

# IMPACT OF SPATIAL PLANNING FOR THE COST AND VALUE OPTIMIZATION IN BUILT ENVIRONMENT AGAINST NATURAL HAZARDS

J.A.C.D. Jayalath<sup>1</sup>, P.A.P.V.D.S. Disaratna<sup>2</sup> and K.T. Withanage<sup>3</sup>

## ABSTRACT

*Spatial planning is managing the environmental, social and economic dimensions of development. Today the built environment suffers from a lot of natural hazards, resulted due to poor concentration over the environmental, social and economic aspects. Magnitudes and frequencies of these natural hazards has shifted from bad to worst in the recent past. Therefore, economic cost of these hazards has increased, and governments has been compelled to spend large amounts of public money to overcome these impacts on the built environment. Thus, in Sri Lankan context, these circumstances warrant the need to have a sustainable and realistic approach for the spatial planning in the built environment. Hence, the aim of this research was to enhance the cost and value efficiency in built environment against natural hazards through proper spatial planning in Sri Lankan context. Research was conducted mainly based on a questionnaire survey following the mixed research approach. Study identified the impact of poor spatial planning in the built environment in Sri Lankan context and study imparted set of guidelines to ensure effective spatial planning in the built environment in order to minimize the impact of adverse natural hazards. Finally, study concluded that, in order to establish a paradigm shift emphasizing the importance of effective spatial planning in the built environment, it is essential to have a clear understanding on natural process and other socio-economic concerns of the country.*

**Key words:** *Built environment; Cost and value optimization; Spatial planning; Natural hazards.*

## 1. INTRODUCTION

“The earth does not belong to man, man belongs to the earth” (Seattle, 1855). Thus, being a part of the nature, human beings are forming relationships with the environment and fulfil their needs through environmental resources over million years. However, due to those informal relationships, human impact over the natural environment, social relations and economic impacts were shifted from bad to worst in the recent past (Mironowicz and Ryser, 2011). Therefore, researchers must find another appropriate dimension to build up the relationship between human development and natural environment. Spatial planning

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<sup>1</sup> Department of Building Economics, University of Moratuwa, Sri Lanka, [charuka960808@gmail.com](mailto:charuka960808@gmail.com)

<sup>2</sup> Department of Building Economics, University of Moratuwa, Sri Lanka, [vijithad@uom.lk](mailto:vijithad@uom.lk)

<sup>3</sup> Department of Quantity Surveying, General Sir John Kotelawala Defence University, Sri Lanka, [kanchukathilakshana@gmail.com](mailto:kanchukathilakshana@gmail.com)

is monitoring and directing the economic, social, political and environmental dimensions of development (Acheampong, 2018). Furthermore, spatial planning is supporting to enhancing value for money in the built environment by offering maximum return on the investment and client can ensure that was worth the price that he has spent (Awodele *et al.*, 2017). Therefore, spatial planning can be defined as a key instrument for development which is balancing demands for development with the need to protect the environment to achieve social and economic objectives (Economic Commission for Europe, 2008).

However, in Sri Lankan context, number of development projects has failed due to lack of concern about the spatial planning specially in environmental aspects such as Kelani riverbank protection project, Ratnapura new city project, Hambanthota city development project and etc. Thus, the natural phenomenon needs to be identified, predicated and modeled during planning stages of any kind of development projects (Jayalath G. and Jayalath S., 2019). Then that will lead to minimize the unexpected costs of the projects and maximize the value for money. Moreover, in Sri Lankan context, no research has been carried out to emphasize the impact of spatial planning over cost of construction and value for money in built environment against natural hazards. Therefore, this research was conducted to enhance the cost and value efficiency in built environment against natural hazards through proper spatial planning in Sri Lankan context. To fulfil the aim of the research, research objectives were established as (1) To identify spatial planning ideologies and relationship with the phenomenon of nature, (2) To identify drawbacks of the built environment against natural hazards due to ineffective spatial planning in Sri Lanka, (3) Identify the effects of spatial planning to the construction cost and value for money in built environment, and finally (4) Formulate a spatial planning guideline to optimize the cost and to enhance the value of the built environment against natural hazards in Sri Lanka. Furthermore, the scope of this research is limited to discuss about the effects of spatial planning only for the economic and environmental aspects.

## **2. LITERATURE SYNTHESIS**

Today, construction industry has direct and indirect impact on the environment in various ways (Enhassi *et al.*, 2014). Therefore, in Sri Lanka, number of development project failures can be investigated in the construction industry due to lack of knowledge on the environment and their natural phenomenon (Jayalath G. and Jayalath S., 2019). Therefore, that would be vital to discover viable solutions to avoid these circumstances while meeting demands for developments and to protect the nature. Moreover, spatial planning is extremely helpful to minimize exposure of people and built environment to natural hazards and to manage the long-term uninterrupted use of urban and rural lands (Sutanta *et al.*, 2013). Thus, the spatial planning can be used to minimize impact of natural phenomenon on the built environment. Therefore, prior to that, there is a need to identify spatial planning ideologies and relationship with the phenomenon of nature.

### **2.1 SPATIAL PLANNING IDEOLOGIES**

According to Economic Commission for Europe (2008), transformation of the space into a place which is more meaningful to humankind will achieve objectives such as reducing environmental damages, enhancing and preserving natural and cultural resources, developing energy resources while ensuring security, limiting the impact of natural hazards and improving relations between the city and the countryside successfully.

Development and Planning Commission (1999) identified the main characteristic of effective spatial planning as safeguarding people's rights, defending the natural system and using resources efficiently. Moreover, Bruin *et al.* (2013), identified some challenges in spatial planning such as demand for the space, facing to the traffic jam, environment-economy relationships, lifestyles and household needs and relationship between governments and individuals.

## **2.2 RELATIONSHIP OF SPATIAL PLANNING TO THE PHENOMENON OF NATURE**

Most of the established ancient civilizations were destroyed from the earth due to the over-exploitation of environmental resources, massive resources depletion and unforeseen natural hazards (Scheffer and Janssen, 2004). Natural hazards cause loss of lives, livelihoods, properties and infrastructures worldwide annually (Perera *et al.*, 2019). According to Jayalath G. and Jayalath S. (2019), an active volcanic island in the Pacific Ocean is not a natural hazard because it does not take place in human habitats. Therefore, the issue is not with these natural processes at all but how humankind is going to build up and establish their habitats without adhering to natural phenomenon and spatial settings of the earth.

In the recent past, Sri Lanka has also experienced an increase in frequency of natural hazards and their impacts which are considerably affecting the economy and development projects (Ministry of Disaster Management, 2016). Landslides can be identified as one of the common natural hazards in Sri Lankan context which has adverse impacts to the human beings and built environment. However, according to the recent scientific literature, land slide is totally a natural process where solid mass lands will shape themselves by moving and flowing from one form to another (Landow, 2012). Landslides represents the natural transformation process where ecological system is trying to come back to their previous balance in terms of "natural balance phenomena" (Loucks and Wu, 1995). Therefore, wrong spatial settings of built environment find a landslide. In proper spatial planning, there are significant features related to the natural environment such as river morphology, evaluation of landforms and extremely helpful to minimize exposure of people and built environment to natural hazards and the vulnerabilities (Sutanta *et al.*, 2013). Thus, proper spatial planning can be used to minimize the impact of natural hazards by making better relationship with the natural phenomena.

## **2.3 DRAWBACKS DUE TO UNSUCCESSFUL SPATIAL PLANNING IN SRI LANKAN CONTEXT**

There are some recent failures occurred in development projects in Sri Lanka caused due to disrespecting the relationship between spatial planning and phenomenon of nature. Among them, Miriyabedda and Aranayake landslides can be identified as the largest construction failures which were occurred due to poor spatial planning (Jayalath G. and Jayalath S., 2019).

### **2.3.1 Meeriyabedda Landslide**

In summing up different causes for a landslide, the physical factors are amounting up to 40% while around 60% has been due to human related factors (Kaleel and Reeza, 2017). Thus, by implementing a comprehensive environmental impact assessment prior to the development project and by practicing proper spatial planning concepts, it will support to

reduce the impact of landslides. Meeriyabedda landslide can be identified as the recent largest construction failure which occurred due to poor spatial planning in the Sri Lankan context which took more than 200 people and 150 houses buried alive on 29<sup>th</sup> of October 2014 (Jayalath G. and Jayalath S., 2019). Thus, it is essential to be aware on geomorphological processes and develop comprehensive environmental impact assessments through proper spatial planning for the development projects prior to beginning of these projects.

### **2.3.2 Aranayake Landslide**

The landslide in Aranayake took place on 17<sup>th</sup> of May 2016 which buried parts of three villages namely Siripura, Elangapitiya and Pallegage and more than 100 people were dead and approximately 75 houses were destroyed (Jayalath G. and Jayalath S., 2019). In this case, Sri Lankan government allocated approximately USD 40,500 to recover the households that have been completely and partially destroyed (Perera *et al.*, 2018). Further author stated that, due to the landslide, 890 families were affected directly and indirectly. Finally, government concluded that, lack of awareness on environment and unplanned tea cultivation were the main contributing factors that increased the severity of the damage (Perera *et al.*, 2018).

### **2.3.3 Riverbank Protection Project - Kelani River**

Throughout the last two decades number of large-scale engineering treatments were implemented to prevent the edge erosion of the Colombo-Hanwella low level road with the lack of understanding of fluvial morphological process of meandering Kelani River (Jayalath G. and Jayalath S., 2019). However, road edge was eroded continuously since this is a perfect natural process. Pre-cast concrete piles, steel sheet piles and finally the gabion retaining structures were used as the engineering treatments to prevent from such issues, but no one was successful as expected (Jayalath G. and Jayalath S., 2019). Therefore, due to the lack of knowledge on river morphology and poor environmental impact assessment, the government spent a large amount of money for precautions, yet the problem has not get resolved. However, river training is the most trending method of fluid engineering where the flow, being the main reason for bank and bed erosion, which is modified by inducing one or more large-scale secondary flows (Werdenberg *et al.*, 2014).

### **2.3.4 Ratnapura New City Project**

Compared to old cities, modern attempts to artificially create new cities has been completely unsuccessful from human perspective (Alexander, 2017). Ratnapura new city, which was built to avoid frequent flooding issue, is one of the best examples for an unsuccessful new city made by the humankind in Sri Lanka. The reason for frequent flooding issue is not only due to the location of Ratnapura city which is located at the lower part of the Kalugaga basin, but also due to plenty of factors related to the urban population settlements and their behavior (Edirisooriya *et al.*, 2018). Accordingly, in the early 1980s the Sri Lankan government decided to shift the main city to a higher elevation near the original location of old city to avoid from major flooding every year. Due to the lack of impact of the new town development for the overall spatial configuration of the Ratnapura city, the new town becomes inactive and lack of functioning after the normal working hours of the government and private offices (Bandara *et al.*, 2010). Therefore, the issue was not only an additional burden on municipal council to maintain an additional area that still does not have a substantial population and activities but also the original

issue of flood and related hazards continuously recording with recurrent losses almost every year. Thus, to integrate the urban activities of new city, there should be substantial considerations of the environment, social and economic aspects to achieve the required degree of spatial planning. Otherwise, general public has to expect these kinds of environmental and economic failures due to poor adaptation of spatial planning.

Therefore, spatial planning will coordinate not only the social factors but also environmental factors to develop the local economy (Biesbroek *et al.*, 2009). Spatial planning aims to integrate different land-use functions and activities efficiently and effectively as possible for maximizing the benefits and profits at a given location (Partidario and Eggenberger, 2014). Therefore, the highest and best use concept also can be employed for this spatial planning system by considering not only about the land to be developed or left vacant but also what kind of improvement should be built (Boshoff, 2016). Therefore, according to Economic Commission for Europe (2008), by adopting effective spatial planning, there would be plenty of positive impacts on the cost of the construction projects and provides the best value for money.

### **3. RESEARCH METHOD**

Mixed approach is a systematic integration of quantitative and qualitative methods in a single study for the purposes of obtaining a complete picture and deeper understanding of the phenomenon (Johnson, et al., 2007). The first three objectives of this research required the collection of quantitative data. The final objective required the collection of qualitative data. Thus, for this study the mixed approach was used. Thus, in order to collect both quantitative and qualitative data, mixed approach was used for this research.

#### **3.1 DATA COLLECTION METHOD**

Primary data for the research was collected through a questionnaire survey. Generally, experienced construction professionals have adequate knowledge on the improper spatial planning and its effect over the built environment. Therefore, considering the available time constraints and often readily and easily available number of participants, convenience sampling method was used as the sampling technique for the questionnaire survey. Moreover, the latter part of questionnaire survey was focused to formulate a spatial planning guideline for the Sri Lankan built environment with the help of given set of international guidelines which were found from literature and attached to the questionnaire. Accordingly, data collected from the first part of the questionnaire were of quantitative nature and the latter part of the questionnaire mainly required the respondents to provide their opinions which were of qualitative nature. The questionnaire was distributed among sample of 42 experts in various professions.

#### **3.2 DATA ANALYSIS METHOD**

Quantitative data which were collected to identify effect of spatial planning to the construction cost and value for money were analyzed through SPSS statistical analysis software since SPSS is the most widely used program for statistical analysis in social science. Moreover, in order to analyze the statistical difference between mean and hypothesized value of the mean in the population, one sample t-test was used in quantitative analysis. Furthermore, the latter qualitative part of the questionnaire survey was analyzed by manual content analysis technique. Manual content analysis technique was used because of a lesser number of questions available to analysis.

## 4. DATA COLLECTION, ANALYSIS AND FINDINGS

### 4.1 RESPONDENT PROFILE

Out of 42 experts, 30 responses were received back. Therefore, overall response rate is approximately 72%. Summary of sample stratification based on their profession, work experience and engaged sectors were summarized in following Table 1.

*Table 1: Summary of the sample stratification*

Sample stratification	Category	Percentage
<b>Profession</b>	Quantity Surveyors	40% (12)
	Architects	23.4% (7)
	Engineers	36.6% (11)
<b>Work experience</b>	0-5 years	43.3% (13)
	5-10 years	30% (9)
	Over 10 years	26.7% (8)
<b>Engaged sector</b>	Residential sector	50% (15)
	Commercial sector	33% (10)
	Industrial sector	36% (11)
	All sectors	46% (14)

100% of the survey respondents stated that, they had experience on the unexpected or unplanned cost involvements during the construction and maintenance phases of construction projects and almost 70% of the respondents believed that the status and applicability of the spatial planning in Sri Lankan context is not adequate in order to minimize those unexpected or unplanned costs of construction projects.

### 4.2 IMPACT OF SPATIAL PLANNING TO THE COST AND VALUE FOR MONEY OF THE BUILT ENVIRONMENT

#### 4.2.1 Impact of Spatial Planning to Cost of the Built Environment

Reduced economic life, impacts over natural environment, inconsistent government policies (bonds, taxes) and design and technical failures were the factors which were identified in literature synthesis that leads to unexpected costs during project lifetime. Table 2 presents the mean values of degree of influence on unexpected costs over built environment. In the questionnaire survey respondents were directed to rank the level of influence over each factor using following 1-5 Likert scale where, (1) represents lowest influence, (2) low influence, (3) medium influence, (4) high influence, and (5) highest influence.

*Table 2: Mean values of degree of influence on unexpected costs over built environment*

	Reduced economic life	Impact over natural environment	Inconsistent government policies	Design and technical failures
Mean	4.03	4.10	3.77	4.23

According to the mean values of above factors, except inconsistent government policies, all other factors have mean greater than 4.00 which means that, those factors have more than “high level of influence” towards the unexpected costs over built environment. One-sample t-test was used to compare these means and 4.00 is the hypothesis value which shows the “high level of influence”. Improper environmental impact assessment, changes of the social behaviour/impacts, political influences, improper feasibility studies and inconsistent government policies were the causes of reduced economic life which shown in Figure 1.

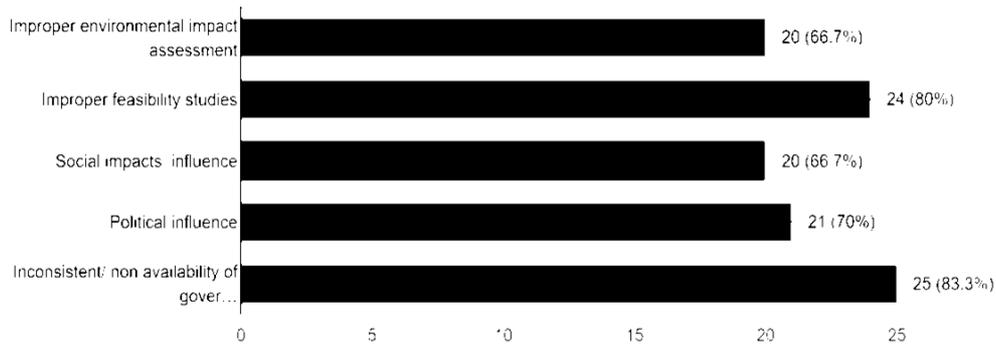


Figure 1: Causes for the reduced economic life

Moreover, 100% of the survey respondents accepted that spatial planning makes an impact over these factors. Further they concluded that spatial planning can be integrated with the environmental, economic and social dimensions to minimize the impact over unexpected costs throughout the life cycle of the development projects.

#### 4.2.2 Impact of Spatial Planning to the Value for Money of the Built Environment

The degree of influence of spatial planning over the factors revealed through the literature synthesis which can ensure value for money, were verified and ranked through the questionnaire survey and represented in Table 3. In the questionnaire survey respondents were directed to use the same 1-5 Likert scale above mentioned.

Table 3: Mean values of degree of influence on the value for money of the built environment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Mean (how spatial planning effect on identified factors)	4.10	4.27	4.13	4.33	4.17	3.80	3.50	4.27	4.03	3.97
Mean (how those factors effect on value for money)	4.43	3.83	3.73	4.43	4.37	4.07	4.33	4.17	3.70	3.90
Average mean (both factors)	4.27	4.05	3.93	4.38	8.54	4.27	3.92	4.19	3.87	3.94

(1) Safeguard client right	(6) Ability to withstand natural disasters
(2) Defending natural system	(7) Construction time saving
(3) Efficient usage of natural resources	(8) Enhanced economic returns of the project
(4) Safeguard on investments	(9) Positive impact over the value of surrounding real estates
(5) Enhance economic life of the project	(10) Risks of disasters and its management

According to the degree of influence, factors having average mean value more than 4.00 can be considered as high influence factors on value for money in the built environment. One sample t-test was used to compare the means and 4.00 is the hypothesis value which shows the “high level of influence”. Therefore, according to respondents’ point of view, proper spatial planning can make high level of influence on ensuring the value for money of the built environment in Sri Lanka with effect of safeguarding client rights, defending natural system, safeguarding on investments, enhancing economic life of the project and enhancing economic returns of the project.

### **4.3 FORMULATION OF A SPATIAL PLANNING GUIDELINE OVER THE BUILT ENVIRONMENT IN THE SRI LANKAN CONTEXT**

According to the findings of the literature synthesis and the results obtained from the questionnaire survey, it was concluded that, through establishing proper spatial planning mechanism over the built environment in the Sri Lankan context, it will be able to obtain social, economic and environmental benefits.

#### **4.3.1 Causes for the Poor Spatial Planning in Sri Lankan Context**

As per the findings of the study, causes for the poor spatial planning and their mean values of degree of agreement are presented in Table 4. In the questionnaire survey respondents were directed to rank the level of agreement over each cause of poor spatial planning using following 1-5 Likert scale where, (1) represents strongly disagree, (2) disagree, (3) neither agree nor disagree, (4) agree, and (5) strongly agree. These causes were identified to use as the basis to develop the spatial planning guideline to optimize the cost and to enhance the value of the built environment against natural hazards in Sri Lanka.

*Table 4: Mean values of degree of influence on the causes for the poor spatial planning*

	<b>Lack of knowledge</b>	<b>Political issues and frequently changing government policies</b>	<b>Time consumption in planning stage</b>	<b>Poor relationship between government and individuals</b>	<b>Social aspect and conventional thinking pattern</b>	<b>Unavailability of proper platform to meet the professionals for decision making</b>
Mean	3.63	4.20	3.93	4.20	3.97	4.13

According to the mean values of degree of agreement, causes for the poor spatial planning in Sri Lankan context can be summarized and ranked as follows.

1. Political issues including corruptions in government authorities and frequent changes in existing national policies
2. Poor relationship between government and individuals
3. Unavailability of proper platform to meet the professionals for decision making
4. Social aspect and conventional thinking pattern
5. Time consumption in planning stage of the construction projects
6. Lack of confidence and knowledge on spatial planning and lack of expert professionals and staff

#### **4.3.2 Development of a Guideline for Modern Spatial Planning over Built Environment**

Based on the findings of the literature synthesis and questionnaire survey, it was concluded that, role of spatial planning in the built environment and construction industry

is far more important in cost and value optimization against natural hazards. Hence, there is a need to establish a proper spatial planning guideline which can be used to optimize the cost and to enhance the value of the built environment against natural hazards in Sri Lanka. They include the following steps.

- Understand the natural processes including geomorphologic settings of the project area during the planning stage of the project and analysis of findings of the feasibility study in a proper way
- Ensure maximum social return by the project, by understanding all-natural processes
- Identify the most optimum land for the development project by integrating the environmental, economic and social dimensions
- Identify the most desirable project for the landscape by considering the national economic development plan of the country
- Keep all stakeholders aware on the advantages of integrating an effective spatial planning within the planning stage
- Ensure better relationship between government and the client to reduce the time consumption during the planning stage
- Every planning related decision should be made by experienced and qualified professionals considering environmental concerns and economic value addition
- Develop a national policy through a transdisciplinary approach with the identification of objectives and their possibilities in order to establish a sustainable, economic and ecologically viable balance
- Government should establish the national policy through a transdisciplinary approach considering urban, suburban and rural areas separately by analysing the population growth aiming decentralization of the facilities while protecting the environment. Moreover, without stuck with the concept of urban and make sure that authorities do their duties in proper manner can be helpful to overcome the continuous urbanization.

## **5. CONCLUSIONS AND RECOMMENDATIONS**

As per the literature survey findings and opinions received from the questionnaire survey respondents, there are number of drawbacks in some of the latest built environments in Sri Lankan context due to ineffective spatial planning. Thus, to overcome these circumstances and protect the environment while fulfilling human needs with enhanced value for money, spatial planning could be recommended as the best solution as per the findings of this research. Furthermore, spatial planning can be used to minimize the vulnerabilities of the natural hazards and other unexpected costs by understanding their ideologies and relationships of the phenomenon of nature.

Further, these findings revealed that, spatial planning makes high impact on the construction cost and the value for money in the built environment by up keeping the investments and client's rights of the project, enhancing the economic life and economic return of the project and defending natural eco system adjoining the built environment. Furthermore, findings of the study concluded that the existing spatial planning strategies are not adequate for the construction industry in Sri Lanka to cost and value optimization against natural hazards. Therefore, this study can be considered as a pilot study to evaluate the impact of spatial planning over the built environment with reference to cost and value

optimization against natural hazards and recommend for better implementation of effective spatial planning in order to protect the environment while meeting human needs in built environment.

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