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Exploring the Relationship between Project Selection and Approval Criteria and Infrastructure Sustainability

Edward Nana-Addy[1,2] and Innocent Musonda[3]

[1]Postgraduate School of Engineering Management, University of Johannesburg, South Africa:

[2]Faculty of Arts and the Built Environment, Department of Building Technology, Sunyani Technical University, Ghana

[3]School of Civil Engineering and the Built Environment; Department of Construction Management and Quantity Surveying, University of Johannesburg, South Africa:

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Abstract

This research aimed at compiling project selection criteria and modelling a robust criterion for infrastructure project selection and approval to enhance sustainability. The decision to select and approve sustainable infrastructure project for development must base on a robust criterion. To handle this properly, first, decision-makers must adopt a robust criterion that aid infrastructure sustainability. The study employed a systematic literature review, methodology and thematic analysis procedure to identify infrastructure project selection and approval criteria from literature. A total of 34 project selection criteria were identified and grouped into five categories. Besides, four approval requirements and four sustainable indicators have been discussed. To avoid any ambiguous and unclear questions in the criterion, 40 professionals were selected purposively for the pilot survey. Descriptive and inferential statistical analyses were employed, and findings were used to improve the criteria. The quantitative phase of the study was conducted on 320 stakeholders who were either project selectors, approvers, advisors, or designers responsible for government projects. S.E.M. were adopted for the analysis and testing of the hypothesis. Moreover, the study has proposed a structure model that integrates identified criteria and indicators to enhance infrastructure selection and approval. Continuous professional development training is vital for all stakeholders to understand and adopt the proposed project selection and approval criteria model to improve infrastructure sustainability performance and to enhance project selection and approval practices. And it was also included in the design brief as a deliverable factor. This outcome serves as preliminary and exploratory research to aid further study on the project selection and approval criteria model for infrastructure sustainability.]

Keywords: Project selection criteria, Project approval requirements, Infrastructure, substantivity, sustainable Indicators

Introduction

The criterion for the selection of sustainable infrastructure for development is a major challenge for most decision-makers. Infrastructures are developed for many purposes, including closing the infrastructure deficit gap, providing socio-economic growth, environmental protection, and G.D.P. growth (IDB, 2018; Rydin, et al., 2018; Xue, et al., 2018). However, infrastructure construction could impact the environment and society negatively when abandoned. Literature shows that several resources go wasted due to project abandonment as a result of inadequate project selection, and approval criteria (P.S.A.C.) used (Yu, et al., 2018; Wells, 2015; LIST, 2013). In dealing with this menace, it is important to develop a robust criterion for selecting bankable and sustainable projects (I.I.S.D., 2020; Xue, et. al., 2018; IDB, 2018). According to Hansen, et. al., (2019), different criteria can be used to evaluate and select projects for development. These include "financial, technical, risk-related, resources-related, contractual conditions, and qualitative criteria". Besides, other researchers have discussed other criteria that differ from one another (Infrastructure Australia, 2018; Budiman and Gunarta, 2018; Wales, 2016; Queensland Treasury, 2015; C.D.I.A., 2010).

Purnus and Bodea (2014) outline five steps that could aid in the selection of project. First, there is a need to establish a criterion that would be used to evaluate the project (Cho and Gibson, 2012). This could be done by setting parameters to assess project proposals, also known as decision parameters (Shao, 2017). Once evaluated, the decision criteria can provide a transparent process Pan et al., (2012) either qualitatively or quantitatively (Osei-Kyei and Chan, 2015). Secondly, Purnus and Bodea (2014) noted that a score scale should be established for each criterion. Lastly, project list should be developed in order to guide the priorities based on the scores generated. After these processes, the project can begin without any problem. The project selection criteria (P.S.C.) are grouped into, "strategic fit, owner philosophies, project funding and timing, project requirements, and value engineering" (Bingham, 2010; Cha, et. al., 2018; Collins, 2015; ElZomor, 2017; Yu, et. al., 2018; Xue, et.al., 2018). However, previous researchers have recognized the complexity issues of project selection and approval (Bakshi, et. al., 2016; Salehi, 2015). With the high demand for infrastructure sustainability (I.S.), there is therefore the need to develop a robust criterion for selecting infrastructure projects. The proposed criteria should ensure validity and transparency by followed a systematic process in project selection and approval. Besides, previous studies on project selection focus on the methods of selection than each item-by-item criteria selection (Hansen, et. al., 2019; Cha, et. al., 2018; Cho and Gibson, 2012). Therefore, this study aimed at compiling P.S.C. and modelling a robust criterion for project selection and approval to enhance I.S.

Theories of Project Selection and Approval Criteria

The theories of project selection criteria and project approval requirements are presented below.

Project Selection Criteria

There are a limited number of projects for organizations to choose, most of which are geared towards increasing awareness through successful executions of the projects (Abas et al., 2016; Ahmad, 2016; Magni and Marchioni, 2020). Generally, infrastructure projects require investment in terms of resources and money, and it is of importance to select projects of good returns on the capital and resources invested before development (Magni and Marchioni, 2020). Project management has, therefore, become crucial as it represents operational death and life

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(Ahmad, 2016). Selection of right project has several future and long-term survival of companies or organizations. Selection of wrong project may lead to project failure and abandonment as well make investors to liquidation (Burke, 2009: 66).

There are various project selection techniques available for organizations and governments. Burke, (2009), outlined various models for evaluation and ranking proposed project for selection and approval. These include numeric, non-numeric, and scoring models. The main focus of these models is to aid decision making leading to project selection in term of financial gain. When choosing a project selection model, the points to consider include; realism, capability, ease of use, flexibility and cost effectiveness. The model must evaluate projects in line with the company's strategic goals and corporate mission. The numeric model considers projects in terms of profit maximization, maximum utilization of the workforce, plant and equipment, increase market share or consolidation of market position (maintain market share), improving the company image and satisfy the needs of the stakeholders and their political aspirations (Burke, 2009). With a numeric value projects can be ranked in line with their contribution to the success of the company.

Therefore, with numeric models' companies tend to prefer financial models and often select solely on profitability (Burke, 2009: 70). More importantly, numeric models have a common limitation factor because they are based on a forecasted cash flow and only look at the financial element of the project. In an attempt to broaden the selection criteria a scoring model called the factor model, which uses multiple criteria to evaluate the project was introduced (Burke, 2009: 79). According to Meredith, (1995) in developing a rating sheet for the factor model a weighted column can be added to increase the score of important factors while reducing the scoring of the less important.

The benefits for using a scoring model include; objectivity in decision making, the used of multiply selection criteria to widen the range of assessment, and easy to change factors. It also uses weighted scoring to reflect the factors' differential importance, making it not biased towards short run projects favoured by financial models. Finally, it is a weighted model which can also be used as a flag to improve projects by identifying the variance between the factors score and the maximum possible score (Burke, 2009 :80). However, the limitations for using a scoring model include; if the factors were not weighted, there will be assumption of equal importance, also a simple model may encourage the development of long lists that could introduce trivial factors, and therefore waste resources and time.

Besides, literature revealed that the existing studies in the building industry in the Sub Sahara Africa including Ghana lacked adequate criteria for project selection and approval (Cho and Gibson 2012; Ahmad, 2016; Magni and Marchioni, 2020). For a project to be initiated, there should be a formal process to establish the need for that project (Ahmad, 2016; Monnappa, 2020). The needs and purposes are important for the implementation of the project. It takes into consideration high-level project definition and scope, as well as existing physical conditions, geographic, and political constraints (Yadollahi and Zin, 2011). The need for the project can be

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identified through various sources, such as the local government, state, or even the federal level. In so doing, the public would have an opportunity to give their opinions and support for the project.

Cooper and Kleinschmidt (2011) discuss a marketplace opportunity whereby demand in the place of the market calls for an organization to meet the need to gain new profits. For communities, the need for roads or pipe-borne water could be at the marketplace opportunity through which governments especially in developing countries can meet such needs. Also, some projects require businesses need while others are not business bias (Kerzner, 2013).

However, Amer and Daim (2011) also agree with most public-based project needs and note that the need would have to stem from the preferences of consumers. Advancement in technology, or even new laws could also lead to organizations and governments pursuing projects that surpass current implementations (Bhaskaran and Ramachandran, 2011; Hwang and Ng, 2013). Once the need is identified, there should be an assessment of the need through preliminary project plans. This could take a week or a year depending on the project type (Vleems, 2018). In some organizations in Pakistan, Ahmad, (2016) noted that the process to determine the need for the project is based on the objectives of the process, orders of the work, and other conditions. At this stage, consistency also assesses how the proposed project could conform to the National Development Defence Goals (Hansen, et al., 2019).

Feasibility and other investment studies are therefore required, concerning project costs and profitability as well as alternatives assessment (Bingham and Gibson, 2017; Quadros and Nassi, 2015: Yadollahi and Zin, 2011). For instance, Kermanshachi, (2016) noted that an advanced plan where alternatives are found before performing detailed analysis with the stakeholders is necessary for project selection. To avoid biases, Ahmad, (2016) suggested that an organized approach should be used to minimize instability and biases. Other considerations before selecting a project outlined are opportunities, increased revenues and return on investment, the attractiveness of the project, and the role of project management (Ahmad, 2016: Dutra, Ribeiro, and de Carvalho, 2014). For organizations, knowledge of the merits and demerits of the proposed choice of methods could be detrimental to their success (Kornfield and Kara, 2011; Teller, Kock, and Gemünden, 2014).

For governments, the project selection of infrastructure proposals may stem from other needs as the method of selection is more complex (Bakshi et al., 2016; Salehi, 2015). A better review is thus needed so that decisions are not influenced by factors other than those that would be geared towards national development. Purnus and Bodea (2014) outline five steps that could aid in the selection of project proposals. First of all, there is a need to establish a criterion that would be used to evaluate the project. This could be done by setting parameters to assess project proposals, also known as decision parameters or criteria (Standards, 2017). Once evaluated, the decision criteria can provide a transparent process (Pan et al., 2012) either qualitatively or quantitatively (Osei-Kyei and Chan, 2015). Secondly, Purnus and Bodea (2014) noted that a score scale for each criterion should be established. There should also be an established scoring method for each

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criterion and further calculations. Lastly, the project list should be in the order of priority based on the score generated. After these are done, the project can begin.

The decision parameter is further organized into five groups, which are a "strategic fit, owner philosophies, project funding and timing, project requirements, and value engineering" (Bingham and Gibson, 2017; Hansen, et al., 2019). The grouping addresses strategic issues concerning projects and significantly contributes to the objectives of every nation (Infrastructure Australia, 2018). In this group, some P.S.C. include the examination of economic issues and stability that may negatively influence the capacity to produce and constrain global competition (Quadros and Nassi, 2015). Also, there may be social and environmental issues to be addressed for the well-being of the community through improved quality of life (Infrastructure Australia, 2018), job creation (Shiau, 2014), reducing inequalities (Quadros and Nassi, 2015), and environmental protection (Yadollahi and Zin, 2011). Team members and stakeholders must coordinate (Bingham and Gibson, 2017), and this can be fully realized when the public is involved. The type of involvement and support could aid in bringing out efficient strategies to improve community engagement in the proposed project (Bingham and Gibson, 2017). There should be the possibility to expand and/or alter the project that has been proposed (Quadros and Nassi, 2015). The risk criterion assesses the risk and uncertainty levels to be faced in the proposed project (Yaddollahi and Zin, 2011).

The project funding and time, deals with detailed goals of the project that are related to timing and funding. Three main criteria are considered: funding and programming, a preliminary schedule of the project, and contingencies. The first assesses the funding sources provided for the project that has been proposed (Bingham and Gibson, 2017; Hansen, et al., 2019). These sources could stem from government entities, the Built operate and transfer financing model of even public-private partnership in the selection criteria (Bingham and Gibson, 2017; Cheung and Chan, 2009). The primary schedule time of the proposed project also comprises the project milestones, consideration of unusual schedules, and contingency time of the master schedule (Bingham and Gibson, 2017; Hansen, et al., 2019). Contingencies are also assessed to mitigate risks in the project.

The information needed on the requirements of the project. Ten criteria are considered: statement of project objectives, functional classification, and use, compliance evaluation, existing conditions of the environment, site characteristics, dismantling and demolition, utility impact determination, workforce, resource handling, and utilization, and work scope.

Stating the project objectives is necessary for prioritization and relates to the criterion on needs and purposes (Bingham and Gibson, 2017; Hansen, et al., 2019). The existing environmental conditions have to be also examined to enable decisions to be made more efficiently while allowing time to address and mitigate problems that may arise. Also, their discrepancy between the characteristics of the site required and that available should be assessed (Bingham and Gibson, 2017).

Project Approval Criteria

The selection of infrastructure project goes hand in hand with its approval worldwide. However, in some cases, delays in approval of the project have been known to lead to project abandonment (Fugar and Agyakwah-Baah, 2010). This is because, approving a project takes a lot of time and resources (Saleman and Jordan, 2014), going through different bodies (if governmental) and management (for organizations). For this reason, in developing countries like Ghana, Fugar and Agyakwah-Baah (2010) noted that funding delay as a result of the approval, especially from the Municipal Assemblies contributes to delays in construction.

The World Bank has prescribed a cycle through which governments in Ghana should go about their projects. Project approval is the fourth phase where all documents are signed by the "board of executive directors" of the World Bank (Ghana procurement Act 2016, Act 914). In this regard, approval is noted to be achieved when all parties involved signing the legal documents which enable the project to commence. Project approval is thus the phase needed for the implementation of projects to begin and is thus a critical stage in the cycle of every project (Damoah and Kumi, 2018; Ghana procurement Act 914, 2016).

Project Approval Requirements

There are different sets of approvals needed for the commencement of each project. Firstly, each project must be selected and approved, after which other approvals follow. According to Damoah and Kumi (2018), stakeholders have the power to influence any project, yet do not pay attention to the details of the project. Governments rely on the sources of financing and approval so that the project does not fail. As such, enough information needs to be provided for the public so that the project progress is not hindered. Stakeholders include government agencies, industry regulators, and regulatory bodies should also be consulted before project approval.

There may also be a hindrance to the approval of project if the project's idea is based on pre-project planning definitions (AlNasseri, 2015). For organizations, stakeholders such as contractors, suppliers, sub-contractors, and clients must be involved in project selection to enhance its approval (Kim and Ballard, 2010). Without their approval, the project has to either be modified or terminated. Kerzner (2017) argues that approval of project scope definition can be improved by considering the different strategies including stakeholder engagement in project scope development. When stakeholders are effectively engaged, the development will be more efficient and relevant to the customers or communities in which the projects are constructed (Fageha and Aibinu, 2013; Nacho and Das, 2014).

Also, a criterion through which project approval can be made possible is with the provision of finance. All projects require funding to succeed and without it, cannot commence. Funding is needed, firstly to conduct feasibility studies that would assist governments in knowing which project to prioritize and ones not viable (Wells, 2015). Projects with higher costs yet limited funding would not be constructed while others with low prices, yet economically advantageous would be pursued. In some cases, corruption leads to a deliberate overestimation of the benefits of the projects, and the costs are underestimated. This could lead to much larger funding and the project may not commence (Wells, 2015). In Zambia, Hawkins and Prado, (2019) noted that about eleven projects examined either had no approved budget or there were issues of overpayment to the contractor. These could affect funding and further approval of projects.

In India, Saleman and Jordan (2014) noted that approval of projects in terms of finance goes through a cumbersome process. In disbursing grants, capacity and incentives are reinforced. With the final approval of the projects comes 10 percent of the first disbursal. Other projects, and their approvals, also have to take place through competition of selected firms. Amidst this, there is also a precondition by the government to pay the consulting fee to the project consultants.

Approval can also be done when all requirements needed for the success of the project are met. For instance, in Angola, in 2011 there is a bridge to be constructed in one of its rural areas, however, upon evaluation, it came to light that, the bridge would be costly and yet lead nowhere. The bridge was therefore not approved by the then government (Wells, 2011). Other requirements would also demand studies to be conducted on the project, calling for other approvals. In Vietnam, Hawkins and Prado, (2019) reported that, the cost estimated for road construction increased in 18 months, between the two approval dates, and there was size reduction from a six-lane to a four-lane.

It is also noteworthy that, when there are more lines of authority, there would have to be longer decision making before project approvals are granted. In India, Saleman and Jordan (2014) added that, the approval process of a project could also be through numerous permits. The complexity of construction works is its impact on some people and has significant implications on health and safety. Thus, several approvals may be mandatory before construction works begin (Fugar and Agyakwah-Baah, 2010; Wells, 2015; Damoah and Kumi, 2018). Usually, the required approvals increase with the complexity, size, and sensitivity of the proposed project. There is a need to acquire planning permission before the project can be approved and initiated. Such a permit is the responsibility of the local planning authorities (Damoah and Kumi, 2018; Abdul Rahman et al., 2016). The obligations are to be met before the permits are acquired. In Ghana, putting up a structure would need permit and registration of land (Fugar and Agyakwah-Baah, 2010). In Scotland, developers must provide a notice to the planning authority soon after the decision on the date to start a development in Regulation 37 of the 1997 Act. The authority in charge of planning may also approve after an environmental impact assessment, site waste management plan among others.

The approval of building regulations could also be necessary as the set-out requirements for specific aspects of the design and construction of the building (Abdul Rahman et al., 2016). An approved inspector may be assigned to the site to evaluate what is needed before the approval is granted. Full details of the proposed building would have to be made and submitted before approval. Other information required could be the emission rate of the building for more advanced countries Damoah and Kumi, 2018; Abdul Rahman et al., 2016; Well, et al., 2015).

Issues on health and safety should be properly considered during the development of a project so that there would be no harm to contractors, users, or structures. To reduce the impact on health and safety, experts should be notified concerning the number of workers, period of construction, and who it may impact. This could lead to more safe zones created for people so that the adverse effects, if any, would not harm them (Agyakwah-Baah, 2010; Wells, 2015; Damoah and Kumi, 2018).

Also, a permit should be sought from the environmental protection agency before the project commences. Some projects might lead to water or air pollution, and in a residential area, could affect residents adversely. An approval is thus needed with alternatives provided so that the public is safe from harm (Abdul Rahman et al., 2016).

Other approvals that may be sought, especially in advanced economies include immunity certificate, designated areas of work, whether there would be the felling of a tree, consent on the use of hazardous substances, licenses to work on highways, and nuclear works. Emergency services should also be provided for large areas in the plans of project managers. This could come from suppliers, insurers, funders, and even telecom providers (Damoah and Kumi, 2018; Abdul Rahman et al., 2016).

Infrastructure Sustainability

Infrastructure development and investment account for the socio-economic growth of every state. They are the backbone for every development (Walkins, 2014; IDB, 2018). Therefore, infrastructure selection and development are crucial for sustainability and investment growth (Haider, et al., 2015; Broman and Robert, 2017; Aizawa, 2019; de Silva, et al., 2020; Shohen, et al., 2020). I.S. has been defined as "projects that are planned, designed, constructed, operated, and decommission in a manner to ensure economic, social, and environmental sustainability" (IDB, 2018; Xue, et. al., 2018). Meng, et al., (2015) defined a sustainable project as "development that meets the needs of the present without compromising the ability of the future generation to meet their need". Moreover, other researchers in the built environment have identified other sustainable factors that could be used. For instance, Shen, et al., (2011) proposed indicators for measuring sustainability, and classified them as "environmental, economic, and social dimensions", using a "fuzzy set" method to "calculate the weighted sustainability scores" for decision-making. Xue, et al., (2018), proposed a normalization procedure, using two indicators: "mandatory screening indicators and judgment indicators" for sustainability evaluation. Besides, Krajangsri and Pongperg, (2017) have proposed eight criteria, which include environmental impact, project management, transport, material and resources, energy, community, water, and waste management. Early, Gan, et al., (2015) had proposed seven indicators including economic feasibility, legislation and regulation, project management, awareness, operability, resource risk, and stakeholder support.

From the literature reviewed it can be identified that most criteria and indicators used to measure sustainability are synergistic with others, requiring trade-off considerations (Holmes, 2015; Pisu, et al., 2015; Bouchet, et al., 2017). Moreover, criteria proliferation and approaches create confusion and could hinder the ability to improve sustainability (Bouchet, et al., 2017; Pisu, et al., 2015). Hence a common criterion will help sustainable infrastructure development goals (Haider, et al., 2015; Gingnell, et al., 2014). In this regard, the study proposes P.S.A.C. for I.S., using four measurement indicators, including a reduction in project abandonment, increase in economic growth, social inclusion, and environmental protection.

Research Methodology

Before the pilot application, 7 sections of quantitative tools items had been written (the background of the respondents, the background of projects, report on the project approval, report on P.S.C., factors influencing project abandonment, impacts of project abandonment, and infrastructure sustainability). The P.S.C. section contains 3 criteria (Basis of project decision, Basis of design, and Execution/operation approach), with 14 sub-criteria and 75 elements. The draft scale, whose items were ordered randomly, was piloted with government officials, community project committee members, professionals, and practitioners in four regions in Ghana (Asante, Bono, Great Accra, and Northern regions). Forty (40) respondents took part in the pilot application, ten from each area. The results were not included in the final quantitative study response. These regions were selected purposively due to their strategic location in the country. Asante represents the central belt, Bono represents the Northwest belt, Great Accra represents the south belt, and the Northern region represents the country's northern belt. As a result of the pilot application, a draft data collection tool filled in by 40 respondents was transferred to the S.P.S.S. 21 software tool. Primary descriptive and inferential statistical analyses were made on the items. After a critical view of the pilot application process, comments, and results, some modifications were made on the item draft and the scales before final administration to the respondents. The purpose of Piloting was to assist in identifying any ambiguous and unclear questions stated (Creswell and Pablo- Clark, 2014). The primary data was collected from key stakeholders of government projects such as government officials involved in project selection and approval, consultants, who have registered in M.M.D.A.s for project contact, and end-users. These respondents were purposively selected from all the regions (16) in Ghana. The questionnaire was intended to respond to the hypotheses of the study, these include the relationship between P.S.C. and infrastructure sustainability, project approval requirements (P.A.R.), and infrastructure sustainability.

A sample size of S.E.M. could be estimated using these factors: "significant level of 5%, the statistical power of 80%, and at least R2 Values of (0.25), including the number of arrows pointing at a latent variable in S.E.M. design" (Hair, et al., 2013: Sarstedt, Ringle, and Hair, 2017). Using these factors, a "minimum sample size required" could be found in the table introduced by (Marcoulides and Saunders, 2006). However, research conducted by (Hoyle, 1995), proposed, "sample size of 100 to 200 as a good starting point for path modeling. Moreover, Ringle, et al., (2005) suggested a maximum sample size of 300, with an explanation that "sample size will need to be increased if the research objective is to explore low- value factor intercorrelations with indicators that have poor qualities". The quantitative phase of the study was conducted on three hundred and twenty (320) stakeholders who were either project selectors, approvers, advisors, or designers responsible for government projects. It was estimated that for each of the 16 regions in Ghana, survey instruments would be administered to each of the listed stakeholders. That is, 16 planning officers, 16 physical planners, 16 head of works, 16 budget officers, 16 presiding members, 16 coordinating directors, 16 end users, 16 estimators/valuers, 16 structural engineers, 16 contractors, 16 architects, 16 environmentalists, 16 land economists, 16 estate managers, 16 quality controllers, 16 facility operation managers, 16 maintenance officers, 16 consultants, 16 project managers, and 16 community development members from each of the regions, giving a total of 20 respondents in each of the 16 regions, thus (20 x 16 = 320). Information about these respondents is shown in table 1. Variables could be classified as "exogenous or endogenous" (Wong, 2013) in the S.E.M. model. The "exogenous variable" has path arrows pointing outwards and none leading to it. However, the "endogenous variable" has at least one path leading to it (Ringle, 2013; Hair, et al., 2011: 2017), showing the effects of other variables (s). Depending on the S.E.M. design, a variable can technically, acts as an "independent variable or a dependent variable" (Wong, 2013; Hair, et. al., 2017) from different "parts of the model" (Wong, 2013: 2019), as long as a "variable has a path leading to it" (Ringle, et. al., 2013; Hair, et al., 2011: 2017).

The appropriateness of the proposed model and the study's finding was measured using "reliability and validity" tests. Flynn, et al (1994) submitted that "reliability and validity", give sureness and assurance that the "empirical findings" were accurate and adequately reflect the proposed constructs.

Findings

Background information on the respondents

Table: 1 list of key stakeholders as respondents

Position	*Frequency*	*Percentage*
Planning officer	*38*	*11.9*
Physical planner	*43*	*13.4*
Head of works	*51*	*15.9*
Budget Officer	*30*	*9.4*
Presiding Member	*16*	*5.0*
Coordinating Director	*9*	*2.8*
End-user	*6*	*1.9*
Structural Engineer	*18*	*5.6*
Contractor	*10*	*3.1*
Environmentalist	*12*	*3.8*
Consultant	*70*	*21.9*
Project Manager	*5*	*1.6*
Community Project Committee Member	*12*	*3.8*
Total	***320***	***100***

Respondents' role in the project selection and approval process

Table 2: Respondents' role

Role	*Frequency*	*Percentage*
Project Selector	*48*	*15.00*
Project Approver	*21*	*6.56*
Adviser	*214*	*66.88*
Designers	*37*	*11.56*
Total	***320***	***100.00***

Structural Equation Model Evaluation and Results

The PLS-SEM estimation was performed using Smart PLS 3.3.2. The estimation of the relationships between P.S.C. and P.A.R. on the outcome of I.S. was ascertained using PLS-SEM to address the hypotheses. The model initially had nine constructs. Five constructs constituting P.S.C. are project selection strategy, project design consideration, project requirement plan, project execution control and project operation strategy. Additionally, four constructs constituting P.A.R. are: project needs assessment, infrastructure prioritization, project permits risk mitigation plan. The outcome of I.S. measured with multiple sub-constructs presented separately as constructs in the model measured using a "five-point scale 1: strongly disagree; 2: disagree; 3: neither; 4: Agree; 5: Strongly agree". According to (Hair, et al., 2011; 2012a, b, c, 2013a; 2014, and Chin, (2010), the measurement model must be assessed and supported before the structural model evaluation.

Construct Reliability

Construct reliability dealt with the "internal consistency" of the "measurement model" according to (Al-Alawi, 2017). The employed measurement techniques used in this study were "Cronbach's alpha (C.A.) and composite reliability (C.R.)" having values greater than 0.70 for acceptance, 0.80 to be adequate and above 0.90 to be excellent. The "Cronbach's alpha" for the constructs ranged from 0.751 to 0.946 indicating very good internal consistency, "composite reliability coefficients" for the constructs ranged from 0.840 to 0.956 indicating adequate "internal consistency" (Table 3 and Table 4). The convergent validity was assessed using AVE as a criterion for reflective indicators. The value of AVE has a threshold of 0.5 or higher to signify adequate "convergent validity" (Hair, et al., 2014). The AVE values in the study were higher for all the constructs within the conventional point of 0.50(50%) (all indicators greater or equal to 0.5). This supported the model's convergent validity, suggesting that at least half of the variance in the latent constructs was explained on average.

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Table 3: Assessment of Measurement Model

Construct / Indicator	Factor Loadings	C.R.	Cronbach's Alpha	AVE	Full Collinearity V.I.F.s
Project Needs Assessment	-	0.885	0.837	0.609	1.291
PNA2 the key stakeholders were engaged	0.687				
PNA3 economic growth factors were considered	0.840				
PNA4 social development factors were considered	0.848				
PNA5 community identification was considered	0.821				
PNA6 environmental protection factors were considered	0.690				
Infrastructure Prioritization	-	0.896	0.856	0.634	1.373
IP4 community developmental agenda was considered	0.761				
IP5 fitness into national development plan was considered	0.793				
IP6 availability funds were considered	0.797				
IP7 investment readiness was considered	0.806				
IP8 economic growth was considered	0.822				
Project Permit	-	0.840	0.751	0.568	1.728
PP4 operation permit was acquired	0.717				
PP5 procurement permit was given	0.780				
PP6 there was a waste management plan	0.802				
PP7 health and safety policy was provided	0.711				
Risk Mitigation Plan	-	0.861	0.786	0.609	1.706
RMP1, there was a risk mitigation plan	0.765				
RMP2 security measures were provided	0.793				
RMP3 compensation package was provided for affected people	0.838				
RMP4 there were health and safety provisions	0.722				
Project Selection Strategy	-	0.855	0.746	0.663	1.078
PSS3 economic analysis was considered	0.752				
PSS4 social analysis was considered	0.866				
PSS7 project objectives statement was considered	0.821				
Project Requirements Plan	-	0.956	0.946	0.755	1.059
PRP1value-analysis was done	0.880				
PRP2 there was a budget available	0.884				
PRP3 project schedules were considered	0.824				
PRP4 the project cost estimate was adequately done	0.863				
PRP5 there contingencies for the project	0.879				
PRP6 there was a program statement for the project	0.870				
PRP7 there was provision for critical resources	0.882				

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Table 1: Assessment of Measurement Model (Cont.)

Construct / Indicator	Factor Loadings	CR	Cronbach's Alpha	AVE	Full Collinearity VIFs
Project Execution Control	-	0.956	0.947	0.729	**1.060**
PEC1 project delivery method was safe	0.844				
PEC2 there was coordination among the key stakeholders	0.869				
PEC3 there was project schedule control	0.844				
PEC4 there were project schedule control techniques	0.850				
PEC5 there was a quality control procedure	0.842				
PEC6 there were cost control techniques	0.859				
PEC7 there were safety procedures	0.882				
PEC8 there was a risk management method	0.843				
Project Operation Strategy	-	0.890	0.836	0.671	**1.622**
POS2 there was a policy for maintenance and repair of the project	0.854				
POS3 there were staff training for the project	0.850				
POS4 there was orientation for the project operators	0.832				
POS5 there was a policy for the project decommission	0.733				
Outcome of Infrastructure Sustainability	-	0.944	0.937	0.470	-
RIPA1 The project is commissioned	0.718				
RIPA2 The project is in operation	0.752				
RIPA3 The community is identified with the project	0.776				
RIPA4 Infrastructure development has Increased	0.773				
RIPA5 There was a reduction in resource wastage	0.761				
RIPA6 reduction in infrastructure gap	0.705				
EG1 increase in employment opportunities	0.635				
EG2 increase in revenue accruable to the state	0.609				
EG3 Increase income from real proprty	0.655				
SI1 End- users satisfaction	0.597				
SI2 increase in social value	0.686				
SI3 Reduces migration of the population	0.645				
SI4 Poverty reduction	0.655				
SI5 Community involvement	0.628				
EP1 Reduce negative effects on the environment	0.738				
EP2 Reduce environmental pollution	0.661				
EP3 Sustain the environmental resources	0.647				
EP4 Beautification of the environment	0.676				
EP5 Emphases on green building/Smart building	0.664				

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Structural Relationship Model

The final step after successfully examined the construct measures and found to be reliable and valid for the structural model outcome (Hair, et al., 2017). The study's postulated hypothesis measured the analysis of the "structural model" to provide a detailed outcome and a picture of the result. Before the analysis, the relationship between the features consisted of P.S.C. and P.A.R., and the response variable outcome of infrastructure sustainability was simultaneously determined. The "structural model" in PLS-SEM does not apply measures of goodness of fit but is based on "heuristic criteria" that establish the "model's predictive capabilities" as shown in Figure 1 (Hair, et al., 2016).

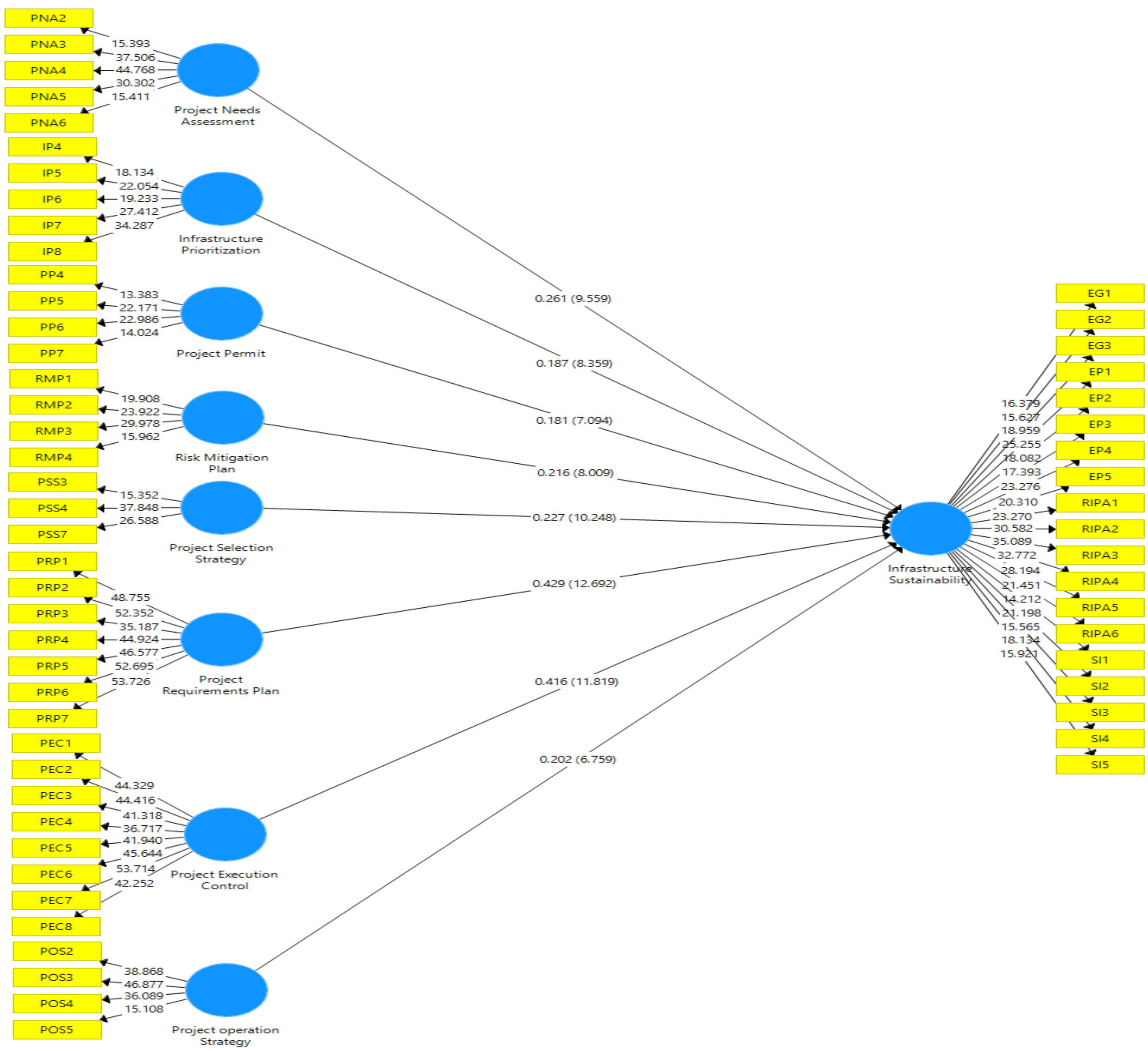

Figure1: The Results of the Structural Relationship Model

Hypotheses Evaluation

The “coefficient of determination” (R2) measuring the predictive power of the model, the value of the path coefficient β, p-value, which measured the “significance of the path coefficients”, and predictive relevance using Q-square. Akter, Ambra, and Ray (2011) defined (R2) as the degree of the model variance explained by the feature variables. According to Hair, et al., (2014), the (R2) coefficient denotes the feature variables joined effect on the response variable(s). The coefficient is the squared correlation of the actual and predicted values and therefore measures the amount of variance in the response constructs explained by the joint feature variables connected to.

The (R2) ranges from 0 to 1 where a higher value close to 1 indicates a higher level of predictive accuracy. According to Hair, et al., (2014), (R2) value of 0.25 was considered weak, while the (R2) value of 0.50 was deemed to be moderate, and (R2) value of 0.75 and above is substantial.

Lleras (2005) explained β as the strength of an effect from the feature variables to the response variables. The “path coefficient” has a standardized value ranging from -1 to 1 where values closer to 1 indicate a strong positive relationship and vice versa for negative value (Hair, et al., 2014). The significance of the “path coefficients” in the study was determined using the bootstrapping method setting it at 5000 bootstrapping reliant on its standard error. This method of estimation permits computing the empirical t-value and significance (p-value). The criterion was that, when the t-value was more significant than the critical value, the coefficient was statistically significant at a certain specified error probability (Hair, et al., 2014). From Table 5, the (R2) value was more significant than the recommended substantial (R2) value of 0.75. The result indicated that the predictive capability of the model was robust.

Table 5: Results of Hypothesis Testing

Hypothesis	Path	Path Coefficient	t-value	p-value	Decision
Hypothesis One					
H1a	PSS --> OIS	0.227	10.248	0.000	Supported
H1c	PRP --> OIS	0.429	12.692	0.000	Supported
H1d	PEC --> OIS	0.416	11.819	0.000	Supported
H1e	POS --> OIS	0.202	6.759	0.000	Supported
Hypothesis Two					
H2a	PNA --> OIS	0.261	9.559	0.000	Supported
H2b	IP --> OIS	0.187	8.359	0.000	Supported
H2c	PP --> OIS	0.181	7.094	0.000	Supported
H2d	RMP --> OIS	0.216	8.009	0.000	Supported
R-square and Q^2 coefficients					
Dependent Variable		R^2-coefficient	Q^2 Coefficient	Assessment	
The outcome of infrastructure sustainability		0.882	0.407	Strong effect	

Relationship between Project Selection Criteria and Infrastructure Sustainability

Table 5 shows that the hypothesized relationship between project selection strategy (P.S.S.) and infrastructure sustainability (I.S.) produced a standardized path coefficient of 0. 227, high correction of 0.312, t-value of 10.284, and p-value of 0.000. The t-value is above the threshold, and the correction value is positively high, indicating that the relationship is supported. This means that project selection strategy, which one of the criteria for project selection, is directly related to I.S., which is the core objective of infrastructure development. This group addresses strategic issues concerning the proposed project and significant contributions to the socio-economic. The project selection strategy comprises (1) Economic analysis (2) Social consideration and (3) Project objectives/statement.

Economic analysis: this group of criteria scrutinizes the effects of the project on the economy. (Infrastructure Australia, 2018; Yadollahi and Zin, 2011; Quadros and Nassi, 2015). It examines opportunities, revenue growth, and return on investment, including the attractiveness of the project (Ahmad, 2016; Dutra, et. al., 2014). Social consideration: this criterion is aimed at assessing the impacts of the project on the “well-being of the community” (Infrastructure Australia,2018: Budiman and Gunarta, 2018; Wales,2016; Quadros and Nassi, 2015). It appraises issues such as quality of life (Infrastructure Australia, 2018), job creation (Shiau, 2014), and reduction of social and regional inequalities (Quadros and Nassi, 2015). Project objectives/statement: this criterion is aimed at assessing the priorities of the proposed project regarding objectives and mission statements (LIST, 2013).

The relationship between the project requirement plan (P.R.P.) and I.S. exhibited a standardized path coefficient of 0. 429, a high correction of 0.524, a t-value of 12.692, and a p-value of 0.000 (table 5). The t-value is above the threshold, and the correction value is positively high, indicating that the relationship between the project requirement plan and I.S. is supported. This criteria group provides information needed on the project to achieve its requirements. It involves (1) Value-analysis/investment studies, (2) Budget allocation, (3) project schedule, (4) Project cost estimate, (5) Contingency, (6) program statement (7) provision of critical resources.

Value-analysis/investment studies: this criterion is required for assessing and evaluating investment feasibility of the proposed project regarding project costs (Yadollahi and Zin, 2011), profitability (Quadros and Nassi, 2015; Yadollahi and Zin, 2011; LIST, 2013), by comparing to alternative projects (LIST, 2013). Budget allocation: is making funds and infrastructure services available for implementation of the proposed project. Project schedule: this criterion evaluates proposed timelines for the project (LIST, 2013; Budiman and Gunarta, 2018). The schedule includes project milestones, consideration of unusual schedules, and contingency time of the master schedule (LIST, 2013). Project cost estimate: this criterion examines the available funds required to enhance design and construction (LIST, 2013). Contingencies: this criterion is aimed at mitigating risk in the proposed project by assessing contingencies assigned to the project (LIST, 2013). Program statement/work scope: this criterion examines whether the work scope conformed to the “Work Breakdown Structure” and work sequence development (LIST, 2013).

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Provision for critical resources: the purpose of this criterion includes examining the proposed project resources, handling, and utilization. (Hansen, et. al., 2019; Lindhard and Wandahl, 2013).

The outcome of the study gives an in-depth knowledge of the conceptual relationship between project execution control (P.E.C.) and infrastructure sustainability (I.S.). The findings further suggest a significant relationship between project execution control and I.S. Table 5 shows that this relationship exhibited a standardized path coefficient of 0. 416, a high correction of 0.530 (Table 25). The t-value (11.819) is above the threshold, and the correction value is positively high, indicating that the relationship between project execution control and I.S. is supported.

This criteria group concern details of the project execution control regarding the safe method of delivery, risk management, and coordination among the key stakeholders (Budiman and Gunarta, 2018; Queensland Treasury, 2015; LIST, 2013; Cheung and Chan,2009). It involves eight criteria, such as; Project delivery method/compliance evaluation: this criterion analyses the proposed project's adherence requirements to other plans that exist (Budiman and Gunarta, 2018), including standards (LIST 2013) and regulations (Budiman and Gunarta, 2018). Coordination among the key Stakeholders: this criterion is aimed at assessing engagement and coordination among stakeholders of the project, including team members (LIST, 2013).

Project schedule control: this criterion is aimed at providing guidelines needed to maintain the schedule of the proposed project (LIST, 2013). Its focus lies in specific controls of operations and planned schedules. (Queensland Treasury, 2015; LIST, 2013; Yadollahi and Zin, 2011). Quality control procedure: is aimed at assessing the quality of project delivery and operations to address and mitigate problems (Lindhard and Wandahl, 2013; LIST, 2013; Yadollahi and Zin, 2011). Cost control techniques: is aimed at considering alternative materials for the proposed project. It assesses the "cost-effective materials selection, use of local materials, and cost-effectiveness during construction" (LIST, 2013). Safety procedures: this criterion is aimed at providing guidelines needed to maintain the operations and safety of the proposed project (LIST, 2013). Its focus lies in specific controls of processes and planned maintenance (Queensland Treasury, 2015; LIST, 2013; Yadollahi and Zin, 2011). Risk management method: this criterion evaluates the risk/uncertainty levels to be faced in the proposed project (Infrastructure Australia, 2018; LIST, 2013; Yadollahi and Zin, 2011).

Moreover, the analysis of the result in Table 6 indicates that project operation strategy (P.O.S.) has a significant influence on I.S. The result shows a standardized path coefficient of 0.202, a high correction of 0.425 (Table 5). The t-value (6.759) is above the threshold and the correction value is positively high, indicating that the relationship between the project requirement plan and I.S. is supported. This group of criteria aimed at examining the overall effectiveness of the project function/operation for value enhancement. There are four criteria in this group. Policy for maintenance and repair: this criterion is aimed at providing guidelines needed to maintain the operations, planned maintenance and safety of the proposed project (Queensland Treasury, 2015; LIST, 2013; Yadollahi and Zin, 201). Project staff training/ workforce orientation: this criterion is aimed at assessing the workforce requirements for the project. The workforce is a vital resource as well as their health (Lindhard and Wandahl, 2013). Policy for the project decommissions: this criterion is aimed at evaluating the requirements for the demolition of the project, operations, timing, and permits (LIST, 2013).

Hypothesized Relationship between Project Approval Requirements and Infrastructure Sustainability

The relationship between P.A.R. shows that the relationship between project needs assessment and I.S. exhibited a standardized path coefficient of 0. 261, a high correction of 0.349 (Table 6), a t-value of 9.559, and a p-value of 0.000. The t-value is above the threshold, and the correlation value is positively high, indicating that the relationship between the project requirement plan and I.S. is supported. Project Need Assessment (PNA): This criterion evaluates the need for the proposed project (Queensland Treasury, 2015: LIST, 2013). For a project to be initiated, there should be a formal process to establish the need for that project (Ahmad, 2016). The needs and purposes are established by asking why it is crucial to implement the project. It takes into consideration community and stakeholders' engagement (LIST, 2013), as well as existing physical conditions, economic issues, social, and environmental protection issues (Yadollahi and Zin, 2011: LIST, 2013).

Regarding the relationship between infrastructure prioritization (I.P.) and infrastructure sustainability (I.S.), the results show that the relationship between infrastructure prioritization and I.S. exhibited a standardized path coefficient of 0. 187, t-value of 8.359, and p-value of 0.000. The t-value is above the threshold, and the correlation value is positively high, indicating that the relationship between I.P. and I.S. is supported. This criterion is aimed at evaluating the proposed project conformity or fitness into "National Development Goals/Plan" (Budiman and Gunarta, 2018; Infrastructure Australia, 2018), impacts and effects of the project on government agenda and economy of the state (Budiman and Gunarta, 2018; Wales, 2016), government priorities as well as the community developmental agenda. It assesses the risks and availability of funds for the project, including social benefits, socio- Economic growth, and Investment readiness. Moreover, on the relationship between project permits (P.P.) and infrastructure sustainability (I.S.), the results show that the relationship between project permits and I.S. exhibited a standardized path coefficient of 0. 181, a high correction of 0.379 (Table 25), a t-value of 7.094, and a p-value of 0.000. The t-value is above the threshold and the correlation value is positively high, indicating that the relationship between infrastructure prioritization (I.P.) and I.S. is supported. The process of infrastructure project approval goes through several permits due to the complex nature of construction works. The construction of many infrastructure projects impacts some people and has significant implications on health and safety, including the environment. Thus, several approvals (permits) may be mandatory before construction works begin.

Also, a permit should be sought from the Environmental Protection Agency before the project commences. Some projects might lead to water or air pollution, and when in a residential area, could affect residents adversely. An approval is thus needed with alternatives provided so that

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the public is safe from harm. Other permits include operation and procurement permits, as well as a waste management plan, health and safety policy, and indemnity certificate.

Finally, the findings give an in-depth knowledge regarding the relationship between the risk management plan (RMP) and infrastructure sustainability (I.S.). The finding suggested a significant relationship between the risk management plan (RMP) and I.S. Table 5 shows that this relationship exhibited a standardized path coefficient of 0. 216, a high correction of 0.314, a t-value of 8.009, and a p-value of 0.000. The t-value is above the threshold, and the correlation value is positively high, indicating that the relationship between project execution control and I.S. is supported. Studies confirmed that issues regarding risk in the project should be adequately considered during the development of a project so that there would be no harm to contractors, users, structures, or the environment.

Before construction begins, and throughout the process, the project managers must ensure that a notice is displayed in areas where there is more likely to be harmful so that individuals and groups passing by are made aware. This could lead to more safe zones being created for people so that the adverse effects, if any, would not harm them without these, project approval would not be granted.

Besides, the analysis of the result indicates that the outcome of I.S. has a strong effect with an R2-coefficient of 0.882 and a Q2 Coefficient of 0.407. This implies that in choosing a project selection criterion and approval requirement, the outcome of I.S. should be considered. The study defines I.S. as “projects that are planned, designed, constructed, operated, and decommission in a manner to ensure economic, social, and environmental sustainability” (IDB, 2018; Xue, et. al., 2018).

From the literature it can be identified that most criteria and indicators used to measure sustainability are synergistic with others, requiring trade-off considerations (Holmes, 2015; Pisu, et. al., 2015; Bouchet, et.al., 2017). Moreover, criteria proliferation and approaches create confusion and could hinder the ability to improve sustainability (Bouchet, et.al., 2017; Pisu, et. al., 2015). Hence a common criterion will help sustainable infrastructure development goals (Haider, et. al., 2015; Gingnell, et. al., 2014). In this regard, this study proposes P.S.A.C. for I.S., using four measurement indicators, including a reduction in project abandonment, an increase in economic growth, social inclusion, and environmental protection.

Conclusion

The findings revealed that many completed infrastructure projects have been abandoned as a result of inadequate selection and approval criteria used for the projects. It was clear from the literature review and face to face interview that the negative impacts of these abandoned projects were significant to I.S. These include project abandonment issues, economic, social, and environmental problems. This study, therefore, offered synthesized indicators and presented them under the following reduction in project abandonment, increase in economic growth, social inclusion, and environmental protection. The S.E.M. developed had eight constructs; four constructs constituting P.S.C. which are project selection strategy, project requirement plan, project execution control and project operation strategy. Additionally, four constructs constituting P.A.R.: project needs assessment, infrastructure prioritization, project permits risk mitigation plan. The conceptual model theorized that P.S.C. had a significant impact on I.S. Besides, the P.A.R. positively influences infrastructure sustainability. Besides, the proposed model could be used to select and approve infrastructure projects and predict I.S. Previous studies have tried to model I.S. in terms of environmental, social, and economic factors. Moving away from the existing theories, this study has shown that there are more than the current factors that can influence I.S. The outcome of the PLS-SEM analysis indicates that P.S.C. has a significant impact on I.S., specifically, all the sub-PSC such P.S.S., P.R.P., P.E.C., and P.O.S. obtained a positive effect on infrastructure sustainability. The result also shows that the P.A.R. had a positive influence on I.S., importantly all sub- approval requirements such as N.A., I.P., P.P., and RMP have a positive impact on I.S. The outcomes of I.S., namely, reduction in project abandonment, environmental protection, increase in economic growth, and social inclusion, achieved a high R2 value (0.882) and a Q2 value (0.407), showing a strong effect or outcome. These outcome variables could be used to select and approve infrastructure projects; they could also measure and predict I.S.

Recommendation

Continuous professional development training (C.P.D.) should be made mandatory for project designers, selectors, approvers, and advisers to understand and adopt the proposed project selection and approval criteria model to improve infrastructure sustainability performance and enhance project selection and approval practices. Further, governments (clients) of public infrastructure projects should understand the proposed model to include them in their design brief as deliverables factors. All stakeholders include end-users, should be involved in the project selection and approval process. And project selectors, approvers, designers, and advisers recognize sustainable indicators to make project performance planning, selection, approval, monitoring, and control possible.

References

Ahmad, B., 2016. Project Selection Techniques, Relevance & Applications in Pakistan. International Journal of Technology and Research, 4(2), pp.52-60.

AlNasseri, H.A., 2015. Understanding Applications of Project Planning and Scheduling in Construction Projects. Department of Construction Sciences, Lund University.

Aizawa, M., 2019. Sustainable development through quality infrastructure: emerging focus on quality over quantity. Journal of Mega Infrastructure & Sustainable Development, 1(2), pp.171-187.

Arif, F., Bayraktar, M.E. and Chowdhury, A.G., 2016. Decision support framework for infrastructure maintenance investment decision making. Journal of Management in Engineering, 32(1), p.04015030.

Ariffin, N.F., Jaafar, M.F.M., Ali, M.I., Ramli, N.I., Muthusamy, K. and Lim, N.H.A.S., 2018. Investigation on factors that contribute to the abandonment of building in construction industry in Malaysia. In E3S Web of Conferences (Vol. 34, p. 01025). EDP Sciences.

Australia, I., 2018. Assessment Framework: For initiatives and projects to be included in the Infrastructure Priority List. March, Infrastructure Australia, Sydney, N.S.W., Australia.

Bakshi, T., Sinharay, A., Sarkar, B. and Sanyal, S.K., 2016. Introduction to soft-set theoretic solution of project selection problem. Benchmarking: An International Journal.

Bouchet, M.I.D.B., Martin, J.M., Avila, J., Kano, M., Yoshida, K., Tsuruda, T., Bai, S., Higuchi, Y., Ozawa, N., Kubo, M. and Asensio, M.C., 2017. Diamond-like carbon coating under oleic acid lubrication: Evidence for graphene oxide formation in super low friction. Scientific reports, 7(1), pp.1-13.

Broman, G.I. and Robèrt, K.H., 2017. A framework for strategic sustainable development. Journal of Cleaner Production, 140, pp.17-31.

Budiman, R.S. and Gunarta, I.K., 2018. Development progress monitoring system in Engineering Procurement Construction (E.P.C.) company with Earn Value Analysis (E.V.A.) approach based on web mobile. In M.A.T.E.C. Web of Conferences (Vol. 204, p. 03012). EDP Sciences.

Cha, Y., Kim, J., Hyun, C.T. and Han, S., 2018. Development of a Program Definition Rating Index for the Performance Prediction of Construction Programs. Sustainability, 10(8), p.2747.

Chan, A.P. and Owusu, E.K., 2017. Corruption forms in the construction industry: Literature review. Journal of Construction Engineering and Management, 143(8), p.04017057.

Chang, A.P., Chou, C.C., Lin, J.D. and Hsu, C.Y., 2013. Road construction project environmental impact assessment scope definition using project definition rating index (P.D.R.I.). In Advanced Materials Research (Vol. 723, pp. 885-892). Trans Tech Publications Ltd.

Cheung, E. and Chan, A.P., 2009. Is B.O.T. the best financing model to procure infrastructure projects?. Journal of Property Investment & Finance.

Cho, C.S. and Gibson, Jr, G.E., 2000. Development of a project definition rating index (P.D.R.I.) for general building projects. In Construction Congress VI: Building Together for a Better Tomorrow in an Increasingly Complex World (pp. 343-352).

Collins, W.A., 2015. Development of the project definition rating index (P.D.R.I.) for small industrial projects. Arizona State University.

Damoah, I.S. and Kumi, D.K., 2018. Causes of government construction projects failure in an emerging economy. International Journal of Managing Projects in Business.

da Silva, J., Fernandes, V., Limont, M. and Rauen, W.B., 2020. Sustainable development assessment from a capitals perspective: Analytical structure and indicator selection criteria. Journal of Environmental Management, 260, p.110147.

Dutra, C.C., Ribeiro, J.L.D. and de Carvalho, M.M., 2014. An economic–probabilistic model for project selection and prioritization. International Journal of Project Management, 32(6), pp.1042-1055

ElZomor, M.A., 2017. Development of the Project Definition Rating Index (P.D.R.I.) for small infrastructure projects (Doctoral dissertation, Arizona State University).

Fageha, M.K. and Aibinu, A.A., 2013. Managing project scope definition to improve stakeholders' participation and enhance project outcome. Procedia-Social and Behavioral Sciences, 74(29), pp.154-164.

Fugar, F.D. and Agyakwah-Baah, A.B., 2010. Delays in building construction projects in Ghana. Australasian Journal of Construction Economics and Building, The, 10(1/2), p.128.

Gan, X., Zuo, J., Ye, K., Skitmore, M. and Xiong, B., 2015. Why sustainable construction? Why not? An owner's perspective. Habitat International, 47, pp.61-68.

Gingnell, L., Franke, U., Lagerström, R., Ericsson, E. and Lilliesköld, J., 2014. Quantifying success factors for I.T. projects—an expert-based Bayesian model. Information systems management, 31(1), pp.21-36.

Hair, J.F., Risher, J.J., Sarstedt, M. and Ringle, C.M., 2019. When to use and how to report the results of PLS-SEM. European Business Review.

Hair, J.F., Sarstedt, M., Pieper, T.M. and Ringle, C.M., 2012. The use of partial least squares structural equation modeling in strategic management research: a review of past practices and recommendations for future applications. Long range planning, 45(5-6), pp.320-340.

Hair, J.F., Sarstedt, M., Pieper, T.M. and Ringle, C.M., 2012c. Applications of partial least squares path modelling in management journals: A review of past practices and recommendations for future applications. Long Range Planning, 45(5-6), pp.320-340.

Hair, J.F., Sarstedt, M., Ringle, C.M. and Mena, J.A., 2012. An assessment of the use of partial least squares structural equation modelling in marketing research. Journal of the academy of marketing science, 40(3), pp.414-433.

Hair, J.F., Sarstedt, M., Ringle, C.M. and Mena, J.A., 2012b. An assessment of the use of partial least squares structural equation modelling in marketing research. Journal of the academy of marketing science, 40(3), pp.414-433.

Hair, J., Hollingsworth, C.L., Randolph, A.B. and Chong, A.Y.L., 2017. An updated and expanded assessment of PLS-SEM in information systems research. Industrial Management & Data Systems.

Hair Jr, J.F., Hult, G.T.M., Ringle, C. and Sarstedt, M., 2016. A primer on partial least squares structural equation modeling (PLS-SEM). Sage publications.

Hair Jr, J.F., Matthews, L.M., Matthews, R.L. and Sarstedt, M., 2017. PLS-SEM or CB-SEM: updated guidelines on which method to use. International Journal of Multivariate Data Analysis, 1(2), pp.107-123.

Haider, H., Sadiq, R. and Tesfamariam, S., 2015. Selecting performance indicators for small and medium sized water utilities: Multi-criteria analysis using E.L.E.C.T.R.E. method. Urban Water Journal, 12(4), pp.305-327.

Hansen, S., Too, E. and Le, T., 2019. Criteria to consider in selecting and prioritizing infrastructure projects. In M.A.T.E.C. Web of Conferences (Vol. 270, p. 06004). EDP Sciences.

Invest, I.D.B. (2018), What is Sustainable Infrastructure? A Framework to Guide Sustainability Across the Project Cycle.

Kerzner, H., 2017. Project management metrics, KPIs, and dashboards: a guide to measuring and monitoring project performance. John Wiley & Sons.

Kim, Y.W. and Ballard, G., 2010. Management thinking in the earned value method system and the last planner system. Journal of management in engineering, 26(4), pp.223-228.

Krajangsri, T. and Pongpeng, J., 2017. Effect of sustainable infrastructure assessments on construction project success using structural equation modeling. Journal of Management in Engineering, 33(3), p.04016056.

Le, Y., Shan, M., Chan, A.P. and Hu, Y., 2014. Overview of corruption research in construction. Journal of management in engineering, 30(4), p.02514001.

Lindhard, S. and Wandahl, S., 2013. Looking for improvement in the last planner system: defining selection criteria. In I.C.C.R.E.M. 2013: Construction and Operation in the Context of Sustainability (pp. 27-35).

LIST, F.W.L.T.S., 2010. City Infrastructure Investment Programming & Prioritisation Toolkit.

Mac-Barango, D., 2017. Construction project abandonment: an appraisal of causes, effects and remedies. World Journal of Innovation and Modern Technology, 1, pp.1-10.

Magni, C.A. and Marchioni, A., 2020. Average rates of return, working capital, and NPV-consistency in project appraisal: A sensitivity analysis approach. International Journal of Production Economics, p.107769.

Meng, J., Xue, B., Liu, B. and Fang, N., 2015. Relationships between top managers' leadership and infrastructure sustainability. Engineering, Construction and Architectural Management.

Meng, J., Yan, J. and Xue, B., 2018. Exploring relationships between national culture and infrastructure sustainability using Q.C.A. Journal of Construction Engineering and Management, 144(9), p.04018082.

Holmes, M., 2015. Water infrastructure vulnerability due to dependency on third party infrastructure sectors (Doctoral dissertation, Newcastle University).

Osei-Kyei, R. and Chan, A.P., 2015. Review of studies on the Critical Success Factors for Public–Private Partnership (P.P.P.) projects from 1990 to 2013. International journal of project management, 33(6), pp.1335-1346.

Pan, W., Dainty, A.R. and Gibb, A.G., 2012. Establishing and weighting decision criteria for building system selection in housing construction. Journal of Construction Engineering and Management, 138(11), pp.1239-1250.

Pisu, M., Pels, B. and Bottini, N., 2015. Improving infrastructure in the United Kingdom.

Purnus, A. and Bodea, C.N., 2014. Project prioritization and portfolio performance measurement in project oriented organizations. Procedia-Social and Behavioral Sciences, 119, pp.339-348.

Quadros, S.G.R. and Nassi, C.D., 2015. An evaluation on the criteria to prioritize transportation infrastructure investments in Brazil. Transport Policy, 40, pp.8-16.

Rydin, Y., Natarajan, L., Lee, M. and Lock, S., 2018. Do local economic interests matter when regulating nationally significant infrastructure? The case of renewable energy infrastructure projects. Local economy, 33(3), pp.269-286.

Salehi, K., 2015. A hybrid fuzzy M.C.D.M. approach for project selection problem. Decision Science Letters, 4(1), pp.109-116.

Shao, F., Peng, R., Lai, H. and Wang, B., 2017. DRank: A semi-automated requirements prioritization method based on preferences and dependencies. Journal of Systems and Software, 126, pp.141-156.

Shen, L., Wu, Y. and Zhang, X., 2011. Key assessment indicators for the sustainability of infrastructure projects. Journal of construction engineering and management, 137(6), pp.441-451.

Shiau, T.A., 2014. Evaluating transport infrastructure decisions under uncertainty. Transportation Planning and Technology, 37(6), pp.525-538.

Sustainable, A.F., 2014. I.I.S.D.

Treasury, Q., 2015. The State of Queensland (Queensland Treasury) Project Assessment Framework.

Wales, I.N.S., 2016. Infrastructure Investor Assurance Framework–Gateway Coordination Agency Framework for Capital Projects under the N.S.W. Gateway Policy.

Wong, K.K.K., 2011. Book review: Handbook of partial least squares: Concepts, methods and applications.

Wong, K.K.K., 2013. Partial least squares structural equation modeling (PLS-SEM) techniques using SmartPLS. Marketing Bulletin, 24(1), pp.1-32.

Wong, K.K.K., 2019. Mastering partial least squares structural equation modeling (PLS-Sem) with Smartpls in 38 Hours. iUniverse.

Xue, B., Liu, B. and Sun, T., 2018. What matters in achieving infrastructure sustainability through project management practices: A preliminary study of critical factors.
Sustainability, 10(12), p.4421.paration. U4 Issue.

Yadollahi, M. and Zin, R., 2011. Applied multi-criteria ideal rehabilitation model for budget allocation across road infrastructure. International Journal of Innovation Science.

Yu, M., Zhu, F., Yang, X., Wang, L. and Sun, X., 2018. Integrating sustainability into construction engineering projects: Perspective of sustainable project planning. Sustainability, 10(3), p.784.