practice	3.6909	70	0.6952					
No cost overrun in Smart city projects	Relevance	4.7545	92	2.0602	0.356**	20	2.15	92	0.034
	Practice	3.8768	72	0.7135					
Smart city Project quality	Relevance	4.6636	92	2.0602	0.386**	8	4.904	92	0.000
	Practice	4.2727	84	0.8433					
Resource availability for the smart city project	Relevance	4.3636	88	0.8944	0.462**	7	1.204	92	0.231
	Practice	4.2457	81	0.7756					
Smart city project sustainability	Relevance	4.8435	95	2.98734	0.478**	6	7.095	92	0.000
	Practice	4.3909	89	1.0951					
Intelligent Communication Technologies (ICT Smart City)	Relevance	4.4565	89	1.1215	0.391**	17	2.10	92	0.034
	Practice	3.8919	72	0.7243					
	Relevance	4.8415	93	2.4029			7.397	92	0.000

Conduct effective risk management in Smart city projects	Practice	4.1545	78	0.7983	0.429**	15			

P < 0.01 *P < 0.05 (high significance, * significant)

Source: Author's own compilation

Following Table 4, the results, findings, and analysis of the enhanced key success indicators, the mean statistics (μ) exceeded 3.0 for both relevance and practice in using EKSIs to manage and measure successful PPPs smart city projects, indicating that participants exceeded the 'disagreed' position. There was a tendency towards an 'agreed' zone (between 4 and 5) for each of the EKSIs. The standard deviation (σ) varied between 0.6952 and 2.98734, while the percentage of the rating agreeing on the relevance and practice of the EKSIs ranged from 70 percent to 95 percent jointly. This indicates that the EKSIs are generally relevant and acceptable in managing and measuring successful PPPs. The detailed findings per EKSI are dealt with in the ensuing section.

4.1 Smart city project scope

Following the reviewed literature on risk management governance, the scope of work was derived as an EKSI for managing and measuring successful PPP smart city projects. Respondents affirmed the application of the concept and its practice, which is 82 percent and 76.8 percent, respectively, for managing and determining successful PPP smart city projects. The mean statistic score for the relevancy of the theory and its practice were 4.2636 and 4.0455, respectively, surpassing the 'disagreed' point towards the 'agreed' zone; thus far, between 4 and 5, respectively for this EKSI. Therefore, the scope can be considered as a component of the EKSIs of a risk management framework for managing and measuring successful PPP smart city projects. However, the standard deviations of 0.78163 and 0.7864 exist between the relevance and practice, respectively, with a variance of 6 percent. As such, it can be deduced that the variance is a potential cause of project failures. This was also confirmed by Ogunberu *et al.* (2018) and Lampa *et al.* (2017) that project failures are associated with poorly defined scope. As such, this EKSI requires the attention of public and private sector organisations and PPP smart city policymakers to bridge the gap by ensuring that all PPP smart city projects are completed within the scope of work. Otherwise, the project could be considered unsuccessful.

4.2 Smart city project schedules

Respondents rated the mean statistical score for the relevancy and practice of schedules in PPP smart cities at 4.6073 and 3.6909, respectively, while the rating agreeing percentages were 91 percent and 70 percent for relevance and practice respectively, indicating that completing a PPP smart city project within the schedule is a critical indicator for managing and achieving successful projects. This is also confirmed by Osei-Kyei *et al.* (2017) that a project schedule is a critical indicator for measuring successful PPPs. However, the EKSI has a standard deviation of 1.6201 and 0.6952 for its relevance and practice, respectively, which suggests that the current practice is inadequate; hence, it is a potential cause of project delays, time overrun, cost overrun, and PPP smart city failures. As such, organisations should pay adequate attention to the project schedule and recognise it as a critical indicator for measuring a successful project.

4.3 Smart city project budget/cost

The respondents rated the mean statistical score of the project cost as 4.7545 and 3.8768, respectively, for the relevancy and practice that there should be 'no-cost overrun' in PPP smart city projects. The rating by respondents in the agreement was 92 percent and 72 percent for relevance and practice, respectively, indicating that completing the project within the prescribed budget or cost is key to effectively managing and measuring successful PPP smart city projects. However, 28 percent of respondents do not use no-cost-overrun as an indicator for managing and measuring successful PPP smart city projects, suggesting a potential cause of budget-overrun and project failure. This was confirmed by Lichtenberg (2016) that poor project cost management and cost over-run trigger project failures. Therefore, it is evident that project cost management is crucial to avoid cost overrun and PPP failures; as such, it is a critical indicator for measuring successful PPP smart city projects.

4.4 Smart city project quality

Based on the literature review, project quality was derived as an EKSI for organising and measuring successful PPP Smart city projects. It was determined that for stakeholders to accept the project as successful, the project governing committee should guarantee project quality. The respondents agreed that the concept is 92 percent relevant, whiles 84 percent of it is practised respectively. The concept had a mean statistical score of 4.6636 and 4.2727 for its relevance and practice for managing and measuring successful PPP smart city projects. This response indicates that project quality is a critical indicator for measuring successful projects, as was also confirmed by Osei-Kyei *et al*. (2017). However, it has a standard deviation of 2.0602 and 0.8433 for its relevance and practice, respectively, with a variance of 8 percent, suggesting that currently, its acceptability for managing and measuring successful PPP smart city projects is inadequate, hence, a potential cause of poor project performance and failure. As such, it requires attention to bridge the gap by using project quality to guide, manage, and measure successful PPP smart city projects.

4.5 Resource availability for smart city projects

Following the literature review, it was eminent that the project governing committee should be proactive in providing resources just in time (JIT) to finish the project within the planned duration. Respondents rated the mean statistical score for this EKSI at (4.3636) and (4.2455) for its relevancy and practice, respectively. The rating 'agreed' percentages were (88%) and (81%) for their relevance and practice, respectively, which indicates that resource availability is critical for completing projects successfully, as confirmed by Li *et al.* (2017). However, it has a standard deviation of 0.8944 and 0.7756 for its relevance and practice, with correlation and variance of 0.462 and 7 percent, respectively, suggesting that this EKSI requires additional attention from organisations and PPP smart city policymakers to promote and measure successful PPP smart city projects.

4.6 Sustainability in smart city projects

The reviewed literature on risk management revealed that the project governing body should guarantee PPP smart city project sustainability. As such, respondents rated the mean statistical scores for the relevancy and practice of sustainable PPPs at 4.8455 and 4.3909, respectively, with a percentage rating of 95 percent and 89 percent for its relevance and practice, exceeding the 'disagreed' point towards the 'agreed' area, thus far between 4 and 5 respectively for this EKSI. As such, it suggests that sustainability is a critical component of the EKSI of a risk management framework for managing and measuring successful PPP smart city projects, as suggested in both Nawawia *et al. (*2015) and Shenhar (2011). However, the standard deviations of 2.98734 and 1.0951 for the relevance and practice, respectively, with a correlation of 0.478 and a variance of 6 percent suggest that the relevance and current practice of using this EKSI is inadequate. This could explain the reason why there are PPP smart city projects that contribute to unsustainable production and consumption, destruction of biodiversity and ecosystem, high carbon emission, climate change, and poor waste management, which often cause stakeholders to revolt against the projects. As such, PPP smart city policymakers should bridge the gap by giving adequate attention to the use of sustainability in all PPP initiatives. That is, governments should ensure that the outcome of PPP smart city projects guarantees the present-day needs of people, depriving the future generation's ability to meet their own needs.

4.7 Intelligent Communication Technologies

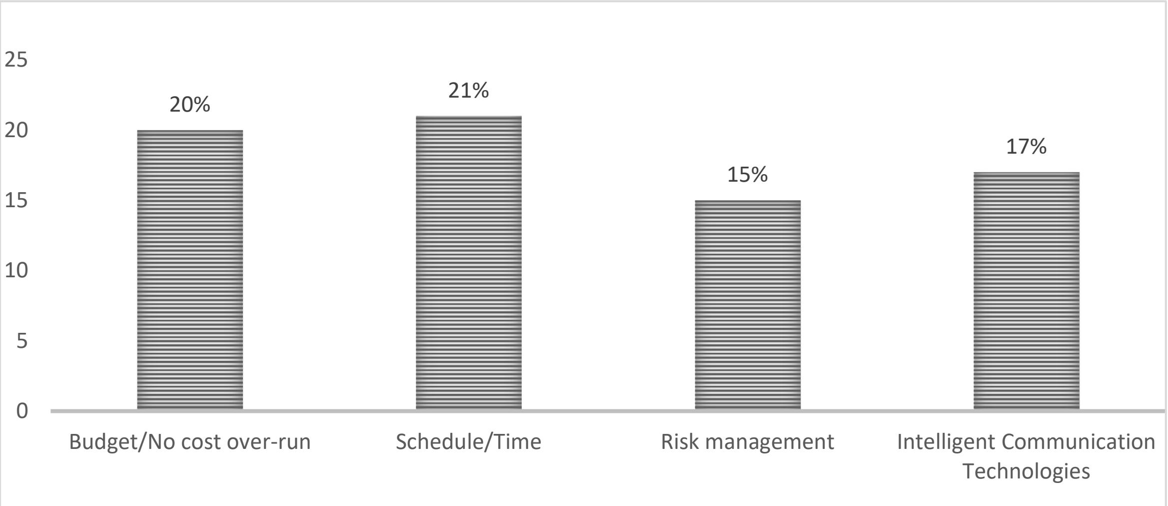
It was gathered from the literature review that intelligent communication technologies (ICTs) should be adapted to reinforce successful PPP smart city project delivery. Respondents rated the mean statistical score for this EKSI at 4.4565 and 3.6919 for its relevancy and practice, respectively. The rating 'agree' was 89 percent and 72 percent for its relevance and practice respectively, which indicates that ICTs are critical for managing successful smart city projects, as confirmed by Jamwal *et al.* (2021); and Gjerde *et al.* (2019). However, it has a standard deviation of 1.1215 and 0.7243 for its relevance and practice and a correlation and a variance of 0.391 and 17 percent, respectively, suggesting that this EKSI requires additional attention from PPP smart city policymakers to manage project risks and measure successful PPP smart city projects.

4.8 Conduct effective risk management

The reviewed literature on risk management process steps revealed that conducting effective risk management can be considered as an EKSI for effectively managing and measuring successful PPP smart city projects. The processes involved in managing risks in PPP smart city projects appeared critical in the literature review. As such, eight interdependent risk management process steps were found to be crucial, namely: risk management planning; risk identification; risk assessment; risk prioritisation; risk response strategies; risks monitoring, controlling, and auditing and assurance; risk communication and feedback; and risk financing. The response rate for agreeing to disagree confirmed the relevance (93%) and practice (78%) for the risk management process steps as an EKSI for organising and measuring successful PPP smart city projects. Statistically, 4.8415 and 4.1545 were analysed as the mean for its relevance and practice, respectively, indicating that organisations exceeded the 'disagreed' position towards the 'agreed' zone; that is, between 4 and 5 for both relevance and practice of this EKSI. As such, it was regarded as an EKSI for managing and measuring successful PPP smart city projects, as confirmed by Osei-Kyei, *et al*. (2017) that effective risk management is a critical indicator for measuring successful PPPs. However, the standard deviation was at 2.4029 and 0.7983 for its relevance and practice, respectively, while its correlation and variance were 0.429 and 15 percent, respectively, suggesting that the relevancy and practice of this indicator to manage and measure successful PPP smart city projects is inadequate. Therefore, this EKSI can be deduced as a potential cause of haphazard risk management activities in PPP smart city projects, as well as project failures. As such, organisations and PPP smart city policymakers should adopt this EKSI to guide, implement, and measure successful PPP smart city projects.

However, the analysis of the eight EKSI reveals four critical indicators that require urgent attention for managing and measuring successful PPPs. The variance analysis among the top four EKSIs surpassed the total average variance of all the EKSIs by 12.5 percent. As such, these top four EKSIs are illustrated in Figure 2.

Figure 2: Percentage of variances for the top four enhanced key success indicators



Source: Author's own compilation

A project schedule is the highest variance of 21 percent among the rating of the top four EKSIs, followed by a project budget of 20 percent, intelligent communication technologies at 17 percent, and risk management at 15 percent, respectively. These EKSIs are not adequately adopted for managing and measuring successful PPP smart city projects. As such, they are top priorities that require critical attention to manage and measure successful PPP smart city projects.

5. CONCLUSIONS AND RECOMMENDATIONS

The purpose of the study was to enhance success indicators and their guiding criteria for PPP smart city projects and embed them into a risk management framework that could serve as an instrument for dealing with and measuring successful smart city projects. The risk management framework components for PPPs were identified as risk governance and system, risk culture, risk management process steps, risk management principles, risk management standards and guides. Following the literature review on the above-mentioned components, eight EKSIs and their guiding criteria were identified: project scope of work, project schedule, project budget/cost, project quality, resource availability, project sustainability, intelligent communication technologies, and effective risk management. However, it can be concluded from this study that organisations should consider the following top four EKSIs when managing and measuring successful PPP smart city projects: project budget/cost, project schedule, intelligent communication technologies, and risk management. In addition, the findings of this study close the gap between the theory and practice of PPP smart city projects and contribute practically to better project completion rates. As such, if project activities are centred on the proposed EKSIs of a risk management framework, it could assist in managing and measuring successful PPP smart city projects. Therefore, it can be concluded that:

- Adequate risk identification prevents smart city project cost over-run, delays, and poor performance.
- The adequate practice of risk governance, culture, standards, and principles ensures effective enterprise risk management (ERM) activities. As such, risk management failure, project delays, poor quality, and scope creep could be prevented to ensure successful smart city project delivery.
- The EKSIs settle the contention about what constitutes a successful PPP smart city project.
- The guiding criteria are critical for managing the risks associated with the EKSIs (illustrated in Table 1) for successful PPP smart city project delivery.
- The EKSIs of a risk management framework is prerequisite for ensuring and measuring successful PPP smart city projects.

Therefore, it is recommended that, in general, organisations should pay particular attention to the following recommendations:

- Subject all PPP smart city project procurement processes, policy frameworks, laws and regulations processes, and other implementation, operation, and maintenance (O&M) activities to the EKSIs of a risk management framework for successful PPP smart city project delivery
- PPP smart city projects should be completed within the scope of work to prevent project failure.
- Organisations and PPP policymakers should recognise a project schedule, cost/budget, risk analysis and management, and quality as critical criteria to guide, implement, and measure successful PPP smart city projects.
- Organisations and PPP policymakers should recognise resource availability as a guiding indicator for a successful project.
- Governments should consider sustainability and intelligent communication technologies as the most critical indicators for managing and measuring successful PPP smart city projects.

The identified EKSIs of a risk management framework for PPP smart city projects is a generic tool applicable to all public-private smart city projects and should be used as a guide towards a structured approach to risk management and measuring successful projects. Organisations could use the rated level of applicability of the EKSIs as benchmarks to measure their level of adherence, identify the potential gaps in their operations, and address them to avoid project failures. The guiding criteria of the EKSIs of a risk management framework could further be researched and expanded, as well as a country-by-country comparison and analysis. Post-experimental research could be carried out in the future to determine if organisations apply the EKSIs of a risk management framework to determine the significance and any areas of improvement. A possible limitation of the study includes the extrapolation of the result is fairly limited considering the sample size of 164 participants from 15 countries despite all efforts to maximise it. However, the author takes consolations that 164 experts from 15 countries with suitable research and industrial experience participated in the study, which outsize previous related studies. As such, it can be concluded that the components of the enhanced key success indicators of a risk management framework add value to the body of knowledge in risks, smart cities, PPPs, and project management literature. Hence, the results remain relevant for risk management practices in PPPs, risk management, smart cities, and project management for further research.

REFERENCES

Ameyaw, E.E. & Chan, A.P.C. 2015. Risk ranking and analysis in PPP water supply infrastructure projects: an international survey of industry experts, *Emerald Group Publishing Limited*, Facilities 33(7/8):428–453. [http://dx.doi.org/10.1108/F-12-2013-0091].

Apanaviciene, R. Vanagas, A. & Fokaides, P.A 2020. Smart Building integration into a smart city (SBISC): development of a new evaluation framework. *MPDI Energies Journal,* 13:2190. [https://doi.org/10.3390/en13092190].

Awuah, E. & Young, J. 2021. Key success indicators of a risk management framework for public-private partnership projects. *Academy of Accounting and Financial Studies Journal,* 25(1):1528-2635 [Internet: https://www.abacademies.org/articles/Key-Success-Indicators-of-a-Risk-Management-Framework-1528-2635-25-1-649.pdf; downloaded on 10th October, 2022].

Bao, F., Martek, I., Chen, C., Chan, A.P.C. & Yu, Y. 2018. Lifecycle performance measurement of public-private partnerships: a case study in China's Water Sector. *International Journal of Strategic Property Management,* 22(6):516-531. [https://doi.org/10.3846/ijspm.2018.6048].

Belle, I. 2017.The architecture, engineering, and construction industry, and blockchain technology. China *Architecture Industry Publishers,* pp. 279-284 [Internet: https://www.iris-belle.com/architecture-engineering-construction-industry-blockchain-technology/; downloaded on 17th July, 2022].

Berssaneti, F.T. & Carvalho, M.M. 2014. Identification of variables that impact project success in Brazilian companies. *International Journal of Project Management*, 33:638–649. [http://dx.doi.org/10.1016/j.ijproman.2014.07.002].

Bin-Ibrahim, M. 2016. Audit as a partner of change. Kuala Lumpur: The Bank of International Settlements, Basel, Switzerland. [www.bis.org/review/r160823b.htm; downloaded on 11th May, 2022].

Bloch, M., Blumberg, S. & Laartz, J. 2012. Delivering large-scale IT projects on time, on budget, and on value *McKinsey Quarterly*, 27:2-7. [https://www.mckinsey.com/~/media/McKinsey/dotcom/client_service/Corporate%20Finance/MoF/PDF; downloaded on 12th May, 2022].

Burke, R. 2011. Advanced project management-fusion method XYZ. 1st edition, Auckland, New Zealand: Burke Publishing.

Chapman, R.J. 2011.Simple tools and techniques for enterprise risk management. 2nd edition. West Sussex: John Wiley and Sons Ltd.

Chartered Institute of Internal Auditors. 2017. What is Internal Audit? [https://www.iia.org.uk/audit-risk-magazine/; ownloaded on 15th March, 2022].

Committee of Sponsoring Organizations of the Treadway Commission (COSO) (2013). Enterprise Risk Management – Integrated Framework. New Jersey. NJ: Grow Publications.

Corina, J. 2013. Understanding the sustainable development concept in Malaysia. *Social Responsibility Journal,* 9(3):441-453. [https://doi.org/10.1108/SRJ-03-2012-0024].

ESPRESSO. 2022. System OIC Standardisation Approach to Empower Smart Cities and Communities. [https://espresso.ru.uni-kl.de/; downloaded on 13th September, 2022].

Goyal, P., Rahman, Z. & Kazmi, A.A. 2013. Corporate sustainability performance and firm performance research.*Management Decision,* 51(2):361-379. [https://doi.org/10.1108/00251741311301867].

Gjerde, M. R. D., Ratnayake, R. M. C.,& K Samarakoon, S. M. S. M. (2019). Effective Implementation of Last Planner System in Construction Projects: *8th IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)* 15-18 Dec. 2019, Macao, China. [https://doi.org/10.1109/IEEM44572.2019.8978719].

Hara, M. Nagao, T. Hannoe, S. & Nakamura, J. 2016. New Key Performance Indicators for a Smart Sustainable City. *Sustainability, 8(3):206.* [https://doi.org/10.3390/su8030206].

Heaton, J. Parlikad, A.K. 2020. A conceptual framework for the alignment of infrastructure assets to citizen requirements within a Smart Cities framework. *The International Journal of Urban Policy and Planning.* 90(1):32-41. [https://doi.org /10.1016/j.cities.2019.01.041].

Hodge, G.A. & Greve, C. 2016. On public-private partnership performance: a contemporary review", *Public Works Management & Policy,* 22(1), 55–78. [https://doi.org/10.1177/1087724X16657830].

Hossain, M. Guest, R. & Smith, C. 2018. Performance indicators of public-private partnership in Bangladesh: An implication for developing countries. *International Journal of Productivity and Performance Management,* 68(1):46-68. [https://doi.org/10.1108/IJPPM-04-2018-0137].

Institute of Directors in Southern Africa 2016. *Report on corporate governance for Southern Africa.* Johannesburg: Institute of Directors in Southern Africa NPC. [https://cdn.ymaws.com/www.iodsa.co.za/ resource/collection/2477EA3B-957A-43AC-BD29- E7C045B41AE9/IoDSA_Integrated_Report_2016.pdf; downloaded on 19th June, 2022].

ISO (The International Standard Organisation) 31000. 2018. The British Standards Institution. London: British Standards Institution. [www.ashnasecure.com/uploads/standards/BS%20ISO%2031000-2018.pdf, downloaded on 21st October, 2022].

International Telecommunication Union (ITU). 2015. Master Plan for smart sustainable cities. [https://www.itu.int/en/ITU-T/climatechange/Pages/default.aspx downloaded on 17th August, 2022].

Jackson, J. 2015. Cognitive closure and risk sensitivity in the fear of crime. *Legal and Criminological Psychology*, 20 (2):222-240. [http://dx.doi.org/10.1111/lcrp.12031].

Jamwal, A., Agrawal, R., Sharma, M. & Giallanza, A. 2021. Industry 4.0 Technologies for Manufacturing Sustainability: A Systematic Review and Future Research Directions. *Journal of Applied. Sciences* 11(3):5725.[https://doi.org/10.3390/app11125725].

Johnson & Johnson. 2013. A Framework for Enterprise Risk Management [https://web.actuaries.ie/sites/default/files/ermresources/jnj_riskmgmt_ermframework_guide_v16a.pdf; downloaded on 14th July, 2022].

King IV Report. 2016. Governing body responsibilities and good governance outcomes. Johannesburg: Institute of Directors in Southern Africa. [https://www.adams.africa/wp-content/uploads/2016/11/King-IV-Report.pdf; downloaded on 12th August, 2022].

Koops, L., van-Loenhout, C., Bosch-Rekveldt, M., Hertogh, M. & Bakker, H. 2017. Different perspectives of public project managers on project success. *Engineering, Construction, and Architectural Management* 24(1): 1294–318 [https://doi.org/10.1108/ECAM-01-2015-0007].

Kruger, N.A., Dickanson, Z. & Meyer, N. 2020. Factors affecting SME risk identification and management in developing regions. *Journal of Contemporary Management, 17(2):*347-368. [https://doi.org/10.35683/jcm20031.79].

Kucukvar, M., Egilmez, G. & Tatari, O. 2014. Sustainability assessment of U.S. final consumption and investments: Triple-bottom-line input-output analysis. *Journal of Cleaner Production,* 81(6):234-243. [http://dx.doi.org/10.1016/j.jclepro.2014.06.033].

Lampa, I., Contessoto, A., Amorim, A., Zafalon, G., Valêncio, C. & Souza, R. 2017. Project Scope Management: A Strategy Oriented to the Requirements Engineering. *The 19th International Conference of Enterprise Information Systems* (ICEIS 2017), Porto, Portugal, 26th-29th April 2017. [www.scitepress.org/Link.aspx?doi=10.5220/0006318603700378; downloaded on 9th May, 2023].

Li, X. B., Nie, M., Yang, G. H. & Wang, X. 2017. The Study of Multi-Project Resource Management Method Suitable for Research Institutes from Application Perspective. *Procedia Engineering,* 174:155-160. [https://doi.org/10.1016/j.proeng.2017.01.191].

Li, C. Liu, X. Dai, Z. & Wu, P. 2019. Understanding Smart City: A Shareable Framework. The Case of China*. 4th International Conference on Smart Data and Smart Cities, 1–3 October 2019, Kuala Lumpur, Malaysia*. [https://doi.org/10.5194].

Liang, Y. & Jia, H. 2018. Key Success Indicators for PPP Projects: Evidence from Hong Kong. *Advances in Civil Engineering,* 2018(10):9576496 [https://doi.org/10.1155/2018/9576496].

Lichtenberg, S. 2016. Successful Control of Major Project Budgets. *Journal of Administrative Sciences* 6(3):8; [https://doi.org/10.3390/admsci6030008].

Mabwe, K., Ring, P. & Webb, R. 2017. Operational Risk and the three lines of defence in UK financial institutions: Is the magic number? *Journal of Operational Risk,* 12(1):53-69. [https://doi.org/10.21314/JOP.2017.187].

Meiring, W.J. 2016. Risk culture at senior and middle management levels. Potchefstroom: North-West University. Masters Dissertation [http://hdl.handle.net/10394/24943; downloaded on 29th November, 2022].

Meyer, N., Meyer, D. & Kot, S. 2017. The development of a process tool for improved risk management in local government. *Quality – Access to Success*, 18(S1):425-429. [https://www.researchgate.net/publication/316664718_The_development_of_a_process_tool_for_improved_risk_management_in_local_government#fullTextFileContent; downloaded on 12 October, 2022]

Nawawia, A.H., Muhammada, F., Mahbuba, R. & Abidin, N.Z. 2015. Perceived Project Sustainability Performance Indicators (PPSPI) for Value Planning. *Procedia - Social and Behavioral Sciences,* 202 (2015):89-97. [https://doi.org/10.1016/j.sbspro.2015.08.211].

Nel, D. 2020. Allocation of Risk in Public-Private Partnerships in Information and Communications Technology. *International Journal of E-business and E-government Studies, (12)1*:17-32 [http://dx.doi.org/10.34111/ijebeg.202012102].

Ogunberu, A.O., Akintelu, S.O. & Olaposi, T.O. 2018. Application of project scope management practices on project success among telecommunication organisations in Nigeria. *International Journal of Development and Sustainability,* 7(20):518-532.[https://isdsnet.com/ijds-v7n2-08.pdf; downloaded on 12th August, 2022].

Okereke, O.C. 2017. Causes of failure and abandonment of projects and project deliverables in Africa. *PM World Journal. 5(1)*:1-16*.* [http://www.pmworldjournal.net/; downloaded on 12th October, 2022].

Osei-Kyei, R., Chan, A.P.C., Javed, A.A. & Ameyaw, E.E. 2017. Critical Success Criteria for Public-Private Partnership Projects: International Experts Opinion. *International Journal of Strategic Property Management,* 21(1):87–100. [https://doi.org/10.3846/1648715X.2016.1246388].

Otairu, A.G., Umar, A.A., Zawawi, N.A.W.A., Sodangi, M. & Hammad, D.B. 2014. Slow Adoption of PPPs in Developing Countries: Survey of Nigerian Construction Professionals, *Procedia Engineering Journal (77):188-195*. [https://doi.org/10.1016/j.proeng.2014.07.014].

Poole, L. 2014. A calculated risk: How donors should engage with risk financing and transfer mechanisms. Paris: The Organisation for Economic Co-operation and Development. [https://www.oecd.org/dac/A%20calculated%20risk.pdf, downloaded 26th July, 2022].

PriceWaterhouseCoopers, 2019. Creating the smart cities of the future. 1PwC/World Economic Forum, Circular Economy in Cities: Evolving the model for a sustainable urban future, 2018. [https://www.pwc.com/gx/en/sustainability/assets/creating-the-smart-cities-of-the-future.pdf; downloaded 20th June, 2022].

Project Management Institute (PMI). 2017. Guide to the Project Management Body of Knowledge *(PMBoK)*. 6th ed. Philadelphia, PA: Project Management Institute. [https://lccn.loc.gov/2017032505; downloaded 20th August, 2023].

Saraju, P.M, Choppali, U. & Kougianos, E. 2016 Everything you wanted to know about smart cities: *IEEE Consumer Electronics Magazine, 2162-2248.* [https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7539244, downloaded 20th July, 2022].

Shenhar, A. 2011. Meeting time, cost, and money-making goals with Strategic Project Leadership. PMI Global 9th Congress. North America, Dallas, TX. Newtown Square, PA, 1st November 2011. Project Management Institute. [https://www.pmi.org/learning/library/meeting-goals-strategic-project- leadership-6112, downloaded on 18th August, 2022].

Shikalepo, E.E. 2020. Defining a Conceptual Framework in Educational Research [http://dx.doi.org/10.13140/RG.2.2.26293.09447; downloaded on 11th October, 2022].

Singh, R. & Lano, K. 2014. Literature survey of previous research work in models and methodologies in project management. *International Journal of Advanced Computer Science and* Applications, 5(9):1071. [https://dx.doi.org/10.14569/IJACSA.2014.050917].

Tolstolesova, L., Igor, G., Natalya, Y., & Otabek, A. 2021.Digital Transformation of Public-Private Partnership Tools. *Journal of Risk and Financial Management*, (14):121. [https://doi.org/10.3390/jrfm14030121].

Vasvári, T. 2015. Risk, risk perception, risk management – A review of the literature. *Public Finance Quarterly*, 60(1):29-48.[http://www.asz.hu/public-finance-quarterly-articles/2015/risk-risk-perceptionriskmanagement-a-review-of-the-literature/a-vasvarir-2015-1.pdf; downloaded on 15th May, 2023].

Villalba-Romero, F. & Liyanage, C. 2016. Evaluating success in PPP road projects in Europe: a comparison of performance measurement approaches. *Transportation Research Procedia,* (14):372-381. [http://dx.doi.org/10.1016/j.trpro.2016.05.089].

Yescombe, E.R. 2017. Public-private partnerships in sub-Saharan Africa: case studies for policymakers. Dar es Salaam: UONGOZIInstitute.[https://media.africaportal.org/documents/Public-Private-Partnerships-in Sub-Saharan-Africa_Digital_FINAL-4.pdf; downloaded on 25th November, 2022].

Young, J. 2015. Guiding criteria for operational risk reporting in a corporate environment. *Corporate Ownership and Control*, 13(1):1241-1256.[https://doi.org/10.22495/cocv13i1c10p10].

Young, J. 2018. Guiding Criteria for an Operational Risk Management Framework for South African Municipalities. *Administration Publication*, 26(1):9-41. [http://hdl.handle.net/10500/24437].

Young, J. 2020. Determinants of a Risk-Based Audit of an Operational Risk Management Framework: A South African Perspective. *Academy of Accounting and Financial Studies Journal,* 24 (2). [https://www.abacademies.org/articles/DeterminantsforARiskBasedAuditofAnOperationalRiskManagement-Framework-1528-2635-24-2-534.pdf; downloaded on 12th July, 2022].

Yuan, J., Wang, C., Skibniewski, M.J. & Li, Q. 2012. Developing key performance indicators for public-private partnership projects: questionnaire survey and analysis, *Journal of Management in Engineering*, 28 (3):252-26 [http://dx.doi.org/10.1061/(ASCE)ME.1943-5479.0000113].

Zhang, L. Li, H., & Chen, K. (2020) Effective Risk Communication for Public Health Emergency: Reflection on the COVID-19 (2019-nCoV) Outbreak in Wuhan, China. *MD, Healthcare Journal, 8(1):64.* [https://doi.org/10.3390/healthcare8010064].