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# Proposing a strategy map for coastal urban project success using the balanced scorecard method

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## Abstract

**Purpose** – This study aims to develop a strategic framework for the success of coastal urban projects in Vietnam, which is one of the Asia Pacific countries significantly affected by climate change.

**Design/methodology/approach** – A questionnaire was used to collect data from practitioners in Vietnam. Principal component analysis (PCA) technique was used to identify critical success factors (CSFs) of coastal urban projects. A strategy map for the success of coastal urban projects was also proposed using the balanced scorecard (BSC) method.

**Findings** – This study identified 41 project success factors that could contribute to project success, and thence, extracted 11 CSFs for coastal urban projects using the PCA technique. In addition, 11 key performance indicators (KPIs) for coastal urban projects were listed and their linking with project success factors and CSFs was explored. Furthermore, a strategy map for the success of coastal urban projects was proposed using the BSC method. The strategy map included five perspectives: learning and growth, internal processes, social and environmental performance, financial performance, and stakeholders' satisfaction.

**Originality/value** – This study identified 11 CSFs for coastal urban projects and proposed a strategy map for the success of coastal urban projects.

**Keywords** Balanced scorecard, Project success, Critical success factors, Key performance indicators, Coastal urban projects

**Paper type** Research paper

## 1. Introduction

Climate change could increase the occurrence and strength of natural disasters (Thomas, 2017). The increasing risks of natural disasters may break the social, economic and political stability and infrastructures (World Trade Organization, 2019; Xu and Kouwoaye, 2019).



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Specifically, droughts, floods, storms and other natural disasters are increasingly causing many serious problems (Orsato *et al.*, 2017), such as destruction of numerous properties and living environment (Van *et al.*, 2019), regrettable human-related damages and diseases (Brecht *et al.*, 2012), which could significantly influence sustainable development worldwide (Metz *et al.*, 2007). Thus, many countries are attempting to seek several effective solutions in order to cope with unexpected natural disasters better (Van *et al.*, 2019).

In coastal areas of various countries, significant sea level rise, which is a bad consequence of climate change (Van *et al.*, 2019), may have serious effects on human settlements, coastal environments and ecosystems (Nicholls and Cazenave, 2010; Brown *et al.*, 2013; Hallegatte *et al.*, 2013; Nicholls *et al.*, 2014). Other dangerous coastal hazards, such as tsunami, can also devastate whole regions and result in high casualties, which hit the northeast coast of Japan in 2011 (Esteban *et al.*, 2013; Kron, 2013). Despite these, coastal areas are always attracting a large number of people (Duraiappah *et al.*, 2015), owing to their rich resources, logistical reasons and recreational/cultural activities (Neumann *et al.*, 2015). Specifically, the population density in coastal areas is significantly higher than non-coastal areas and the migration trend into coastal regions is still increasing (Small and Nicholls, 2003; Balk *et al.*, 2009; Hugo, 2011). Compared with non-coastal hinterlands, urban land expansion rates in coastal regions are very fast (Seto *et al.*, 2011; Duraiappah *et al.*, 2015). Most of the world's megacities are located in coastal zones (Brown *et al.*, 2013). These together indicate a need to develop coastal urban areas effectively in order to bring people stable and prosperous lives. In other words, the success of coastal urban development projects becomes very important. However, so far there has been a lack of lessons learned about the implementation and management practices of these projects. Thus, understanding how to successfully implement these projects is vital.

Together with coastal regions' sustainable development, local organizations' business and project success are significantly affected by significant sea level rise and serious coastal hazards. Strategic management is crucial in maintaining these organizations' long-term success (Wheelen and Hunger, 2012). Strategic planning becomes important as the environments are unstable (Brews and Purohit, 2007). Besides, devising and maintaining an engaged and focused strategy is the first of four essential management practices which can best differentiate between successful and unsuccessful companies (Joyce, 2005). For coastal regions, especially those in developing countries which are suffering from the severe impacts of climate change, such a strategy for coastal urban development projects is really useful. It could help various organizations (e.g. clients) to minimize ambiguity in the early stages of these projects when it discloses need-to-focus activities to increase the likelihood of project success later. Thus, developing a strategic management framework for private and public organizations to enhance these projects' success chance is necessary.

Performance measurement is a critical part of the strategic management process (Bassioni *et al.*, 2004), due to its function in controlling strategies (Morris and Jamieson, 2004; Wheelen and Hunger, 2012; Todorović *et al.*, 2015). The way to comprehensively manage projects is to create a framework that would establish the connection between critical success factors (CSFs) and success criteria (Morris and Jamieson, 2004). The goal of project success analysis model is to convince the steps that would enable efficient and consistent measuring and monitoring of project performance during the entire life cycle (Todorović *et al.*, 2015). This may be because project success means different values to different stakeholders and definitions of project success are dependent on various factors, such as project type, size and sophistication, project participants and experience of owners (Chan and Chan, 2004). During recent decades, there have been some popular performance measurement frameworks in the construction industry, which could be grouped into criteria-based and model-based frameworks. Key performance indicators (KPIs), which are the core elements of a performance measurement framework (Lin *et al.*, 2011; Mellado *et al.*, 2019), have gained an increase in the group of criteria-based frameworks. Besides, there are also several famous model-based frameworks, such as performance measurement matrix (Keegan *et al.*, 1989), balanced scorecard (BSC) (Kaplan and Norton, 1992), performance prism (Kennerley and Neely, 2002) and two-dimension importance analysis diagram (Chou and Pramudawardhani, 2015). Traditionally, the project management metrics of time, cost, quality and safety have been considered as the most important criteria for a successful project. De Wit (1988) expanded from these evaluation aspects into general technical performance requirements and from the satisfaction of participants into different stakeholders relating to parent organizations, project team and end-users. Recently, many researchers have also started to assess project success with multi-dimensional views (Fortune and White, 2006). Especially, sustainability referred to the "triple bottom line" of economic, environmental and social dimensions has been increasingly emphasized in numerous studies (Labuschagne *et al.*, 2005; Singh *et al.*, 2012; Gianni *et al.*, 2017; Cantele and Zardini, 2018; Nawaz and Koç, 2018). Despite different contents, the consensus of models and success criteria is to assist various organizations in explaining the usefulness of measures to their goal obtainability and their performance assessment appropriately. Thus, these frameworks should be multi-dimensional and explicitly-balanced in financial and non-financial measures.

This study aims to explore the potential relationship between CSFs in the planning phase of coastal urban projects with KPIs in the later phases. Specifically, the specific objectives of this study are as follows:

(1) To identify CSFs for coastal urban projects;

(2) To identify KPIs for performance evaluation of coastal urban projects;

(3) To explore the constructive connection between CSFs and KPIs; and

(4) To propose a strategy map for coastal urban project success using the BSC method.

## 2. Literature review

### *2.1 Managerial challenges of coastal urban projects*

Large-scale urban projects have been used as a means to promote a certain direction of urban transformation (Garcia, 2008). Especially, coastal urban projects are becoming attractive to various organizations, as coastal urban areas provide more advantages and opportunities for development than other inland city zones. Regeneration projects in coastal brownfield or greenfield lands could help to connect the city to the coast which attracts investors (Marshall, 2004). Brownfield sites have some chances to become large shopping centers/green central parks, old industrial ports revitalize into sustainable construction sites/creative city quarters, and railway station areas transform into commercial office zones and/or stimulate sustainable urban mobility (Block and Paredis, 2013). Nevertheless, coastal urban projects generally contain complex challenges in terms of technology and management. Given their complicated characteristics with different scale ranges (e.g. from small block spaces/streets to neighborhoods/city-wide systems), urban development projects must take into account various factors, such as timing and order of investments, transportation, water and sanitation facilities, residential patterns, financial issues and social infrastructure expansion scenarios (Hopkins, 2001). In addition to typical urban elements (e.g. infrastructures, architectures and public spaces), coastal urban projects may be facilitated with man-made coastal infrastructures, such as jetties, breakwater, pilings, diaphragms and quay walls. Although these constructed artificial structures could help to protect coastline properties from several coastal hazards (Bulleri and Chapman, 2010), unforeseen climate change requires coastal urban regions to have more long-term investments (Oh *et al.*, 2018).

Under the unexpected threats of climate change (e.g. rising sea levels and lowering water levels in inland seas), there are currently three approaches of orienting the urban development in coastal regions: retreat, protect and accommodate (Duraiappah *et al.*, 2015). Regarding the "retreat" approach, infrastructure and housing could be moved far away from the coastlines or located on the higher lands. Such an approach allows water into coastal cities but minimizes damages due to flooding. The "protect" approach is inclined to construct physical defenses (e.g. sea walls and levees) to prevent water from entering coastal cities. The "accommodate" approach is concentrated to reclaim and expand about water via accommodation responses (e.g. raised floor levels, movement of infrastructure and drainage systems).

Although there have been some expenditures to adapt to climate change in the future such as flooding, the field of study and policy development for urbanization and flooding in coastal zones still needs greater emphasis. Science and policies need to be integrated together to underpin a solid, collaborative and effective policy framework. Such a framework may result in better allocations of financial resources based on better communication among government, civil society and community groups who are most affected by coastal urbanization (Duraiappah *et al.*, 2015). Nevertheless, this is not an easy task towards coastal projects, whose managerial challenges are to not only facilitate the decision makers, engineers and scientists to clarify the legal regulations and socioeconomic factors which affect the projects, but also translate the technical design details of the projects to the government, decision makers and project stakeholders (Kamphuis, 2011). In addition, coastal projects have more difficulties in management activities than other projects when all project participants are required to have a broad understanding of most complex project characteristics, such as regulations, socioeconomic aspects, environmental impacts and technical requirements (Kamphuis, 2011). Up to now, there have been several studies on economic performance evaluation considering the uncertainties of the climate-related impacts towards urban development projects. Storch and Downes (2011) used a geographic information system to quantitatively assess the impact of flood risks on urban development projects in Ho Chi Minh City (Vietnam) based on scenarios. Bruin *et al.* (2014) tried to apply a probabilistic assessment method for the Zuidplaspolder region of the Netherlands. Oh *et al.* (2018) proposed a rainbow option-based methodology using a case study of the national capital integrated coastal development project in Jakarta (Indonesia). However, there is no focus on developing comprehensive strategies to support the investments in "vulnerable" areas like coastal zones. Thus, there is a need to develop such strategies for managing coastal urban projects effectively in order to cope with the threats and challenges of climate change better.

### *2.2 Strategic management and performance measurement frameworks in construction*

The basic strategic management model has four main elements: environmental scanning, strategy formulation, strategy implementation, and evaluation and control (Wheelen and Hunger, 2012). The main aspects of strategic management in the construction industry are comprehensively reviewed by Price and Newson (2003). They highlighted some key paradoxes in the strategy development process of construction organizations, which were logical (rational) versus creative (generative) strategies, intended (deliberate) versus realized (emergent) strategies, revolutionary versus transformational strategies, strategic fit versus strategic stretch and strategy versus organizational effectiveness. They also emphasized the importance of selecting strategy development tools and techniques for successful planning. Until now, there have been a number of studies on utilizing and implementing strategic management frameworks for the construction industry (e.g. Kazaz and Ulubeyli, 2009; De Paula *et al.*, 2017; Aghimien *et al.*, 2018; Rahman *et al.*, 2018; Laryea, 2019).

To measure and evaluate the performance of organizations' strategies, criteria for both company success and project success have been presented their usefulness. Criteria of project success can be defined as the set of principles or standards by which favorable outcomes can be completed within a set of specifications (Chan and Chan, 2004). Ashley *et al.* (1987) compared the success of average and outstanding projects using 10 success criteria based on previous studies. They identified six important criteria for measuring project success: budget, schedule, functionality, contractor satisfaction, client satisfaction and project manager/team satisfaction. Freeman and Beale (1992) reviewed 14 published papers on measuring project success and identified a set of common criteria for project success measurement: technical performance, efficiency of execution, managerial and organizational implications, personal growth, manufacturability, and business performance. Based on data collected from completed projects and telephone interviews, Griffith *et al.* (1999) developed a performance measuring index of industrial project execution, which was comprised of budget achievement, schedule achievement, design capacity and plant utilization.

Within the construction industry, KPIs are the collective terms for performance measures (Beatham *et al.*, 2004). KPIs are helpful to measure the project and organizational performance throughout the construction industry (KPI Working Group, 2000; Mellado *et al.*, 2019; Orgut *et al.*, 2020). KPIs are recognized as a useful tool for measuring construction project success or failure by numerous studies. For example, KPI Working Group (2000) identified seven main KPI categories: time, cost, quality, client satisfaction, change orders, business performance, and health and safety. Based on the earlier work by Chan *et al.* (2002), Chan and Chan (2004) developed a consolidated framework for measuring project success and identified a set of KPIs for construction projects, which were grouped in nine KPI categories: time, cost, value and profit, health and safety, environmental performance, quality, functionality, expectation and satisfaction of users, and satisfaction of participants. Further KPIs-related information is available elsewhere (e.g. Toor and Ogunlana, 2010; Shdid *et al.*, 2019).

In general, KPIs need to be comprised of qualitative and quantitative measures (Cooke-Davies, 2002). It is also reasonable to develop KPIs into objective and subjective indicators (Chan and Chan, 2004). Accordingly, the development of KPIs for an organization should consider the guidelines and suitable methods. Collin (2002) concluded that the KPI developing process should consider eight important instructions:

(1) KPIs are general indicators that should only focus on critical aspects of outcomes;

(2) The number of KPIs should be limited for utilizing easily;

(3) KPIs require the systematic and consistent use over many projects of the organization;

(4) The collected data for KPIs should be simple;

(5) KPIs should be designed for use on every building;

(6) KPIs must be accepted, understood and owned across the organization;

(7) KPIs should have the ability of evolvement; and

(8) The graphic diagram of KPIs should be simple and easy to update.

*2.3 Project success factors and strategy development process*

The concept of "success factor" was early introduced by Daniel (1961), who asserted that organizational planning information should focus on "success factors" for setting objectives, shaping strategies, making decisions and measuring results. Then, the original concept of Daniel (1961) was widened to be "critical success factors" (i.e. CSFs) by Rockart (1979). CSFs are defined as "areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization" (Rockart, 1979). Since then, a large number of researchers have published numerous lists of factors applied to many types of projects, including construction projects (e.g. Chan *et al.*, 2018; Chan *et al.*, 2019; Sinesilassie *et al.*, 2019; Wang *et al.*, 2018; He *et al.*, 2019). Sanvido *et al.* (1992) were the pioneers in adapting CSFs to construction through an integrated building process model. This model identified the elements of information and physical entities between the management, planning, design, construction and operation functions, which were grouped into nine sub-categories: planning information; design information; construction information; contracts, changes and obligations; facility team; facility experience; resources; optimization information; and performance information. Chua *et al.* (1999) proposed a hierarchical model for construction project success. This model considered 67 factors grouped into four main project aspects: project characteristics, contractual arrangements, project participants and interactive processes. Chan *et al.* (2004) developed a CSFs-based conceptual framework, which consisted of five major groups: human, project, project procedures, project management actions and external environment. CSFs of public-private partnership (PPP) projects have also attracted many researchers in recent decades. Tiong *et al.* (1992) had an early use of CSFs for infrastructure PPP projects. Six CSFs, which would improve the probability of a successful result if given higher attention by sponsors, were proposed: entrepreneurship, picking the right project, a strong team of stakeholders, an imaginative technical solution, a competitive financial proposal and the inclusion of special features in the bid. Zhang (2005) developed a systematic list of 47 success sub-factors for PPPs in infrastructure development and grouped them into five CSFs: favorable investment environment, economic viability, reliable concessionaire consortium with strong technical strength, sound financial package and appropriate risk allocation via reliable contractual arrangements. Through proposing an evaluation index system that considered the interaction among CSFs, Wang *et al.* (2018) revealed that efficient and well-structured payment mechanism was the most important CSF, and this CSF combined with good governance could provide the most positive interaction to PPP projects.

To maximize the success chance of most projects, the importance of strategic management needs to be focused from the first phase. Overall, a project in any type will go through four phases: planning, build-up, implementation and close-out (Harvard Business Review Staff, 2016). The planning phase is an important contributor to project success because the project will be mapped out with several critical questions: "What problems do need solving?"; "Who will be involved?"; and "What will be done?" (Harvard Business Review Staff, 2016). According to the PMBOK Guide (Project Management Institute, 2017), five project management process groups include initiating, planning, executing, monitoring and controlling, and closing phases during the project life-cycle. In the first phase, the project scope, the project objectives and the course of action required to attain the objectives need to be planned after the authorization to start the project is obtained. Thus, the role of the planning phase to overall project success is significantly increased, especially in today's dynamic and risky environment.

Most researchers have highly appreciated the usefulness of considering CSFs for project success, especially in developing countries (e.g. Chan *et al.*, 2010; Cheung *et al.*, 2012; Hwang *et al.*, 2013; Raisbeck and Tang, 2013; Osei-Kyei and Chan, 2015; Kavishe *et al.*, 2018; Khattak and Mustafa, 2019; Hasan and Jha, 2019). In today's essential trend of sustainability, construction projects should integrate sustainability into project management practices from the identification stage to the implementation stage (Banihashemi *et al.*, 2017; De Paula *et al.*, 2017; Yevu and Yu, 2019). The unexpected challenges of climate change towards coastal urban projects must be first met by mitigation or adaptation policies which should be not only stopped at definition but also focused on actual implementation (Kamphuis, 2011).

It can be seen that many studies have focused on strategic management and strategy performance evaluation frameworks in construction. However, as yet there has been still a lack of strategic management frameworks for the case of coastal urban development projects. To fill this gap, this study mainly attempts to propose a strategy map for the success of coastal urban projects using the BSC method. Specifically, to develop this strategy map, KPIs will be linked to CSFs in the planning phase, which is, discussed above, vital to overall project success.

*2.4 Applications of balanced scorecard method*

The BSC method was first introduced by Kaplan and Norton in 1992. In the original BSC version, Kaplan and Norton (1992) explained financial performance measures and incorporated operational (non-financial) performance measures grouped by three perspectives: customer satisfaction, internal business, and innovation and learning. Then, in the 1996 BSC version, "internal business perspective" was re-labeled to "internal processes perspective" and "innovation and learning perspective" was renamed to "learning and growth perspective" with the additional element of growth while "innovation element" was removed (Kaplan and Norton, 1996). Furthermore, Kaplan and Norton (2004) highly appreciated the link between BSC measures and an organizational strategy map. The strategy map is useful in enhancing the operational efficiency that employees' everyday operational activities will support in acquiring organizational strategic objectives (Kaplan and Norton, 2004). Each BSC's perspective is relevant to one definite open-question: "How do shareholders benefit?" (financial perspective); "How do customers see the organization?" (customer perspective); "What would be improved?" (internal business processes); and "Is it possible to continue to improve and create value?" (learning and growth) (Lawrence and Sharma, 2002). The cause-and-effect concept is a very important element to consider in an attempt to construct the BSC method (Chytas *et al.*, 2011).

So far, there have been hundreds of published researches (including journal articles, proceeding papers and books) highlighting the BSC's impacts on economic (financial) benefits, performance improvement and decision-making process in private and public sectors (Hoque, 2014). For instance, Speckbacher *et al.* (2003) revealed that corporate long-term business results were improved after applying the BSC. A positive contribution of the BSC to non-for-profit firms' sustainable improvement was also recorded (Aidemark, 2001; Kershaw and Kershaw, 2001; Brewer, 2002). Paplexandris *et al.* (2004) recommended that the BSC was a good guideline for successful strategy implementation and communication through a case study of the Greek information technology company. The BSC's effectiveness in the public sector was also promoted, as it enabled leaders, employees and stakeholders to understand their role and orientate the organizational administration into strategic performance-based measures (Carmona and Granlund, 2003; Greatbanks and Tapp, 2007; Hoque and Adams, 2011).

Actually, the BSC is the most popular performance measurement framework for construction companies (Yang *et al.*, 2010). Kagioglou *et al.* (2001) proposed a matrix-like performance measurement conceptual framework based on the BSC's perspectives: supplier, project, innovation and learning, internal business, customer and financial. They revealed the strengths and weaknesses of applying the BSC to the performance measurement process in construction companies, but they did not present the contribution of this framework to the corporate strategy management. Yu *et al.* (2007) conducted a performance comparison of 34 Korean construction companies, using a suggested framework which was structured with four conventional BSC perspectives (financial, customer, internal business process, and learning and growth perspectives), 12 criteria and 16 KPIs. Then, they proposed a strategy map for performance management based on the suggested framework. However, they just studied for the company level and have not yet mentioned for the project level, such as strategic business units of construction companies. Luu *et al.* (2008) integrated the SWOT (strengths, weaknesses, opportunities and threats) analysis with the BSC perspectives and proposed KPIs to develop a performance measurement framework for a construction company in Vietnam. In that study, they applied the SWOT analysis to find out eight company strategic objectives, which were arranged into four conventional BSC perspectives; and linked with a range of the proposed KPIs to calculate the performance scores and compare them with the competitors. Overall, the general deficiencies of previous studies are that they have not yet concentrated on the exploitation of the BSC method in measuring the performance and development strategy at the project level. In addition, prior studies have not clarified the root causes for organization results which are popularly measured by criteria and KPIs. Indeed, the analyzed cause-and-effect relationship between CSFs and KPIs is vital to a better performance measure for projects (e.g. Wheelen and Hunger, 2012; Todorović *et al.*, 2015; Kärnä and Junnonen, 2017; Salvatierra *et al.*, 2019).

On the other hand, for adapting to various research and practice purposes, the BSC approach allows organization managers to edit into different forms as well as add new perspectives regarding the interest of the organization (Figge *et al.*, 2002; Falle *et al.*, 2016). Accordingly, many studies highly recommended adding new dimensions in terms of sustainability (e.g. environmental or social performance) to the traditional BSC to meet new challenges of sustainable development (Sidiropoulos *et al.*, 2004; Kang *et al.*, 2015; Hansen and Schaltegger, 2016; Falle *et al.*, 2016; De Andrade *et al.*, 2018).

The construction industry is among the industries releasing greenhouse gases hugely to the environment as well as one of the areas strongly affected by climate change (Intergovernmental Panel on Climate Change, 2014). It is necessary for organizations in the construction industry to have more supporting tools for organizational operation management in the context of sustainable development. However, after a comprehensive literature review, this study realizes that the number of studies on the BSC in the construction industry is still limited. To develop a BSC for construction projects in general and coastal urban projects in particular, this study proposes adding the dimension of social and environmental perspective (i.e. sustainability) to four existing traditional BSC dimensions. This sustainability BSC should be designed to be applicable to both company and project levels.

## 3. Research methodology

### *3.1 Research process*

Figure 1 presents the research framework for this study. The main phases include: (1) identification of CSFs for coastal urban projects, (2) identification of KPIs for coastal urban projects and (3) proposing strategy map for coastal urban development project success.

In Phase 1, a strict investigation process was conducted to identify CSFs for coastal urban projects. Potential project success factors were identified through reviewing previous studies. Specifically, multiple searches were conducted to gather prior relevant papers using the Boolean "AND" and "OR" operators, with various search terms, such as "factor," "success," "project," "success factor," "project success," "construction project," "coastal urban," "coastal project" and "construction industry." Such searches were based on various literature sources, including academic, engineering and business databases (e.g. Google Scholar, Scopus, Web of Science, Emerald Insight, Taylor and Francis, ScienceDirect and SpringerLink), online libraries (e.g. ASCE Library, PMI Online Library and Wiley Online Library) and web search engines (Nguyen *et al.*, 2015). Comprehensive check was conducted to exclude any inappropriate publications, such as non-English, non-peer-reviewed, non-indexed-journal, working and conference articles, editorial notes and reports (Rajabion *et al.*, 2019). Given that

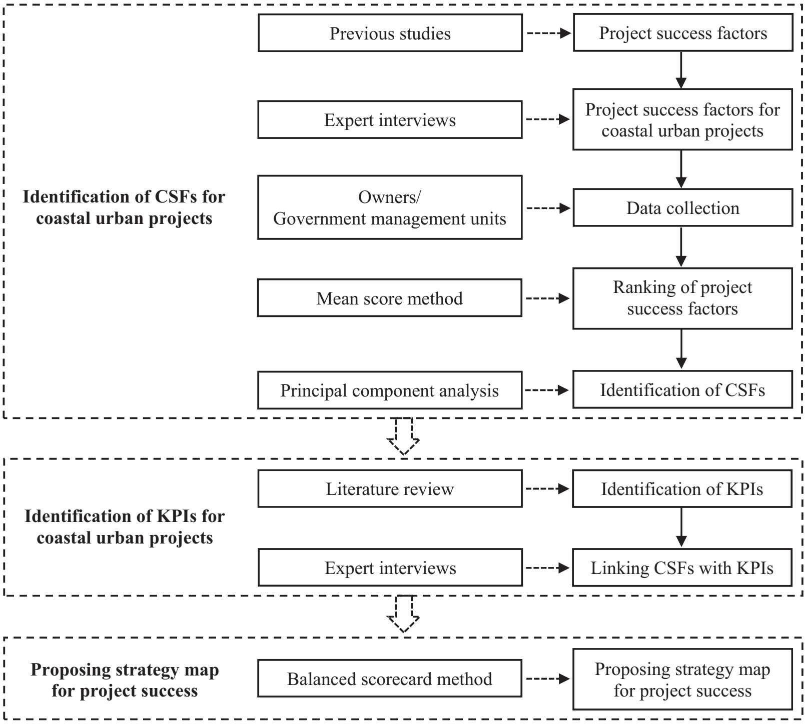


**Figure 1.**
Research framework

a research paper could be simultaneously indexed in different literature databases (Wuni *et al.*, 2019), an endeavor to exclude the duplicated downloads was also made. Accordingly, a set of more than 40 peer-reviewed-journal papers was obtained to filter out a preliminary list of potential project success factors for coastal urban projects. The first interview-based survey was deployed to receive feedback from experts about the suitability of this list. The selected project success factors were used for the first questionnaire-based survey to collect feedback data from owners and government management units (GMUs). Mean score method was used to determine the perceived relative importance of project success factors. Principal component analysis (PCA) was employed to identify CSFs for coastal urban projects.

Phase 2 conducted the second interview-based survey to identify KPIs for coastal urban projects. A list of KPIs was identified through the literature review. The searches for KPIs were mainly based on academic databases. Expert interviews were carried out to verify the direct link between the identified KPIs and the CSFs obtained from PCA.

Finally, in Phase 3, a strategy map for coastal urban development project success was proposed using the BSC method. Several modifications were added to Kaplan and Norton's (2004) original strategy map to develop the strategy map. The proposed strategy map was also validated using three coastal urban projects in Vietnam.

*3.2 Data analysis methods*

*3.2.1 Data reliability.* Cronbach's alpha (denoted as $\alpha$) is the most widely used measure to assess the internal consistency of the entire scale (Khattak and Mustafa, 2019; Sinesilassie *et al.*, 2019). The generally agreed-upon lower limit for Cronbach's alpha is 0.70 (Chan *et al.*, 2019; Sinesilassie *et al.*, 2019). One issue in assessing Cronbach's alpha is its positive relationship with the number of items in the scale (Hair *et al.*, 2009). Cronbach's alpha is calculated by correlating the score for each scale item with the total score for each observation and, then, comparing that with the variance for all individual item scores as follows (DeVellis, 1991):

$$\alpha = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum_{i=1}^{k}\sigma_{y_i}^2}{\sigma_x^2}\right)$$

where $k$ refers to the number of scale items, $\sigma_{y_i}^2$ refers to the variance associated with item $i$ and $\sigma_x^2$ refers to the variance associated with the observed total scores.

*3.2.2 Principal component analysis.* PCA, first introduced by Pearson (1901), could be one of the oldest and widely-used techniques of multivariate analysis (Jolliffe and Cadima, 2016). Then, PCA is developed independently by Hotelling (1933) and Jolliffe (2002). PCA is often used to reduce the dimensionality of a data set, in which there are a large number of interrelated variables while retaining as much as possible of the variation present in the data set (Naik, 2017). The motivation of PCA is to project the original data (which are represented as high-dimensional vectors) to the coordinates with maximal variances (Richardson, 2009).

Before applying PCA, some tests were performed to check its appropriateness. Both Kaiser-Meyer-Olkin (KMO) test and Bartlett's test are suggested for this check. The KMO measure of sampling adequacy, which checks whether the partial correlations among observed variables are small (Khazanchi, 2005), should be greater than 0.5. The Bartlett's test of sphericity, which indicates whether the correlation matrix is not an identity matrix, must be significant at 0.05 (Hair *et al.*, 2009).

Besides exploratory factor analysis, which is used to uncover the underlying factor structure or latent constructs that may explain the intercorrelation between variables (Sharma, 1996; Nguyen *et al.*, 2015), PCA is commonly employed to reduce data dimensionality before running another technique, such as cluster analysis, discriminant analysis and commonly multiple regression analysis (Jolliff, 2002). In prior literature, PCA is applied in a range of domains from economic to engineering, such as examining air pollution and meteorological data (Statheropoulos *et al.*, 1998), forecasting summer monsoon rainfall (Rajeevan *et al.*, 2000) and estimating construction project cost (Chan and Park, 2005; Dang and Le-Hoai, 2018). Especially, PCA can be used to simplify principal components (PCs) to aid interpretation to deal with big datasets (Jolliffe and Cadima, 2016). Specifically, using PCA allows a large number of observed factors to be represented by several PCs without a substantial loss of information (Sharma, 1996), which is similar in nature to the first objective of this study (i.e. to identify CSFs for coastal urban projects from numerous potential project success factors identified from prior relevant studies). Thus, to achieve such an objective, PCA was adopted in this study.

*3.2.3 Balanced scorecard method.* The typical strategy map, originally explored by Kaplan and Norton (2004), was built based on four perspectives: learning and growth, internal process, customer, and finance. Kaplan and Norton (2004) highlighted the role of "learning and growth" and "internal process" as "leading indicators" while looking at "customer" and "finance" as "lagging indicators."

In this study, the strategy map is built by maintaining the fundamental positions of "learning and growth" and "internal processes" and, simultaneously, adding the "social and environmental" aspect as a "lagging indicator" at the third position. On the other hand, "stakeholders' satisfaction" is also suggested as the highest goal, instead of "financial performance" perspective, which was often used at the company level in previous studies.

Accordingly, the proposed strategy map involves five perspectives: learning and growth, internal processes, social and environmental, financial, and stakeholder.

The process of developing the strategy map using the BSC method could be implemented as follows:

(1) Determine the organizational mission, project goal and project scope;

(2) Develop the hierarchy of strategic project perspectives;

(3) Identify the strategic objectives in each perspective;

(4) Design the measures for evaluating project performance;

(5) Discover which CSFs significantly affect project success; and

(6) Construct and reinforce the causal relationships between CSFs and KPIs.

## 4. Identification of critical success factors for coastal urban projects

### *4.1 Questionnaire design*

Through reviewing previous studies, this study identified a preliminary list of 47 potential project success factors, which were initially grouped into four main categories: project characteristics (e.g. Chen *et al.*, 2012; Cserháti and Szabó, 2014; Dang and Le-Hoai, 2016; Banihashemi *et al.*, 2017; Wang *et al.*, 2018; Whang *et al.*, 2019), socioeconomic factors (e.g. Li *et al.*, 2005; Tang *et al.*, 2012; Yu and Shen, 2015; Banihashemi *et al.*, 2017; Wang *et al.*, 2018; Whang *et al.*, 2019), sustainability-related factors (e.g. Kamphuis, 2011; Xiao *et al.*, 2015; Yalegama *et al.*, 2016; Banihashemi *et al.*, 2017; Oh *et al.*, 2018; Whang *et al.*, 2019) and participant-related factors (e.g. Tang and Shen, 2013; Zou *et al.*, 2014; Liu *et al.*, 2014; Aldhaheri *et al.*, 2018; Zuo *et al.*, 2018; Hasan and Jha, 2019).

To refine the preliminary list of 47 factors, experts (i.e. experienced professionals) were directly interviewed. A group of nine experts (five and four experts were working for owners and GMUs, respectively) were interviewed. They had much experience with not only construction projects but also large-scale coastal urban projects: three and six experts were involved in coastal urban projects with the investment values of VND200-400bn and more than VND400bn (1 USD = 20,000 VND), respectively. Some experts were not only key managers in large-scale coastal urban projects but also top management. In terms of experience, three, four and two experts had 6–10, 11–20 and more than 20 years of experience, respectively. They were requested to check the adequacy and appropriateness of 47 factors with the context of coastal urban projects in Vietnam. They suggested excluding several inappropriate factors and adding many other factors based on their experience of coastal urban projects. Following these suggestions, the final list consisted of 41 project success factors, of which a number of project success factors were emphasized by many experts such as:

(1) attractiveness of project (toward lenders, vendors, real-estate businessmen and end-users);

(2) profit return from land business;

(3) minimizing clearance compensations and/or use of agricultural land;

(4) availability of local material sources;

(5) effective technical solutions to minimize impacts of project on ecological environment;

(6) consideration of disaster risk scenarios;

(7) capability of selecting proper calculation and assessment methods (e.g. calculating economic efficiency and assessing project investment efficiency) with consideration of risks;

(8) selecting appropriate materials for applying new solutions;

(9) assessing environmental impacts in coastal project area;

(10) appropriateness of project characteristics (e.g. location, investment models and technical solutions) with sustainable development criteria;

(11) project-related solutions (e.g. land-use planning, urban design, architecture and structural alternatives) towards sustainable development; and

(12) synchronization and multifunction of technical solutions.

Based on the final list of 41 project success factors, a questionnaire was drafted for review or feedback by another group of eight experts, who also played a vital role in coastal urban projects. In terms of experience, four and four experts have 11–20 and more than 20 years of experience, respectively. They were requested to provide comments for the questionnaire characteristics, such as adequacy and appropriateness of project success factors, clarity of questions and structure of questionnaire. When the questionnaire characteristics were accepted by most experts, the questionnaire design was completed. The final questionnaire, which consisted of 41 project success factors, could be used for data collection.

*4.2 Data collection*

A questionnaire survey was conducted to collect data with regard to project success factors. Respondents were requested to indicate their level of agreement for 41 project success factors on a five-point Likert scale (1 = "strongly disagree" to 5 = "strongly agree"). Respondents' answers were based on coastal urban projects in which they participated.

From various contactable organizations and professionals, this study preliminarily listed coastal urban projects, in which owners together with appraisal/approval government units were included. Information of respondents (e.g. government management officers, engineers and managers of owners), who were directly involved in coastal urban projects, was identified. As a result, a list of 300 potential respondents was established for the questionnaire survey. Based on this list, the questionnaire was hand-delivered or emailed to respondents. In total, 220 respondents received the hard copies of the questionnaire and 30 respondents received the questionnaire via personal emails.

After about two months, there were 211 responses (199 hard copies and 12 emails) with the overall response rate of 84.4%. It should be noted that only responses collected from owners and GMUs were accepted. An endeavor to eliminate invalid responses, which had unanswered questions and two answers or more for a certain question, was also conducted. Following these checking processes, 66 possibly invalid responses were excluded. Finally, data of 145 responses, whose profile of respondents is presented in Table 1, were considered to be valid.

As shown in Table 1, most of the respondents (both owners and GMUs) had senior positions in their organizations with plentiful experience in coastal urban projects. In total, over 50% were at the top and medium administrative hierarchy. In terms of experience, approximately 60% had more than 10 years of working experience. It can be seen that the respondents participating in the survey are much experienced and competent with coastal urban projects and, therefore, could provide useful information and reliable data about coastal urban projects for this study.

According to the Vietnam urban planning and development association, Vietnam has 28 coastal provinces and cities from the North to the South with more than 3,200 kilometers of

| Category | Owner Frequency | % | GMU Frequency | % | Total % |
|---|---|---|---|---|---|
| *Experience* | | | | | |
| 5–10 years | 43 | 41 | 15 | 37 | 40.0 |
| 11–20 years | 52 | 50 | 17 | 41 | 47.6 |
| Over 20 years | 9 | 9 | 9 | 22 | 12.4 |
| *Position* | | | | | |
| Senior managers/ Leaders | 6 | 6 | 7 | 17 | 9.0 |
| Project managers/ Directors | 32 | 31 | 2 | 5 | 23.4 |
| Functional managers | 18 | 17 | 11 | 27 | 20.0 |
| Project team/ Staff | 48 | 46 | 21 | 51 | 47.6 |
| *Project size* | | | | | |
| Less than VND200bn | 23 | 22 | 6 | 15 | 20.0 |
| VND200bn–400bn | 15 | 14 | 4 | 10 | 13.1 |
| Over VND400bn | 66 | 63 | 31 | 76 | 66.9 |

**Note(s)**: GMU: Government management unit; 1 USD = 20,000 VND

**Table 1.** Profile of respondents

coastline (Tung, 2018). In Vietnam, urban projects, whose budgets are over VND300bn, are categorized into the large-project group. Accordingly, the important project documents (e.g. feasibility study, environmental impact assessment report and project design) must be examined to obtain the investment registration certificates. This reflects the relevance between large-scale budget characteristics of coastal urban projects in Vietnam and sample characteristics in this study, in which approximately two-thirds of the respondents involved in coastal urban projects with a budget of over VND400bn (Table 1).

Regarding discussions on appropriate sample sizes for CSFs-related research, convenience sampling is more commonly applied than random sampling, as the data of the total population distribution are not available (Chou *et al.*, 2012). To verify the acceptable number of the sample size, this study attempted to compare the sample sizes of some previous related studies conducted in recent years and the 145-response sample size of this study (Table 2). The ratio of 3.54 (145 responses over 41 project success factors) in this study is approximate to the average ratio of 3.77 from previous related studies in Table 2. This implies that this study's sample size is acceptable.

Furthermore, a Cronbach's alpha coefficient was calculated to test the reliability and internal consistency (Khattak and Mustafa, 2019; Sinesilassie *et al.*, 2019). The yielded coefficient of 0.942 (>0.7) demonstrated that the collected data is reliable for further analyses (Chan *et al.*, 2019; Sinesilassie *et al.*, 2019).

| References | Number of variables | Sample size | Ratio of sample per variable |
|---|---|---|---|
| Banihashemi *et al.* (2017) | 43 | 101 | 2.35 |
| Yu and Shen (2015) | 51 | 97 | 1.90 |
| Liu *et al.* (2014) | 24 | 51 | 2.13 |
| Zou *et al.* (2014) | 8 | 51 | 6.38 |
| Cserháti and Szabó (2014) | 20 | 104 | 5.20 |
| Tang *et al.* (2013) | 18 | 122 | 6.78 |
| Chou *et al.* (2012) | 18 | 64 | 3.56 |
| Cheung *et al.* (2012) | 18 | 33 | 1.83 |
| Average ratio | | | 3.77 |

**Table 2.** Ratio of sample per variable in previous related studies

*4.3 Ranking of project success factors*

Using the mean score method, the mean values and ranking of 41 project success factors (Table 3) are obtained according to two groups: owner and GMU. In general, all 41 project success factors have mean values larger than 3, implying that they all are the important factors for the success of coastal urban projects. Especially, "financial capability of owner" (F37) is ranked 1 by both owner and GMU, indicating that "financial capability of owner" is the most important factor in coastal urban projects. This may be because coastal urban development projects are usually large-scale projects which need to be financed adequately and continuously from owners during project implementation processes.

Spearman's coefficient is then used to check whether these two groups have a consistency in ranking 41 project success factors. The Spearman coefficient of 0.843 (with $p$-value = 0.000) between the two groups shows that this correlation is statistically significant at the 0.01 level. This implies that there is a very strong agreement between the two groups on ranking 41 project success factors.

As Spearman's rank correlation test does not show whether there is a difference in assessing an individual factor, $t$-test is employed to investigate the difference of mean values of 41 project success factors between the two groups. The results of $t$-test (Table 3) show that there is no significant difference in the perceptions of the two groups at the 0.01 level on rating most of the identified project success factors. In general, it could be assumed that there is a relative consensus of the two groups on rating the identified project success factors.

*4.4 Identification of critical success factors*

To identify CSFs for coastal urban projects, the PCA technique is applied to 41 project success factors in Table 3. The KMO measure of sampling adequacy, which has a value of 0.870, is satisfactory. The Bartlett's test of sphericity, which has a significance level of 0.000 with a Chi-square value of 3,001.080, indicates that the correlation matrix is not an identity matrix. Thus, the PCA technique is applicable.

Table 4 presents the results of applying the PCA technique, where the varimax rotation method is selected. The application of the PCA technique extracts 11 PCs, whose total amount of variance explained is 68.096%: comprehensive project feasibility study (PC1), well-organized administrative procedures (PC2), approaching sustainable development goal (PC3), well-oriented development planning (PC4), assessment of project impacts (PC5), project management skills (PC6), well-prepared project planning (PC7), manpower capability (PC8), attractiveness of project to various sponsors (PC9), wide range of potential benefits (PC10) and profitability of land business (PC11). The identified 11 PCs are considered as CSFs for coastal urban projects. Especially, with the eigenvalue of 4.175 and 10.436% of variance explained, comprehensive project feasibility study (PC1) is considered as the most important to coastal urban project success.

## 5. Identification of key performance indicators for coastal urban projects

Based on the aforementioned KPI development instructions together with the result of the literature review, this study identified a preliminary list of 11 KPIs in 9 categories (Table 5):

(1) Time (Ashley *et al.*, 1987; Freeman and Beale, 1992; Griffith *et al.*, 1999; KPI Working Group, 2000; Chan and Chan, 2004; Toor and Ogunlana, 2010; Chou *et al.*, 2013; Davis, 2017; He *et al.*, 2019; Shdid *et al.*, 2019; Tang *et al.*, 2019; Yan *et al.*, 2019);

(2) Cost (Ashley *et al.*, 1987; Griffith *et al.*, 1999; KPI Working Group, 2000; Chan and Chan, 2004; Toor and Ogunlana, 2010; Chou *et al.*, 2013; Davis, 2017; He *et al.*, 2019; Shdid *et al.*, 2019; Tang *et al.*, 2019; Yan *et al.*, 2019);

| Code | Project success factors | Overall Mean | Overall Rank | Owner Mean | Owner Rank | GMU Mean | GMU Rank | t-test *t*-value | t-test *p*-value |
|---|---|---|---|---|---|---|---|---|---|
| F37 | Financial capability of owner | 4.221 | 1 | 4.115 | 1 | 4.488 | 1 | −2.358 | 0.020 |
| F25 | Appropriateness of project characteristics (e.g. location, investment models and technical solutions) with sustainable development criteria | 4.166 | 2 | 4.115 | 1 | 4.293 | 8 | −1.192 | 0.235 |
| F4 | Minimizing clearance compensations and/or use of agricultural land | 4.159 | 3 | 4.048 | 4 | 4.439 | 2 | −2.780 | 0.006* |
| F1 | Achieved multiple benefits of project | 4.103 | 4 | 4.087 | 3 | 4.146 | 17 | −0.344 | 0.732 |
| F39 | Competent and experienced consultants | 4.097 | 5 | 4.000 | 7 | 4.341 | 4 | −2.138 | 0.034 |
| F15 | Needs of residents and society | 4.090 | 6 | 3.990 | 8 | 4.341 | 4 | −2.274 | 0.024 |
| F3 | Profit return from land business | 4.069 | 7 | 4.029 | 5 | 4.171 | 15 | −0.811 | 0.419 |
| F36 | Clear understanding of legal framework and regulations | 4.062 | 8 | 3.942 | 13 | 4.366 | 3 | −2.495 | 0.014 |
| F33 | Support of local authorities | 4.062 | 8 | 3.981 | 9 | 4.268 | 10 | −1.965 | 0.051 |
| F19 | Consideration of natural and mechanical population growth for reasonable land-use planning | 4.055 | 10 | 3.971 | 10 | 4.268 | 10 | −1.918 | 0.057 |
| F2 | Attractiveness of project (toward lenders, vendors, real-estate businessmen and end-users) | 4.055 | 10 | 4.010 | 6 | 4.171 | 15 | −1.073 | 0.285 |
| F8 | Feasibility of project zoning (e.g. appropriateness of detail plans with general plan) | 4.041 | 12 | 3.923 | 15 | 4.341 | 4 | −2.882 | 0.005* |
| F26 | Project-related solutions (e.g. land-use planning, urban design, architecture and structural alternatives) towards sustainable development | 4.035 | 13 | 3.923 | 15 | 4.317 | 7 | −2.330 | 0.021 |
| F17 | Availability of local material sources | 4.028 | 14 | 3.952 | 12 | 4.220 | 12 | −1.811 | 0.072 |
| F22 | Capability of selecting proper calculation and assessment methods (e.g. calculating economic efficiency and assessing project investment efficiency) with consideration of risks | 4.000 | 15 | 3.923 | 15 | 4.195 | 14 | −1.639 | 0.103 |

*(continued)*

**Table 3.**
Ranking of project success factors

| Code | Project success factors | Overall Mean | Overall Rank | Owner Mean | Owner Rank | GMU Mean | GMU Rank | *t*-test *t*-value | *t*-test *p*-value |
|---|---|---|---|---|---|---|---|---|---|
| F40 | Clearly-demonstrated division of management-related responsibilities between owner and government management units | 3.972 | 16 | 3.875 | 18 | 4.220 | 12 | −2.676 | 0.009* |
| F13 | Good construction zoning plans | 3.966 | 17 | 3.933 | 14 | 4.049 | 21 | −0.698 | 0.487 |
| F16 | Availability of local human resource | 3.938 | 18 | 3.971 | 10 | 3.854 | 28 | 0.821 | 0.413 |
| F9 | Comprehensiveness of investment construction project report | 3.931 | 19 | 3.788 | 20 | 4.293 | 8 | −3.272 | 0.001* |
| F18 | Adequate consideration of human health and safety conditions for project-surrounding areas | 3.897 | 20 | 3.798 | 19 | 4.146 | 17 | −2.306 | 0.023 |
| F24 | Assessing environmental impacts in coastal project area | 3.869 | 21 | 3.788 | 20 | 4.073 | 20 | −1.699 | 0.092 |
| F27 | Predicting long-term development needs for appropriate strategies of infrastructure development | 3.855 | 22 | 3.788 | 20 | 4.024 | 24 | −1.340 | 0.182 |
| F32 | Support of government (e.g. stable and flexible financial policy) | 3.807 | 23 | 3.712 | 24 | 4.049 | 21 | −2.152 | 0.033 |
| F20 | Effective technical solutions to minimize impacts of project on ecological environment | 3.800 | 24 | 3.788 | 20 | 3.829 | 30 | −0.233 | 0.816 |
| F41 | Solving interdisciplinary technical issues effectively | 3.779 | 25 | 3.673 | 28 | 4.049 | 21 | −2.993 | 0.004* |
| F38 | Experience of owner about coastal urban projects | 3.766 | 26 | 3.702 | 25 | 3.927 | 26 | −1.307 | 0.193 |
| F34 | Skills of applying project management tools | 3.759 | 27 | 3.692 | 26 | 3.927 | 26 | −1.717 | 0.090 |
| F23 | Selecting appropriate materials for applying new solutions | 3.745 | 28 | 3.606 | 32 | 4.098 | 19 | −3.530 | 0.001* |
| F21 | Consideration of disaster risk scenarios | 3.738 | 29 | 3.692 | 26 | 3.854 | 28 | −0.834 | 0.405 |
| F29 | Proper attention to post-inspection works | 3.717 | 30 | 3.606 | 32 | 4.000 | 25 | −2.397 | 0.019 |
| F12 | Reasonable planning policies for land use | 3.710 | 31 | 3.673 | 28 | 3.805 | 31 | −0.803 | 0.423 |
| F35 | Synchronization and multifunction of technical solutions | 3.697 | 32 | 3.654 | 30 | 3.805 | 31 | −0.951 | 0.343 |
| F6 | Clear and well-controlled project schedule | 3.683 | 33 | 3.635 | 31 | 3.805 | 31 | −1.124 | 0.263 |

**Table 3.** (*continued*)

| Code | Project success factors | Overall Mean | Overall Rank | Owner Mean | Owner Rank | GMU Mean | GMU Rank | *t*-test *t*-value | *t*-test *p*-value |
|---|---|---|---|---|---|---|---|---|---|
| F30 | Systematic and effective reformation of administrative procedures | 3.614 | 34 | 3.577 | 34 | 3.707 | 34 | −0.838 | 0.404 |
| F11 | Stability of legal policies and mechanisms | 3.593 | 35 | 3.548 | 37 | 3.707 | 34 | −1.011 | 0.314 |
| F28 | Effectiveness of government management structure | 3.579 | 36 | 3.558 | 36 | 3.634 | 40 | −0.433 | 0.666 |
| F7 | Explicit contractual agreements | 3.559 | 37 | 3.567 | 35 | 3.537 | 41 | 0.196 | 0.845 |
| F14 | Positive support from society | 3.531 | 38 | 3.471 | 38 | 3.683 | 36 | −1.581 | 0.117 |
| F31 | Suitability of project for privatization | 3.531 | 38 | 3.471 | 38 | 3.683 | 36 | −1.057 | 0.292 |
| F5 | Adequate and synchronous plans for deployment of all project items | 3.490 | 40 | 3.423 | 40 | 3.659 | 38 | −1.236 | 0.218 |
| F10 | Careful consideration of currency rate risks (including scenarios of foreign currency risk) | 3.428 | 41 | 3.337 | 41 | 3.659 | 38 | −1.952 | 0.053 |

**Note(s)**: GMU: Government management unit; *: Significant at the 0.01 level

**Table 3.**

(3) Quality (Ashley *et al.*, 1987; KPI Working Group, 2000; Chan and Chan, 2004; Toor and Ogunlana, 2010; Chou *et al.*, 2013; Davis, 2017; He *et al.*, 2019; Shdid *et al.*, 2019; Tang *et al.*, 2019; Yan *et al.*, 2019);

(4) Environment, health and safety (KPI Working Group, 2000; Chan and Chan, 2004; Toor and Ogunlana, 2010; Chou *et al.*, 2013; Davis, 2017; Tang *et al.*, 2019; Yan *et al.*, 2019);

(5) Legislation (Hui *et al.*, 2008; Chou *et al.*, 2013; Carvalho *et al.*, 2015);

(6) Predictability (Chou *et al.*, 2013; Carvalho *et al.*, 2015);

(7) Consumption of project resources (Chou *et al.*, 2013; Carvalho *et al.*, 2015; Todorović *et al.*, 2015; Davis, 2017; Yan *et al.*, 2019);

(8) Satisfaction (Ashley *et al.*, 1987; KPI Working Group, 2000; Chan and Chan, 2004; Toor and Ogunlana, 2010; Chou *et al.*, 2013; Davis, 2017; Shdid *et al.*, 2019; Tang *et al.*, 2019; Yan *et al.*, 2019); and

(9) Technology and professions (Freeman and Beale, 1992; Griffith *et al.*, 1999; Chan and Chan, 2004; Toor and Ogunlana, 2010; Chou *et al.*, 2013; Davis, 2017).

First of all, it should be noted that KPIs need to be assessed at the end of the defect liability period. Among the identified 11 KPIs (Table 5), "predictability level on project time" (KPI1), "predictability level on project costs" (KPI2) and "project profitability" (KPI3) are the quantitative indicators, which can be calculated using data directly collected from owners' project reports (e.g. project closure report and annual financial report). On the other hand, the remaining eight KPIs are qualitative and, therefore, may be assessed using data collected from various sources (e.g. owner's project management unit, board of directors, GMUs, users, project neighborhood, consultant or contractor) based on project closure reports and/or questionnaire surveys. As shown in Table 5, a five-point Likert scale (1 = low, 2 = relatively

**Table 4.**
Critical success factors of coastal urban projects

| Code | Critical success factors | Factor loading | Eigen value | % of variance explained | Cumulative % of variance explained |
|---|---|---|---|---|---|
| *PC1* | *Comprehensive project feasibility study* | | *4.175* | *10.436* | *10.436* |
| F41 | Solving interdisciplinary technical issues effectively | 0.793 | | | |
| F40 | Clearly-demonstrated division of management-related responsibilities between owner and government management units | 0.743 | | | |
| F23 | Selecting appropriate materials for applying new solutions | 0.612 | | | |
| F8 | Feasibility of project zoning (e.g. appropriateness of detail plans with general plan) | 0.569 | | | |
| F36 | Clear understanding of legal framework and regulations | 0.533 | | | |
| F9 | Comprehensiveness of investment construction project report | 0.492 | | | |
| *PC2* | *Well-organized administrative procedures* | | *3.341* | *8.352* | *18.788* |
| F11 | Stability of legal policies and mechanisms | 0.789 | | | |
| F30 | Systematic and effective reformation of administrative procedures | 0.661 | | | |
| F32 | Support of government (e.g. stable and flexible financial policy) | 0.505 | | | |
| F28 | Effectiveness of government management structure | 0.488 | | | |
| F13 | Good construction zoning plans | 0.466 | | | |
| F35 | Synchronization and multifunction of technical solutions | 0.460 | | | |
| F12 | Reasonable planning policies for land use | 0.432 | | | |
| *PC3* | *Approaching sustainable development goal* | | *2.991* | *7.477* | *26.265* |
| F26 | Project-related solutions (e.g. land-use planning, urban design, architecture and structural alternatives) towards sustainable development | 0.729 | | | |
| F37 | Financial capability of owner | 0.630 | | | |
| F25 | Appropriateness of project characteristics (e.g. location, investment models and technical solutions) with sustainable development criteria | 0.552 | | | |
| *PC4* | *Well-oriented development planning* | | *2.709* | *6.773* | *33.038* |
| F19 | Consideration of natural and mechanical population growth for reasonable land-use planning | 0.663 | | | |
| F15 | Needs of residents and society | 0.654 | | | |
| F4 | Minimizing clearance compensations and/or use of agricultural land | 0.651 | | | |
| F17 | Availability of local material sources | 0.575 | | | |
| F14 | Positive support from society | 0.550 | | | |
| *PC5* | *Assessment of project impacts* | | *2.671* | *6.679* | *39.717* |

(*continued*)

| Code | Critical success factors | Factor loading | Eigen value | % of variance explained | Cumulative % of variance explained |
|---|---|---|---|---|---|
| F24 | Assessing environmental impacts in coastal project area | 0.704 | | | |
| F21 | Consideration of disaster risk scenarios (e.g. sea level rising, storm, unusual local flooding) | 0.675 | | | |
| F20 | Effective technical solutions to minimize impacts of project on ecological environment | 0.482 | | | |
| F27 | Predicting long-term development needs for appropriate strategies of infrastructure development | 0.477 | | | |
| *PC6* | *Project management skills* | | *2.667* | *6.667* | *46.384* |
| F22 | Capability of selecting proper calculation and assessment methods (e.g. calculating economic efficiency and assessing project investment efficiency) with consideration of risks | 0.758 | | | |
| F18 | Adequate consideration of human health and safety conditions for project-surrounding areas | 0.596 | | | |
| F34 | Skills of applying project management tools | 0.576 | | | |
| *PC7* | *Well-prepared project planning* | | *2.145* | *5.362* | *51.746* |
| F5 | Adequate and synchronous plans for deployment of all project items | 0.799 | | | |
| F7 | Explicit contractual agreements | 0.557 | | | |
| F6 | Clear and well-controlled project schedule | 0.498 | | | |
| *PC8* | *Manpower capability* | | *1.914* | *4.785* | *56.531* |
| F16 | Availability of local human resource | 0.765 | | | |
| F38 | Experience of owner about coastal urban projects | 0.630 | | | |
| *PC9* | *Attractiveness of project to various sponsors* | | *1.736* | *4.340* | *60.871* |
| F2 | Attractiveness of project (toward lenders, vendors, real-estate businessmen and end-users) | 0.716 | | | |
| *PC10* | *Wide range of potential benefits* | | *1.510* | *3.775* | *64.646* |
| F31 | Suitability of project for privatization | 0.849 | | | |
| F1 | Achieved multiple benefits of project | 0.523 | | | |
| *PC11* | *Profitability of land business* | | *1.380* | *3.450* | *68.096* |
| F3 | Profit return from land business | 0.807 | | | |

**Table 4.**

low, 3 = average, 4 = relatively high, 5 = high) is used for these qualitative indicators. This scale's more detailed information is presented in Table 6.

The linkage between KPIs and CSFs allows transferring strategies into concrete actions that each project's participants should perform. This linkage has the meaning of cause-effect relationship, whereby the results of implementing CSFs are causes for practical performances which are evaluated by KPIs. To explore such a relationship for coastal urban projects, a questionnaire was designed based on the KPIs (Table 5) and the CSFs (Table 4) for expert interviews. A group of eight experts (three experts from GMUs (also involved in government project appraisal councils) and five experts from owners' project development departments),

**Table 5.**
List of KPIs for coastal urban projects

| Category | Code | KPIs | Description | Unit | Assessment method | Source of data |
|---|---|---|---|---|---|---|
| Time | KPI1 | Predictability level on project time | $\frac{(\text{Actualtime} - \text{Plannedtime})}{\text{Plannedtime}} \times 100\%$ | % | Project closure report | Project management unit of owner |
| Cost | KPI2 | Predictability level on project costs | $\frac{(\text{Actualcost} - \text{Plannedcost})}{\text{Plannedcost}} \times 100\%$ | % | Project closure report | Project management unit of owner |
| | KPI3 | Project profitability | $\frac{\text{Profitbeforeinterestandtax}}{\text{Turnover}} \times 100\%$ | % | Annual financial report | Financial department of owner |
| Quality | KPI4 | Project quality | Meeting technical specifications | 1 = 'low' to 5 = 'high' | Project closure report; Questionnaire survey | Project management unit of owner |
| Environment, health and safety | KPI5 | Meeting level to strategic environmental objectives | Evaluated by public council on all potential environmental impacts toward nature and community | 1 = 'low' to 5 = 'high' | Questionnaire survey | Board of directors; Government management unit |
| | KPI6 | Meeting level to society's health and safety conditions | Project's satisfaction to environment, health and safety conditions of users, project neighborhood and society | 1 = 'low' to 5 = 'high' | Questionnaire survey | Board of directors; Government management unit; Users; Project neighborhood |
| Legislation | KPI7 | Legal performance | Meeting level of contract terms; consistency level of applied policies; legal practice of project participants | 1 = 'low' to 5 = 'high' | Questionnaire survey | Board of directors |
| Predictability | KPI8 | Predictability of project | Meeting to future needs and potentials | 1 = 'low' to 5 = 'high' | Questionnaire survey | Board of directors |
| Consumption of project resources | KPI9 | Optimization level of using project's resources | Optimization of available local resources in consumption of all resources for project completion and operation | 1 = 'low' to 5 = 'high' | Project closure report; Questionnaire survey | Project management unit of owner |
| Satisfaction | KPI10 | Satisfaction level of stakeholders | Degree of overall satisfaction of main stakeholders and end-users | 1 = 'low' to 5 = 'high' | Feedback collection; Questionnaire survey | Board of directors; Project management unit; Consultant; Contractor; Government management unit; Users; Project neighborhood |
| Technology and professions | KPI11 | Development level of professional skills and applied technologies | Development level of professional skills of all project participants | 1 = 'low' to 5 = 'high' | Questionnaire survey | Board of directors; Project management unit; Consultant; Contractor |

**Table 6.** Description of 5-point Likert scale for qualitative indicators

| Code | KPIs | Description of 5-point likert scale (1 = 'low' to 5 = 'high') 1 = low | 2 = relatively low | 3 = average | 4 = relatively high | 5 = high |
|---|---|---|---|---|---|---|
| KPI4 | Project quality | Project is totally defective | Project has major defects that impact significantly on owner | Project has some defects that impact moderately on owner | Project has few defects that impact insignificantly on owner | Project is apparently defect-free |
| KPI5 | Meeting level to strategic environmental objectives | Project has major long-term impact | Project has major short-term impact | Project has significant impact | Project has short-term impact | Project has minimal impact |
| KPI6 | Meeting level to society's health and safety conditions | Less than 20% of all health and safety criteria could meet regulations and there is fatal accident during the construction process | 21–40% of all health and safety criteria could meet regulations and there are accidents related to injured people moderately during the construction phase | 41–60% of all health and safety criteria could meet regulations and there are accidents related to injured people but insignificantly during the construction phase | 61–80% of all health and safety criteria could meet regulations and there are few accidents (not injured) insignificantly during the construction phase | Over 80% of all health and safety criteria could meet regulations and there is no accident during the construction phase |
| KPI7 | Legal performance | Low compliance with contract terms, policies and legal regulations | Relatively low compliance with contract terms, policies and legal regulations | Moderate compliance with contract terms, policies and legal regulations | Relatively high compliance with contract terms, policies and legal regulations | High compliance with contract terms, policies and legal regulations |
| KPI8 | Predictability of project | Less than 20% of business goals are achieved after 2 years of operation | 21–40% of business goals are achieved after 2 years of operation | 41–60% of business goals are achieved after 2 years of operation | 61–80% of business goals are achieved after 2 years of operation | Over 80% of business goals are achieved after 2 years of operation |
| KPI9 | Optimization level of using project's resources | Low utilization of available local resources | Relatively low utilization of available local resources | Moderate utilization of available local resources | Relatively high utilization of available local resources | High utilization of available local resources |
| KPI10 | Satisfaction level of stakeholders | Totally dissatisfied | Dissatisfied | Medium | Satisfied | Totally satisfied |
| KPI11 | Development level of professional skills and applied technologies | Low improvement of employees' skills and technological knowledge | Relatively low improvement of employees' skills and technological knowledge | Moderate improvement of employees' skills and technological knowledge | Relatively high improvement of employees' skills and technological knowledge | High improvement of employees' skills and technological knowledge |

**Note(s)**: KPI4 and KPI10: adapted from KPI Working Group (2000); KPI5 and KPI 6: adapted from Vietnam Ministry of Construction (2008, 2014) who participated in large-scale coastal urban projects in Vietnam, were interviewed using the designed questionnaire. With the view and consideration from the planning phase of coastal urban projects, they were requested to give answers for two main questions: (1) "Are the listed 11 KPIs appropriate and adequate?" and (2) "Which CSFs could be related/correlated to each KPI?" All suggestions and feedback from eight experts were recorded. Then, a table for the KPIs and their linking with the project success factors and CSFs was summarized and sent to eight experts for further verification/confirmation. The expert interview process was completed after two rounds when there were no further modifications with a high agreement from eight experts. The finalized results of the KPIs and their linking with the project success factors and CSFs are presented in Table 7.

## 6. Proposing strategy map for coastal urban project success

Based on the identified relationship between KPIs and CSFs (Table 7), a project strategy map is developed using the BSC approach. This study suggests a project strategic management framework presented graphically via the strategy map (Figure 2) with five dimensions: "learning and growth," "internal processes," "social and environmental," "financial" and "stakeholder" perspectives.

The strategic objective of "learning and growth" is to identify the infrastructure that an organization should build for long-term development. It is important to focus on "internal processes" inside the organization to identify which processes are critical. The section of "social and environmental" aspect helps to indicate how the organizational objectives are aligned with the mission toward the society and environment. The objective of "financial strategy" section is to explain how business performance is achieved, while the strategy of "stakeholder" expects to understand how stakeholders and end-users are satisfied with the organization. Furthermore, the results of project success factors and CSFs and the linking between CSFs and KPIs are integrated to identify which CSFs should be highly focused in order to obtain the organization's success.

As the "basement" of the "organization house," the learning and growth perspective should be constructed and improved continuously project by project. Human, system and culture are three main aspects on which an organization should focus. People (employees and leaders) in a company/project need to enhance their professional competencies as well as personal and interpersonal skills. Resources of information, databases and software/tools are "goodwill" assets that a company/project should effectively exploit and improve for the achievement of organizational objectives. The construction of teamwork spirit, organizational culture and alignment in a company/project becomes more important in modern life.

Time, quality, technology, project resource and legislation are five key management aspects, which can strengthen the "structure frame" of the "organization house" if they are well-practiced. Performance measurement for such internal processes can be implemented with the CSFs and KPIs described in Table 7. Specifically, if the project planning activities are well-prepared (PC7), the project time would be ensured. The comprehensive project feasibility study (PC1), the well-organized administrative procedures (PC2) and the approached sustainable development goals (PC3) could also help to enhance the project quality. The technological performance of the organization could be improved if the project feasibility study is developed comprehensively (PC1), the administrative procedures are well-organized (PC2), the sustainable development goals are emphasized in the project (PC3) and the project management skills (PC6) as well as the project manpower (PC8) are concentrated. In addition, if the development planning activities are well-oriented (PC4) and the manpower capability is highlighted (PC8), the effectiveness of project resource management could be achieved. Furthermore, the comprehensive project feasibility study (PC1) and the well-organized administrative procedures (PC2) would contribute to the organization's legislation performance.

| Category | Code | KPIs | Code | Project success factors | Reference of related CSFs |
|---|---|---|---|---|---|
| Time | KPI1 | Predictability level on project time | F5 | Adequate and synchronous plans for deployment of all project items | PC7 |
| | | | F6 | Clear and well-controlled project schedule | |
| | | | F7 | Explicit contractual agreements | |
| Cost | KPI2 | Predictability level on project costs | F3 | Profit return from land business | PC3, PC4, PC6, PC11 |
| | | | F4 | Minimizing clearance compensations and/or use of agricultural land | |
| | | | F22 | Capability of selecting proper calculation and assessment methods (e.g. calculating economic efficiency and assessing project investment efficiency) with consideration of risks | |
| | KPI3 | Project profitability | F3 | Profit return from land business | PC3, PC4, PC6, PC11 |
| | | | F4 | Minimizing clearance compensations and/or use of agricultural land | |
| | | | F22 | Capability of selecting proper calculation and assessment methods (e.g. calculating economic efficiency and assessing project investment efficiency) with consideration of risks | |
| Quality | KPI4 | Project quality | F8 | Feasibility of project zoning (e.g. appropriateness of detail plans with general plan) | PC1, PC2, PC3 |
| | | | F9 | Comprehensiveness of investment construction project report | |
| | | | F13 | Good construction zoning plans | |
| | | | F23 | Selecting appropriate materials for applying new solutions | |
| | | | F25 | Appropriateness of project characteristics (e.g. location, investment models and technical solutions) with sustainable development criteria | |
| | | | F26 | Project-related solutions (e.g. land-use planning, urban design, architecture and structural alternatives) towards sustainable development | |
| | | | F35 | Synchronization and multifunction of technical solutions | |

(*continued*)

**Table 7.**
Linking between KPIs and CSFs of coastal urban projects

| Category | Code | KPIs | Code | Project success factors | Reference of related CSFs |
|---|---|---|---|---|---|
| Environment, health and safety | KPI5 | Meeting level to strategic environmental objectives | F20 | Effective technical solutions to minimize impacts of project on ecological environment | PC1, PC3, PC5 |
| | | | F21 | Consideration of disaster risk scenarios (e.g. sea level rising, storm, unusual local flooding) | |
| | | | F23 | Selecting appropriate materials for applying new solutions | |
| | | | F24 | Assessing environmental impacts in coastal project area | |
| | | | F25 | Appropriateness of project characteristics (e.g. location, investment models and technical solutions) with sustainable development criteria | |
| | | | F26 | Project-related solutions (e.g. land-use planning, urban design, architecture and structural alternatives) towards sustainable development | |
| | KPI6 | Meeting level to society's health and safety conditions | F18 | Adequate consideration of human health and safety conditions for project-surrounding areas | PC3, PC5, PC6 |
| | | | F20 | Effective technical solutions to minimize impacts of project on ecological environment | |
| | | | F21 | Consideration of disaster risk scenarios (e.g. sea level rising, storm, unusual local flooding) | |
| | | | F25 | Appropriateness of project characteristics (e.g. location, investment models and technical solutions) with sustainable development criteria | |
| | | | F26 | Project-related solutions (e.g. land-use planning, urban design, architecture and structural alternatives) towards sustainable development | |
| | | | F27 | Predicting long-term development needs for appropriate strategies of infrastructure development | |

**Table 7.**

*(continued)*

| Category | Code | KPIs | Code | Project success factors | Reference of related CSFs |
|---|---|---|---|---|---|
| Legislation | KPI7 | Legal performance | F7 | Explicit contractual agreements | PC1, PC2 |
| | | | F11 | Stability of legal policies and mechanisms | |
| | | | F12 | Reasonable planning policies for land use | |
| | | | F28 | Effectiveness of government management structure | |
| | | | F30 | Systematic and effective reformation of administrative procedures | |
| | | | F36 | Clear understanding of legal framework and regulations | |
| | | | F40 | Clearly-demonstrated division of management-related responsibilities between owner and government management units | |
| Predictability | KPI8 | Predictability of project | F1 | Achieved multiple benefits of project | PC3, PC4, PC5, PC8, PC10, PC11 |
| | | | F2 | Attractiveness of project (toward lenders, vendors, real-estate businessmen and end-users) | |
| | | | F3 | Profit return from land business | |
| | | | F4 | Minimizing clearance compensations and/or use of agricultural land | |
| | | | F15 | Needs of residents and society | |
| | | | F25 | Appropriateness of project characteristics (e.g. location, investment models and technical solutions) with sustainable development criteria | |
| | | | F27 | Predicting long-term development needs for appropriate strategies of infrastructure development | |
| | | | F31 | Suitability of project for privatization | |
| Consumption of project resources | KPI9 | Optimization level of using project's resources | F12 | Reasonable planning policies for land use | PC4, PC8 |
| | | | F16 | Availability of local human resource | |
| | | | F17 | Availability of local material sources | |
| | | | F19 | Consideration of natural and mechanical population growth for reasonable land-use planning | |
| | | | F23 | Selecting appropriate materials for applying new solutions | |

(*continued*)

**Table 7.**

| Category | Code | KPIs | Code | Project success factors | Reference of related CSFs |
|---|---|---|---|---|---|
| Satisfaction | KPI10 | Satisfaction level of stakeholders | F2 | Attractiveness of project (toward lenders, vendors, real-estate businessmen and end-users) | PC2, PC4, PC9 |
| | | | F14 | Positive support from society | |
| | | | F15 | Needs of residents and society | |
| | | | F32 | Support of government (e.g. stable and flexible financial policy) | |
| Technology and professions | KPI11 | Development level of professional skills and applied technologies | F16 | Availability of local human resource | PC1, PC2, PC3, PC6, PC8 |
| | | | F22 | Capability of selecting proper calculation and assessment methods (e.g. calculating economic efficiency and assessing project investment efficiency) with consideration of risks | |
| | | | F26 | Project-related solutions (e.g. land-use planning, urban design, architecture and structural alternatives) towards sustainable development | |
| | | | F30 | Systematic and effective reformation of administrative procedures | |
| | | | F34 | Skills of applying project management tools | |
| | | | F35 | Synchronization and multifunction of technical solutions | |
| | | | F37 | Financial capability of owner | |
| | | | F38 | Experience of owner about coastal urban projects | |
| | | | F40 | Clearly-demonstrated division of management-related responsibilities between owner and government management units | |
| | | | F41 | Solving interdisciplinary technical issues effectively | |

**Table 7.**

The triple bottom line of sustainability (i.e. social–environment–economic) is the heart of the strategy map. The dimensions of social, environmental and financial performance are measured by the KPIs about health and safety, environment and business benefits in coastal urban projects. The factors of approaching sustainable development goal (PC3), project impact assessment (PC5) and project management skills (PC6) need to be enforced to meet the requirements of health and safety. To enhance the environmental management efficiency in a coastal urban project, the project's practitioners should endeavor for the feasibility study in the planning phase (PC1), seriously consider the sustainable development goal (PC3) and adequately assess the project's impacts on the environment (PC5). It is complicated and challenged for coastal urban projects to achieve the financial effectiveness due to the risky context of climate change. In the planning phase, if practitioners define the objectives

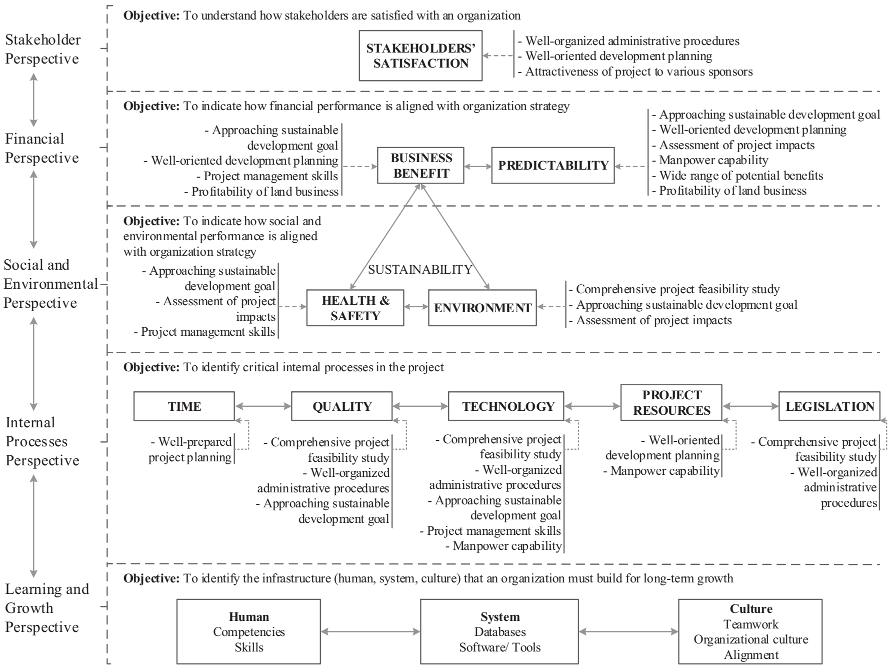


**Figure 2.** Strategy map for coastal urban project success

considering sustainable development goals (PC3), equip a well-oriented development plan (PC4), enhance project management skills for participants (PC6) and make the profitability in land business better (PC11), the economic effectiveness can be earned. Moreover, a coastal urban project can be successful in the financial perspective when the future needs of stakeholders and end-users are predicted. This can be achieved if practitioners consider the following CSFs: approaching sustainable development goal (PC3), well-oriented development planning (PC4), assessment of project impacts (PC5), manpower capability (PC8), wide range of potential benefits (PC10) and profitability of land business (PC11).

In addition to the factors relating to learning and growth, internal processes, social and environmental, and financial perspectives, project stakeholders can be satisfied if the administrative procedures (PC2), the orientation for project development planning (PC4) and the attractiveness to various sponsors (PC9) are more emphasized in coastal urban projects.

## 7. Validation process and case study

The validation process has two main purposes. The first purpose is to check whether the proposed strategy map (Figure 2) is applicable to coastal urban projects. The second purpose is to verify the proposed KPIs included in the strategy map. For these purposes, three coastal urban projects in Vietnam, whose information is presented in Table 8, were used.

To achieve the first purpose, direct interviews were conducted. Specifically, managers and leaders (i.e. interviewees in Table 8) of three aforementioned projects were invited to participate in direct interviews, which focused on some main characteristics of the strategy map: e.g. framework structure, hierarchy of strategic objectives, applicability and data collection capability. The results of feedback for validating the strategy map are presented in Table 9. The table shows that the average values for six assessment items are all high,

**Table 8.** Information of coastal urban projects used for strategy map validation

| No | Project type | Project area (hectare) | Project phase | Budget (VNDbn) | Interviewee |
|---|---|---|---|---|---|
| Project 1 | Resort (including 118 luxury villas, two high-rise apartment buildings, office and commercial center for lease, public service area for business (e.g. beach club and sea pool bar) and 9-story condotel area) | 15.6 | Operation | 1645 | Board of director, city authority and district authority |
| Project 2 | Urban area project (including hotel, shopping mall, conference center, school, golf course and housing buildings) | 180 | Construction | 6000 | Board of director, city authority and district authority |
| Project 3 | Resort and tourism complex (including hotel, villas, convention center, restaurant, hi-tech agricultural area, amusement park and golf course) | 179 | Construction | 4800 | Board of director, province authority and local authority |

confirming that the strategy map may have high applicability in their on-going and coming coastal urban projects.

For the second purpose, coastal urban projects in the operation phase would be selected for data collection. Accordingly, Project 1 (Table 8) is selected as a case study to illustrate the proposed KPIs due to its appropriateness (started to operate from mid-2015 until now). About project characteristics, Project 1 consists of functional areas, internal roads, technical infrastructure, landscapes and sea walls. It should also be noted that Project 1 is one of the two most successful projects, which has received some famous awards, such as the world's second best hotel for families in 2018 and 2019 (TripAdvisor Vietnam, 2019). The results of 11 KPIs in Project 1 are presented in Table 10. In general, Project 1 has good performance of 11 KPIs. Specifically, the value of KPI1 is −16.7%, meaning that Project 1 was ahead of schedule 16.7% (or 8 months) when compared with the planned time. The positive outcome of project schedule was worthy for the project team's efforts in well-prepared project planning (PC7). In addition, Project 1 was under its budget due to the KPI2 value of −3.2%. The value of KPI3 is 19.7% based on the business results in 2018, showing a positive result with return on revenue. The high scores of KPI2 and KPI3 were compatible with the assessments of Project 1's managers and leaders on the consideration of the sustainable development goal (PC3), development planning activities (PC4), project management skills (PC6) and the profitability

**Table 9.** Results of feedback for strategy map validation

| Description | Score* Project 1 | Project 2 | Project 3 | Average value |
|---|---|---|---|---|
| Well-structured framework | 5 | 5 | 5 | 5 |
| Reasonable hierarchy of strategy perspectives | 5 | 4 | 4 | 4.3 |
| Strategy map's applicability in practice | 4 | 4 | 4 | 4 |
| Ease of data collection for measuring strategy performance | 5 | 4 | 4 | 4.3 |
| Strategy map's ease to follow | 5 | 4 | 4 | 4.3 |
| Framework's reference for future work | 5 | 5 | 5 | 5 |

**Note(s)**: *: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree

Table 10. Results of KPIs in project 1

| Category | Code | Time and cost information | Survey score A | B | C | D | E | F | G | Assessment result |
|---|---|---|---|---|---|---|---|---|---|---|
| Time | KPI1 | Planned time: 48 months Actual time: 40 months | | | | | | | | $\frac{(40-48)}{48}\times 100\% = -16.7\%$ (ahead of schedule) |
| Cost | KPI2 | Planned cost: VND1699bn Actual cost: VND1645bn | | | | | | | | $\frac{(1645-1699)}{1699}\times 100\% = -3.2\%$ (under budget) |
| | KPI3 | Profit before interest and tax: VND66.3bn Turnover: VND336.3bn | | | | | | | | $\frac{66.3}{336.3}\times 100\% = 19.7\%$ |
| Quality | KPI4 | | | 4 | | | | | | 4 |
| Environment, health and safety | KPI5 | | 5 | | | | 4 | 4 | | 4.33 |
| | KPI6 | | 5 | | | | 4 | 4 | 5* | 4.5 |
| Legislation | KPI7 | | 3 | | | | | | | 3 |
| Predictability | KPI8 | | 4 | | | | | | | 4 |
| Consumption of project resources | KPI9 | | | 4 | | | | | | 4 |
| Satisfaction | KPI10 | | 5 | 5 | 5 | 5 | 4 | 4 | 5* | 4.71 |
| Technology and professions | KPI11 | | 5 | 5 | 5 | 5 | | | | 5 |

**Note(s)**: A = Board of directors; B = Project management unit; C = Consultant; D = Contractor; E = City authority; F = Local authority; G = Users; *: based on users' feedback on TripAdvisor Vietnam website

of land business (PC11). Due to the changes in city land planning (2010) which made Project 1 late to be started, the owner just rates 3 points for legislation (KPI7) while still giving high scores for other KPIs. Especially, customers of Project 1 voted with a very high ranking of 5/5 (TripAdvisor Vietnam, 2019). These results imply that Project 1's evaluation results based on 11 KPIs are consistent with its actual achievements, thereby confirming the appropriateness and adequacy of the proposed KPIs as well as the applicability of the developed strategic framework.

## 8. Conclusions

This study proposed a strategy map which would support practitioners involved in coastal urban development projects to increase the chance of project success in the context of climate change occurring more and more strongly. Based on the collected data with regard to 41 project success factors, 11 CSFs (i.e. PCs) which could significantly affect the success of coastal urban projects were identified using the PCA technique. In addition, 11 KPIs were recognized to measure the performance of coastal urban projects. Then, the linking of 11 KPIs with project success factors and CSFs was explored. Furthermore, a strategy map for the success of coastal urban projects was proposed using the BSC method. The strategy map concerned both traditional and sustainability perspectives into everyday organizational operations. Specifically, the strategy map included five perspectives: learning and growth, internal processes, social and environmental performance, financial performance and stakeholders' satisfaction. The value of learning and growth should be acknowledged as the foundation for the development of an organization. Internal processes of time, quality, technology, project resources and legislation management aspects are the engines of organizational operations while social and environmental perspective needs to be emphasized seriously and adequately in coastal urban projects. Financial performance should also be measured and controlled carefully for the achievement of organizational objectives with high predictability. Accordingly, coastal urban projects would reach project success in terms of satisfaction of stakeholders and end-users.

Despite some contributions mentioned above, this study's limitation should also be noted. Country-specific findings may be a possible limitation of this study. The strategy map is proposed specifically for coastal urban projects in Vietnam, whose nature and socio-political characteristics may differ from other countries. In addition, each coastal urban project is unique due to its various project characteristics, located areas, stakeholders' objectives and end-users' needs etc. Thus, the proposed strategy map cannot be used automatically for all types of marine projects and/or in other countries without additional data collection. However, the approach of developing the strategy map using the BSC method may be widely applied for any type of construction project in any area.

Further research could be expanded into several different trends. Future studies may extend the work of this study to involve other marine project types in other regions. Such studies may help this study's results (e.g. the proposed strategy map) to become more comprehensive and, therefore, enable them to be applicable to more types of marine projects in different countries. On the other hand, future work could also attempt to improve the comprehensive reliability of the approach used in this study based on fuzzy theory and quantitative methods of decision making. Furthermore, post-strategy research may be critical to measure and manage completely during the project life cycle.

## References

Aghimien, D., Aghimien, E., Fadiyimu, A. and Adegbembo, T. (2018), "Survival strategies of built environment organisations in a challenging economy", *Engineering Construction and Architectural Management*, Vol. 25 No. 7, pp. 861-876.

Aidemark, L. (2001), "The meaning of balanced scorecards in the health care organization", *Financial Accountability and Management*, Vol. 17 No. 1, pp. 23-40.

Aldhaheri, M., Bakchan, A. and Sandhu, M.A. (2018), "A structural equation model for enhancing effectiveness of engineering, procurement and construction (EPC) major projects: end-user's perspective", *Engineering Construction and Architectural Management*, Vol. 25 No. 9, pp. 1226-1252.

Ashley, D.B., Lurie, C.S. and Jaselskis, E.J. (1987), "Determinants of construction project success: a process view", *Project Management Journal*, Vol. 18 No. 2, pp. 69-79.

Balk, D., Montgomery, M.R., McGranahan, G., Kim, D., Mara, V., Todd, M., Buettner, T. and Dorélien, A. (2009), "Mapping urban settlements and the risks of climate change in Africa, Asia and South America", in Guzmán, J.M., Martine, G., McGranahan, G., Schensul, D. and Tacoli, C. (Eds), *Population Dynamics and Climate Change*, UNFPA, New York, NY, pp. 80-103.

Banihashemi, S., Hosseini, M.R., Golizadeh, H. and Sankaran, S. (2017), "Critical success factors (CSFs) for integration of sustainability into construction project management practices in developing countries", *International Journal of Project Management*, Vol. 35 No. 6, pp. 1103-1119.

Bassioni, H.A., Price, A.D. and Hassan, T.M. (2004), "Performance measurement in construction", *Journal of Management in Engineering*, Vol. 20 No. 2, pp. 42-50.

Beatham, S., Anumba, C., Thorpe, T. and Hedges, I. (2004), "KPIs: a critical appraisal of their use in construction", *Benchmarking: An International Journal*, Vol. 11 No. 1, pp. 93-117.

Block, T. and Paredis, E. (2013), "Urban development projects catalyst for sustainable transformations: the need for entrepreneurial political leadership", *Journal of Cleaner Production*, Vol. 50, pp. 181-188.

Brecht, H., Dasgupta, S., Laplante, B., Murray, S. and Wheeler, D. (2012), "Sea-level rise and storm surges: high stakes for a small number of developing countries", *Journal of Environment and Development*, Vol. 21 No. 1, pp. 120-138.

Brewer, P.C. (2002), "An approach to organizing a management accounting curriculum", *Issues in Accounting Education*, Vol. 15 No. 2, pp. 211-235.

Brews, P. and Purohit, D. (2007), "Strategic planning in unstable environments", *Long Range Planning*, Vol. 40 No. 1, pp. 64-83.

Brown, S., Nicholls, R.J., Woodroffe, C.D., Hanson, S., Hinkel, J., Kebede, A.S., Neumann, B. and Vafeidis, A.T. (2013), "Sea-level rise impacts and responses: a global perspective", in Finkl, C.W. (Ed), *Coastal Hazards*, Springer, Dordrecht, The Netherlands, pp. 117-149.

Bruin, K.D., Goosen, H., Ierland, E.C.V. and Groeneveld, R.A. (2014), "Costs and benefits of adapting spatial planning to climate change: lessons learned from a large-scale urban development project in the Netherlands", *Regional Environmental Change*, Vol. 14 No. 3, pp. 1009-1020.

Bulleri, F. and Chapman, M.G. (2010), "The introduction of coastal infrastructure as a driver of change in marine environments", *Journal of Applied Ecology*, Vol. 47 No. 1, pp. 26-35.

Cantele, S. and Zardini, A. (2018), "Is sustainability a competitive advantage for small businesses? An empirical analysis of possible mediators in the sustainability-financial performance relationship", *Journal of Cleaner Production*, Vol. 182, pp. 166-176.

Carmona, S. and Grönlund, A. (2003), "Measures vs actions: the balanced scorecard in Swedish law enforcement", *International Journal of Operations and Production Management*, Vol. 23 No. 12, pp. 1475-1496.

Carvalho, M.M.D., Patah, L.A. and Bido, D.D.S. (2015), "Project management and its effects on project success: cross-country and cross-industry comparisons", *International Journal of Project Management*, Vol. 33 No. 7, pp. 1509-1522.

Chan, A.P.C. and Chan, A.P.L. (2004), "Key performance indicators for measuring construction success", *Benchmarking: An International Journal*, Vol. 11 No. 2, pp. 203-221.

Chan, S.L. and Park, M. (2005), "Project cost estimation using principal component regression", *Construction Management and Economics*, Vol. 23 No. 3, pp. 295-304.

Chan, A.P., Scott, D. and Lam, E.W. (2002), "Framework of success criteria for design/build projects", *Journal of Management in Engineering*, Vol. 18 No. 3, pp. 120-128.

Chan, A.P.C., Scott, D. and Chan, A.P.L. (2004), "Factors affecting the success of a construction project", *Journal of Construction Engineering and Management*, Vol. 130 No. 1, pp. 153-155.

Chan, A.P., Lam, P.T., Chan, D.W., Cheung, E. and Ke, Y. (2010), "Critical success factors for PPPs in infrastructure developments: Chinese perspective", *Journal of Construction Engineering and Management*, Vol. 136 No. 5, pp. 484-494.

Chan, A.P., Yang, Y. and Gao, R. (2018), "Factors affecting the market development of steel construction", *Engineering, Construction and Architectural Management*, Vol. 25 No. 9, pp. 1146-1169.

Chan, D.W., Olawumi, T.O. and Ho, A.M. (2019), "Critical success factors for building information modelling (BIM) implementation in Hong Kong", *Engineering, Construction and Architectural Management*, Vol. 26 No. 9, pp. 1838-1854.

Chen, Y.Q., Zhang, Y.B., Liu, J.Y. and Mo, P. (2012), "Interrelationships among critical success factors of construction projects based on the structural equation model", *Journal of Management in Engineering*, Vol. 28 No. 3, pp. 243-251.

Cheung, E., Chan, A.P. and Kajewski, S. (2012), "Factors contributing to successful public private partnership projects: comparing Hong Kong with Australia and the United Kingdom", *Journal of Facilities Management*, Vol. 10 No. 1, pp. 45-58.

Chou, J.S. and Pramudawardhani, D. (2015), "Cross-country comparisons of key drivers, critical success factors and risk allocation for public-private partnership projects", *International Journal of Project Management*, Vol. 33 No. 5, pp. 1136-1150.

Chou, J.S., Tserng, H.P., Lin, C. and Yeh, C.P. (2012), "Critical factors and risk allocation for PPP policy: comparison between HSR and general infrastructure projects", *Transport Policy*, Vol. 22, pp. 36-48.

Chou, J.S., Irawan, N. and Pham, A.D. (2013), "Project management knowledge of construction professionals: cross-country study of effects on project success", *Journal of Construction Engineering and Management*, Vol. 139 No. 11, pp. 1-15.

Chua, D.K.H., Kog, Y.C. and Loh, P.K. (1999), "Critical success factors for different project objectives", *Journal of Construction Engineering and Management*, Vol. 125 No. 3, pp. 142-150.

Chytas, P., Glykas, M. and Valiris, G. (2011), "A proactive balanced scorecard", *International Journal of Information Management*, Vol. 31 No. 5, pp. 460-468.

Collin, J. (2002), "Measuring the success of building projects – improved project delivery initiatives", Report for the Queensland, Department of Public Works, Australia.

Cooke-Davies, T. (2002), "The 'real' success factors on projects", *International Journal of Project Management*, Vol. 20 No. 3, pp. 185-190.

Cserháti, G. and Szabó, L. (2014), "The relationship between success criteria and success factors in organisational event projects", *International Journal of Project Management*, Vol. 32 No. 4, pp. 613-624.

Dang, C.N. and Le-Hoai, L. (2016), "Critical success factors for implementation process of design-build projects in Vietnam", *Journal of Engineering, Design and Technology*, Vol. 14 No. 1, pp. 17-32.

Dang, C.N. and Le-Hoai, L. (2018), "Revisiting storey enclosure method for early estimation of structural building construction cost", *Engineering, Construction and Architectural Management*, Vol. 25 No. 7, pp. 877-895.

Daniel, D.R. (1961), "Management information crisis", *Harvard Business Review*, pp. 111-121.

Davis, K. (2017), "An empirical investigation into different stakeholder groups perception of project success", *International Journal of Project Management*, Vol. 35 No. 4, pp. 604-617.

De Andrade, J.B.S.O., Garcia, J., De Andrade Lima, M., Barbosa, S.B., Heerdt, M.L. and Berchin, I.I. (2018), "A proposal of a balanced scorecard for an environmental education program at universities", *Journal of Cleaner Production*, Vol. 172, pp. 1674-1690.

De Paula, N., Arditi, D. and Melhado, S. (2017), "Managing sustainability efforts in building design, construction, consulting, and facility management firms", *Engineering, Construction and Architectural Management*, Vol. 24 No. 6, pp. 1040-1050.

De Wit, A.D. (1988), "Measurement of project success", *International Journal of Project Management*, Vol. 6 No. 3, pp. 164-170.

DeVellis, R.F. (1991), *Scale Development: Theory and Applications*, 1st ed., Sage Publications, Newbury Park, CA.

Duraiappah, A.K., Scherkenbach, C., Bai, X., Griffith, C., Kremer, H., Lampis, A., McEvoy, D., Nicholls, R.J., Pelling, M., Roberts, D. and Zelaya, S. (2015), Coastal zones and urbanization: summary for decision makers, UN University – International Human Dimensions Programme (UNU-IHDP), Bonn.

Esteban, M., Tsimopoulou, V., Mikami, T., Yun, N.Y., Suppasri, A. and Shibayama, T. (2013), "Recent tsunamis events and preparedness: development of tsunami awareness in Indonesia, Chile and Japan", *International Journal of Disaster Risk Reduction*, Vol. 5, pp. 84-97.

Falle, S., Rauter, R., Engert, S. and Baumgartner, R.J. (2016), "Sustainability management with the sustainability balanced scorecard in SMEs: findings from an Austrian case study", *Sustainability*, Vol. 8 No. 6, pp. 1-16.

Figge, F., Hahn, T., Schaltegger, S. and Wagner, M. (2002), "The sustainability balanced scorecard – linking sustainability management to business strategy", *Business Strategy and the Environment*, Vol. 11 No. 5, pp. 269-284.

Fortune, J. and White, D. (2006), "Framing of project critical success factors by a systems model", *International Journal of Project Management*, Vol. 24 No. 1, pp. 53-65.

Freeman, M. and Beale, P. (1992), "Measuring project success", *Project Management Journal*, Vol. 23 No. 1, pp. 8-17.

Garcia, M. (2008), "Framing strategic urban projects: learning from current experiences in European urban regions", Salet, W. and Gualini, E. (Eds), *International Journal of Urban and Regional Research*, Vol. 32 No. 3, pp. 751-753.

Gianni, M., Gotzamani, K. and Tsiotras, G. (2017), "Multiple perspectives on integrated management systems and corporate sustainability performance", *Journal of Cleaner Production*, Vol. 168, pp. 1297-1311.

Greatbanks, R. and Tapp, D. (2007), "The impact of BSC in a public sector environment: empirical evidence from Dunedin City Council New Zealand", *International Journal of Operations and Production Management*, Vol. 27 No. 8, pp. 846-873.

Griffith, A.F., Gibson, G.E., Hamilton, M.R., Tortora, A.L. and Wilson, C.T. (1999), "Project success index for capital facility construction projects", *Journal of Performance of Constructed Facilities*, Vol. 13 No. 1, pp. 39-45.

Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2009), *Multivariate Data Analysis*, 7th ed., Prentice Hall, Upper Saddle River, New Jersey, NJ.

Hallegatte, S., Green, C., Nicholls, R.J. and Corfee-Morlot, J. (2013), "Future flood losses in major coastal cities", *Nature Climate Change*, Vol. 3 No. 9, pp. 802-806.

Hansen, E.G. and Schaltegger, S. (2016), "The sustainability balanced scorecard: a systematic review of architectures", *Journal of Business Ethics*, Vol. 133 No. 2, pp. 193-221.

Harvard Business Review Staff (2016), "Project management: the four phases of project management", *Harvard Business Review*, available at: https://hbr.org/2016/11/the-four-phases-of-project-management (accessed 09 September 2018).

Hasan, A. and Jha, K.N. (2019), "Client and contractor roles in schedule incentive/disincentive projects: an empirical study from India", *Engineering, Construction and Architectural Management*, Vol. 26 No. 3, pp. 386-407.

He, Q., Wang, T., Chan, A.P., Li, H. and Chen, Y. (2019), "Identifying the gaps in project success research: a mixed bibliographic and bibliometric analysis", *Engineering, Construction and Architectural Management*, Vol. 26 No. 8, pp. 1553-1573.

Hopkins, L.D. (2001), *Urban Development: The Logic of Making Plans*, Island Press, Washington DC.

Hoque, Z. (2014), "20 years of studies on the balanced scorecard: trends, accomplishments, gaps and opportunities for future research", *British Accounting Review*, Vol. 46 No. 1, pp. 33-59.

Hoque, Z. and Adams, C. (2011), "The rise and use of balanced scorecard measures in Australian government departments", *Financial Accountability and Management*, Vol. 27 No. 3, pp. 308-334.

Hotelling, H. (1933), "Analysis of a complex of statistical variables into principal components", *Journal of Educational Psychology*, Vol. 24 No. 6, pp. 417-441.

Hugo, G. (2011), "Future demographic change and its interactions with migration and climate change", *Global Environmental Change*, Vol. 21S, pp. S21-S33.

Hui, E.C., Wong, J.T. and Wan, J.K. (2008), "A review of the effectiveness of urban renewal in Hong Kong", *Property Management*, Vol. 26 No. 1, pp. 25-42.

Hwang, B.G., Zhao, X. and Gay, M.J.S. (2013), "Public private partnership projects in Singapore: factors, critical risks and preferred risk allocation from the perspective of contractors", *International Journal of Project Management*, Vol. 31 No. 3, pp. 424-433.

Intergovernmental Panel on Climate Change (2014), "Climate change 2014: synthesis report", *Contribution of Working Groups I, II and III to the 5th Assessment Report of the Intergovernmental Panel on Climate Change*, Core Writing Team, Pachauri, R.K. and Meyer, L.A. (Eds), Geneva, Switzerland, pp. 1-151.

Jolliffe, I. (2002), *Principal Component Analysis*, 2nd ed., Springer, New York, NY.

Jolliffe, I.T. and Cadima, J. (2016), "Principal component analysis: a review and recent developments", *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, Vol. 374 No. 2065, pp. 1-16.

Joyce, W.F. (2005), "What really works", *Organizational Dynamics*, Vol. 2 No. 34, pp. 118-129.

Kagioglou, M., Cooper, R. and Aouad, G. (2001), "Performance management in construction: a conceptual framework", *Construction Management and Economics*, Vol. 19 No. 1, pp. 85-95.

Kamphuis, J.W. (2011), "Coastal project management", *Coastal Management*, Vol. 39 No. 1, pp. 72-81.

Kang, J.S., Chiang, C.F., Huangthanapan, K. and Downing, S. (2015), "Corporate social responsibility and sustainability balanced scorecard: the case study of family-owned hotels", *International Journal of Hospitality Management*, Vol. 48, pp. 124-134.

Kaplan, R.S. and Norton, D.P. (1992), "The balanced scorecard: measures that drive performance", *Harvard Business Review*, Vol. 70 No. 1, pp. 71-79.

Kaplan, R.S. and Norton, D.P. (1996), *The Balanced Scorecard: Translating Strategy into Action*, Harvard Business School Press, Boston, MA.

Kaplan, R.S. and Norton, D.P. (2004), *Strategy Maps: Converting Intangible Assets into Tangible Outcomes*, Harvard Business School Press, Boston, MA.

Kärnä, S. and Junnonen, J.M. (2017), "Designers' performance evaluation in construction projects", *Engineering, Construction and Architectural Management*, Vol. 24 No. 1, pp. 154-169.

Kavishe, N., Jefferson, I. and Chileshe, N. (2018), "An analysis of the delivery challenges influencing public-private partnership in housing projects: the case of Tanzania", *Engineering, Construction and Architectural Management*, Vol. 25 No. 2, pp. 202-240.

Kazaz, A. and Ulubeyli, S. (2009), "Strategic management practices in Turkish construction firms", *Journal of Management in Engineering*, Vol. 25 No. 4, pp. 185-194.

Keegan, D.P., Eiler, R.G. and Jones, C.R. (1989), "Are your performance measures obsolete?", *Management Accounting*, Vol. 70 No. 12, pp. 45-50.

Kennerley, M. and Neely, A. (2002), "A framework of the factors affecting the evolution of performance measurement systems", *International Journal of Operations and Production Management*, Vol. 22 No. 11, pp. 1222-1245.

Kershaw, R. and Kershaw, S. (2001), "Developing a balanced scorecard to implement strategy as St. Elsewhere Hospital", *Management Accounting Quarterly*, Vol. 2 No. 2, pp. 28-35.

Khattak, M.S. and Mustafa, U. (2019), "Management competencies, complexities and performance in engineering infrastructure projects of Pakistan", *Engineering, Construction and Architectural Management*, Vol. 26 No. 7, pp. 1321-1347.

Khazanchi, D. (2005), "Information technology (IT) appropriateness: the contingency theory of 'fit' and IT implementation in small and medium enterprises", *Journal of Computer Information Systems*, Vol. 45 No. 3, pp. 88-95.

KPI Working Group (2000), *KPI Report for the Minister for Construction*, Department of the Environment, Transport and the Regions, London, UK.

Kron, W. (2013), "Coasts: the high-risk areas of the world", *Natural Hazards*, Vol. 66 No. 3, pp. 1363-1382.

Labuschagne, C., Brent, A.C. and Erck, R.P.V. (2005), "Assessing the sustainability performances of industries", *Journal of Cleaner Production*, Vol. 13 No. 4, pp. 373-385.

Laryea, S. (2019), "Procurement strategy and outcomes of a new universities project in South Africa", *Engineering, Construction and Architectural Management*, Vol. 26 No. 9, pp. 2060-2083.

Lawrence, S. and Sharma, U. (2002), "Commodification of education and academic labour: using the balanced scorecard in a university setting", *Critical Perspectives on Accounting*, Vol. 13 Nos 5/6, pp. 661-677.

Li, B., Akintoye, A., Edwards, P.J. and Hardcastle, C. (2005), "Critical success factors for PPP/PFI projects in the UK construction industry", *Construction Management and Economics*, Vol. 23 No. 5, pp. 459-471.

Lin, G., Shen, G.Q., Sun, M. and Kelly, J. (2011), "Identification of key performance indicators for measuring the performance of value management studies in construction", *Journal of Construction Engineering and Management*, Vol. 137 No. 9, pp. 698-706.

Liu, J., Love, P.E., Smith, J., Regan, M. and Davis, P.R. (2014), "Life cycle critical success factors for public-private partnership infrastructure projects", *Journal of Management in Engineering*, Vol. 31 No. 5, pp. 1-7.

Luu, T.V., Kim, S.Y., Cao, H.L. and Park, Y.M. (2008), "Performance measurement of construction firms in developing countries", *Construction Management and Economics*, Vol. 26 No. 4, pp. 373-386.

Marshall, R. (2004), *Waterfronts in Post-Industrial Cities*, Spon Press, London.

Mellado, F., Lou, E.C. and Becerra, C.L.C. (2019), "Synthesising performance in the construction industry: an analysis of performance indicators to promote project improvement", *Engineering, Construction and Architectural Management*, Vol. 27 No. 2, pp. 579-608.

Metz, B., Davidson, O.R., Bosch, P.R., Dave, R. and Meyer, L.A. (2007), "Climate change 2007: mitigation of climate change", *Working Group III contribution to the 4th Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, New York, NY.

Morris, P.W.G. and Jamieson, A. (2004), *Translating Corporate Strategy into Project Strategy: Realizing Corporate Strategy through Project Management*, Project Management Institute, Newton Square, PA.

Naik, G.R. (2017), *Advances in Principal Component Analysis: Research and Development*, Springer, Gateway East, Singapore.

Nawaz, W. and Koc, M. (2018), "Development of a systematic framework for sustainability management of organizations", *Journal of Cleaner Production*, Vol. 171, pp. 1255-1274.

Neumann, B., Vafeidis, A.T., Zimmermann, J. and Nicholls, R.J. (2015), "Future coastal population growth and exposure to sea-level rise and coastal flooding - a global assessment", *PloS One*, Vol. 10 No. 3, pp. 1-34.

Nguyen, A.T., Nguyen, L.D., Le-Hoai, L. and Dang, C.N. (2015), "Quantifying the complexity of transportation projects using the fuzzy analytic hierarchy process", *International Journal of Project Management*, Vol. 33 No. 6, pp. 1364-1376.

Nicholls, R.J. and Cazenave, A. (2010), "Sea-level rise and its impact on coastal zones", *Science*, Vol. 328 No. 5985, pp. 1517-1520.

Nicholls, R.J., Hanson, S.E., Lowe, J.A., Warrick, R.A., Lu, X. and Long, A.J. (2014), "Sea-level scenarios for evaluating coastal impacts", *Wiley Interdisciplinary Reviews: Climate Change*, Vol. 5 No. 1, pp. 129-150.

Oh, S., Kim, K. and Kim, H. (2018), "Investment decision for coastal urban development projects considering the impact of climate change: case study of the Great Garuda project in Indonesia", *Journal of Cleaner Production*, Vol. 178, pp. 507-514.

Orgut, R.E., Batouli, M., Zhu, J., Mostafavi, A. and Jaselskis, E.J. (2020), "Critical factors for improving reliability of project control metrics throughout project life cycle", *Journal of Management in Engineering*, Vol. 36 No. 1, pp. 1-14.

Orsato, R.J., Barakat, S.R. and De Campos, J.G.F. (2017), "Organizational adaptation to climate change: learning to anticipate energy disruptions", *International Journal of Climate Change Strategies and Management*, Vol. 9 No. 5, pp. 645-665.

Osei-Kyei, R. and Chan, A.P. (2015), "Review of studies on the critical success factors for public-private partnership (PPP) projects from 1990 to 2013", *International Journal of Project Management*, Vol. 33 No. 6, pp. 1335-1346.

Paplexandris, A., Ioannou, G. and Prastacos, G.P. (2004), "Implementing the BSC in Greece: a software firm's experience", *Long Range Planning*, Vol. 37 No. 4, pp. 351-366.

Pearson, K. (1901), "On lines and planes of closest fit to systems of points in space", *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, Vol. 2 No. 11, pp. 559-572.

Price, A.D. and Newson, E. (2003), "Strategic management: consideration of paradoxes, processes, and associated concepts as applied to construction", *Journal of Management in Engineering*, Vol. 19 No. 4, pp. 183-192.

Project Management Institute (2017), *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, Project Management Institute, Newtown Square, PA.

Rahman, A., Bridge, A., Rowlinson, S., Hubbard, B. and Xia, B. (2018), "Multinational contracting and the eclectic paradigm of internationalization", *Engineering, Construction and Architectural Management*, Vol. 25 No. 11, pp. 1418-1435.

Raisbeck, P. and Tang, L.C. (2013), "Identifying design development factors in Australian PPP projects using an AHP framework", *Construction Management and Economics*, Vol. 31 No. 1, pp. 20-39.

Rajabion, L., Mokhtari, A.S., Khordehbinan, M.W., Zare, M. and Hassani, A. (2019), "The role of knowledge sharing in supply chain success: literature review, classification and current trends", *Journal of Engineering, Design and Technology*, Vol. 17 No. 6, pp. 1222-1249.

Rajeevan, M., Guhathakurta, P. and Thapliyal, V. (2000), "New models for long range forecasts of summer monsoon rainfall over North West and Peninsular India", *Meteorology and Atmospheric Physics*, Vol. 73 Nos 3/4, pp. 211-225.

Richardson, M. (2009), *Principal Component Analysis*, University of Ljubljana, Ljubljana, Slovenia, pp. 1-23.

Rockart, J.F. (1979), "Chief executives define their own data needs", *Harvard Business Review*, Vol. 57 No. 2, pp. 81-93.

Salvatierra, J.L., Gálvez, M.Á., Bastías, F., Castillo, T., Herrera, R.F. and Alarcón, L.F. (2019), "Developing a benchmarking system for architecture design firms", *Engineering, Construction and Architectural Management*, Vol. 26 No. 1, pp. 139-152.

Sanvido, V., Grobler, F., Parfitt, K., Guvenis, M. and Coyle, M. (1992), "Critical success factors for construction projects", *Journal of Construction Engineering and Management*, Vol. 118 No. 1, pp. 94-111.

Seto, K.C., Fragkias, M., Güneralp, B. and Reilly, M.K. (2011), "A meta-analysis of global urban land expansion, *PloS One*, Vol. 6 No. 8, pp. 1-9.

Sharma, S. (1996), *Applied Multivariate Techniques*, John Wiley & Sons Inc., New York, NY.

Shdid, C.A., Andary, E., Chowdhury, A.G. and Ahmad, I.U. (2019), "Project performance rating model for water and wastewater treatment plant public projects", *Journal of Management in Engineering*, Vol. 35 No. 2, pp. 1-9.

Sidiropoulos, M., Mouzakitis, Y., Adamides, E. and Goutsos, S. (2004), "Applying sustainable indicators to corporate strategy: the eco-balanced scorecard", *Environmental Research, Engineering and Management*, Vol. 1 No. 27, pp. 28-33.

Sinesilassie, E.G., Tripathi, K.K., Tabish, S.Z.S. and Jha, K.N. (2019), "Modeling success factors for public construction projects with the SEM approach: engineer's perspective", *Engineering Construction and Architectural Management*, Vol. 26 No. 10, pp. 2410-2431.

Singh, R.K., Murty, H.R., Gupta, S.K. and Dikshit, A.K. (2012), "An overview of sustainability assessment methodologies", *Ecological Indicators*, Vol. 15 No. 1, pp. 281-299.

Small, C. and Nicholls, R.J. (2003), "A global analysis of human settlement in coastal zones", *Journal of Coastal Research*, Vol. 19 No. 3, pp. 584-599.

Speckbacher, G., Bischof, J. and Pfeiffer, T. (2003), "A descriptive analysis on the implementation of balanced scorecards in German-speaking countries", *Management Accounting Research*, Vol. 14 No. 4, pp. 361-388.

Statheropoulos, M., Vassiliadis, N. and Pappa, A. (1998), "Principal component and canonical correlation analysis for examining air pollution and meteorological data", *Atmospheric Environment*, Vol. 32 No. 6, pp. 1087-1095.

Storch, H. and Downes, N.K. (2011), "A scenario-based approach to assess Ho Chi Minh City's urban development strategies against the impact of climate change", *Cities*, Vol. 28 No. 6, pp. 517-526.

Tang, L. and Shen, Q. (2013), "Factors affecting effectiveness and efficiency of analyzing stakeholders' needs at the briefing stage of public private partnership projects", *International Journal of Project Management*, Vol. 31 No. 4, pp. 513-521.

Tang, L., Shen, Q., Skitmore, M. and Cheng, E.W. (2012), "Ranked critical factors in PPP briefings", *Journal of Management in Engineering*, Vol. 29 No. 2, pp. 164-171.

Tang, Z.W., Ng, S.T. and Skitmore, M. (2019), "Influence of procurement systems to the success of sustainable buildings", *Journal of Cleaner Production*, Vol. 218, pp. 1007-1030.

Thomas, V. (2017), *Climate Change and Natural Disasters: Transforming Economies and Policies for a Sustainable Future*, Routledge, New York, NY.

Tiong, R.L., Yeo, K.T. and McCarthy, S.C. (1992), "Critical success factors in winning BOT contracts", *Journal of Construction Engineering and Management*, Vol. 118 No. 2, pp. 217-228.

Todorović, M.L., Petrović, D.Č., Mihić, M.M., Obradović, V.L. and Bushuyev, S.D. (2015), "Project success analysis framework: a knowledge-based approach in project management", *International Journal of Project Management*, Vol. 33 No. 4, pp. 772-783.

Toor, S.R. and Ogunlana, S.O. (2010), "Beyond the 'iron triangle': stakeholder perception of key performance indicators (KPIs) for large-scale public sector development projects", *International Journal of Project Management*, Vol. 28 No. 3, pp. 228-236.

TripAdvisor Vietnam (2019), "Premier village Danang resort - managed by accorhotels", available at: https://www.tripadvisor.com.vn/Hotel_Review-g298085-d6370235-Reviews-Premier_Village_Danang_Resort_Managed_by_Accorhotels-Da_Nang.html (accessed 20 March 2019).

Tung, T. (2018), "Coastal land planning: implications from loose management", available at: https://ashui.com/mag/tuongtac/phanbien/14379-quy-hoach-dat-dai-ven-bien-he-luy-tu-su-buong-long-quan-ly.html?fbclid=IwAR0z7qbuMiWW6-qpUFLeerCTTU1us23Yvw4pkQGm7OlcYnpqodTsA1Tu5lo (accessed 15 March 2019).

Van, S.Q., Le-Hoai, L. and Dang, C.N. (2019), "Predicting implementation cost contingencies for residential construction projects in flood-prone areas", *International Journal of Managing Projects in Business*, Vol. 12 No. 4, pp. 1097-1119.

Vietnam Ministry of Construction (2008), *Vietnam Building Code: Dwellings and Public Buildings - Occupational Health and Safety*, Vietnam Ministry of Construction, Ha Noi, Vietnam.

Vietnam Ministry of Construction (2014), *Vietnam Engineering Code: National Technical Regulation on Safety in Construction*, Vietnam Ministry of Construction, Ha Noi, Vietnam.

Wang, L., Zhang, P., Zhang, P., Li, R., Zhang, Y. and Wu, Y. (2018), "A systematic approach for public-private partnership projects CSFs evaluation", *Engineering, Construction and Architectural Management*, Vol. 25 No. 9, pp. 1127-1145.

Whang, S.W., Park, K.S. and Kim, S. (2019), "Critical success factors for implementing integrated construction project delivery", *Engineering*", *Construction and Architectural Management*, Vol. 26 No. 10, pp. 2432-2446.

Wheelen, T.L. and Hunger, J.D. (2012), *Strategic Management and Business Policy: Toward Global Sustainability*, 13th ed., Pearson Education, Upper Saddle River, New Jersey, NJ.

World Trade Organization (2019), *Natural Disasters and Trade Research - Study I*, World Trade Organization, Geneva, Switzerland, pp. 2-230.

Wuni, I.Y., Shen, G.Q. and Osei-Kyei, R. (2019), "Scientometric review of global research trends on green buildings in construction journals from 1992 to 2018", *Energy and Buildings*, Vol. 190, pp. 69-85.

Xiao, Y.B., Fu, X., Ng, A.K. and Zhang, A. (2015), "Port investments on coastal and marine disasters prevention: economic modeling and implications", *Transportation Research Part B: Methodological*, Vol. 78, pp. 202-221.

Xu, A. and Kouwoaye, A.R. (2019), "How do natural disasters affect services trade?" WTO Staff Working Paper, No. ERSD-2019-12, World Trade Organization, Geneva, pp. 0-35.

Yalegama, S., Chileshe, N. and Ma, T. (2016), "Critical success factors for community-driven development projects: a Sri Lankan community perspective", *International Journal of Project Management*, Vol. 34 No. 4, pp. 643-659.

Yan, H., Elzarka, H., Gao, C., Zhang, F. and Tang, W. (2019), "Critical success criteria for programs in China: construction companies' perspectives", *Journal of Management in Engineering*, Vol. 35 No. 1, pp. 1-13.

Yang, H., Yeung, J.F., Chan, A.P., Chiang, Y.H. and Chan, D.W. (2010), "A critical review of performance measurement in construction", *Journal of Facilities Management*, Vol. 8 No. 4, pp. 269-284.

Yevu, S.K. and Yu, A.T.W. (2019), "The ecosystem of drivers for electronic procurement adoption for construction project procurement: a systematic review and future research directions", *Engineering, Construction and Architectural Management*, Vol. 27 No. 2, pp. 411-440.

Yu, A.T. and Shen, G.Q. (2015), "Critical success factors of the briefing process for construction projects", *Journal of Management in Engineering*, Vol. 31 No. 3, pp. 1-10.

Yu, I., Kim, K., Jung, Y. and Chin, S. (2007), "Comparable performance measurement system for construction companies", *Journal of Management in Engineering*, Vol. 23 No. 3, pp. 131-139.

Zhang, X. (2005), "Critical success factors for public-private partnerships in infrastructure development", *Journal of Construction Engineering and Management*, Vol. 131 No. 1, pp. 3-14.

Zou, W., Kumaraswamy, M., Chung, J. and Wong, J. (2014), "Identifying the critical success factors for relationship management in PPP projects", *International Journal of Project Management*, Vol. 32 No. 2, pp. 265-274.

Zuo, J., Zhao, X., Nguyen, Q.B.M., Ma, T. and Gao, S. (2018), "Soft skills of construction project management professionals and project success factors: a structural equation model", *Engineering, Construction and Architectural Management*, Vol. 25 No. 3, pp. 425-442.

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