ISSN XXXX XXXX © 2018 IJESC

Research Article Volume 8 Issue No.4

Sustainability Performance in Infrastructure Projects In the State of Kuwait

Rashid Aldaiyat
Independent researcher

Abstract:
The main aim of this study was to examine the sustainability performance of infrastructure projects in Kuwait by examining the sustainable performance of some of the largest infrastructure projects in Kuwait form the construction managers' point of view. A checklist was developed based on previous studies to measure the four main aspects of sustainable performance (economic, social, environmental, engineering/resource utilization) with the indicators that are following each aspect. The checklist was distributed to a sample of (50) construction managers who worked or still working in the largest infrastructure projects in Kuwait that were reported in 2015. The results revealed that there is a great interest in the social and economic aspects besides a setback in the environmental aspects. Therefore, it is necessary to incorporate all the sustainable performance indicators in the comprehensive plans of infrastructure projects in Kuwait in order to assure more sustainable practices.

Keywords: Infrastructure Projects, Sustainability Performance, Kuwait

1. INTRODUCTION

Lately, environmental concerns have become an important part of all main infrastructure projects. Now, when the environment is considered, it will not only include pollution prevention, biodiversity, water and air quality, species and habitat protection, visual amenity and land use. Nevertheless, it is now a more comprehensive approach that includes the future and present impact on communities, efficient resource use, climate change considerations, whole of life considerations, source of materials, future proofing and waste management (Griffiths, 2007).

Infrastructure projects are vital for reducing poverty and increasing economic progress. The decisions made in the scale and type of infrastructure investment has major consequences for the environmental sustainability. So far, yet, inadequate progress has been conducted in increasing infrastructure access in the majority of developing countries including Kuwait. Furthermore, the expansion of infrastructure has come frequently at the local environment expense, where complicating responses to the longer-term climate change challenge (Fay &Toman, 2010).

These observations highlight the difficulty in building, planning, and maintaining infrastructure for environmental sustainability and socioeconomic progress. Many factors clarify why there has been such inadequate progress in accommodating the environmental and economic challenges of the provision of infrastructure service. From an economic perspective, infrastructure is costly, needs considerable upfront investment for benefits that are extent with time, and is hindered with difficulties associated with cost-recovery. For a large number of countries, particularly the poorer ones, the needed investments amount is shocking. Furthermore, infrastructure, like many others dominated services by the public sector, has often been managed in the wrong way (Fay et al., 2011).

This study is examining the sustainability performance of infrastructure projects in Kuwait by examining the sustainable performance of some of the largest infrastructure projects in Kuwait form the construction managers' point of view.

2. SUSTAINABILITY AND INFRASTRUCTURE

Lately, “Green” and “Sustainability” have become common words. Still, while the sustainability concept seems to have wide range of applications, it was difficult to define. The way to achieve sustainable infrastructure is through generating systems that address material demands and can continue in order to meet the future generations' demands. It essentially must be active in its ability to incorporate several fields with the goal of reaching the ideal situations (Andreas et al., 2010).

For sustainable advantages to be effective, the infrastructure issues have to be addressed. So far, most initiatives of environmental design have concentrated on building design. LEED® success has highlighted the design of the built environment and emissions. Nonetheless, even if all structures were able to attain the rating of LEED, further sustainable initiatives are needed to be attained to global warming and counter-act ozone-depletion resulting from energy consumption and non-building related emissions. It is anticipated that “global energy consumption will increase by 2.7% annually from 1997 to 2020.” (Bradley, 2001)

Infrastructure plays a considerable role in the built environment sustainability. Infrastructure works at a larger scales and needs careful planning in order to work efficiently and well. It involves many resources, while facing the longer life cycle expectation than other new construction. Also, infrastructure construction has often a considerable influence on local communities; therefore, it has to be completed quickly as possible with many taken efforts to limit conflicts. Due to these exceptional issues, infrastructure is not guided easily by systems like LEED that have been successful at the building scale (Umer et al., 2016).

When infrastructure construction project is completed sustainably and well, it will limit energy loss in the delivery of power, more effectively transmit and clean water, to allow for more unified travel through air, motor vehicle, bike, train and foot. The infrastructure design has huge implications on businesses and local community. Infrastructure is not limited to transportation and roadways, but also includes pipelines, power sources as well as public commodities including hospitals and schools systems. These broad- reaching types of

construction, which can fall within the "infrastructure" conventions show how this term remains generic and broad. Due to the inherent differences among the varied infrastructure categories, a rating-system related to sustainable infrastructure has to be tailored separately/specifically for each individual type (Handayani et al., 2017).

As there is a strive to provide a sustainable infrastructure associated framework, it is vital, as with any "sustainable" activities, to analyze and view infrastructure as it relates to the three sustainability sub-categories that are broadly-accepted: social sustainability, environmental sustainability and economic sustainability. Within the three categorizations fall industrial base, people, built environment, natural environment and resource base. These five aspects relate to the time, space, finance, economy, ecology and environment scales. This categorization increases the obligation to approach infrastructure through understanding the different factors, or influence lenses. The largest of these, the largest the impact that time has on a project. It seems like time has not played an important role in the current sustainable construction models. It demands attention across operations, design, construction as well as eventual decommissioning. Time is very relevant due to the typically longer life phases of infrastructure when it is compared to the construction of buildings (Vanegas, 2003).

2.1 Sustainability performance of infrastructure projects

Across the life cycle construction project, sustainability performance is a vital aspect in obtaining the sustainable development goal (Shen et al., 2007). Sustainability factors drive and monitor performance to the performances of construction project (Litman, 2007). Later, sustainability performance degree of construction project including a satisfaction of the client's need/objectives, solution of the problem, clear instruction term and etc. are influenced by the sustainability factors implementation (Vanegas, 2003). Usually, cost, quality and time have long been known as the main criteria of measuring the performance of construction projects (Chan & Chan, 2004).

However, sustainability factors implementation has led to sustainable project delivery performance including minimize wastage, better decision-making, avoid delays, efficient project delivery and minimize constructability problems (claim, rework, etc.) (Ugwu&Haupt, 2007). The resulting performance from the sustainability factors implementation in infrastructure projects are to minimize environmental impacts and pollution, fit for quality and purpose, community/public acceptance, minimize maintenance and operation cost, completion on time, minimization risk, protect cultural heritage, safe construction and etc. (Lim, 2009).

2.2 Sustainable construction in Kuwait

Kuwait is small Arab country located in the north-western of the Arabian Gulf. It spans for 170 kilometers from east to west and 200 kilometers from north to south at 29° (MEW, 2011). Kuwait occupies 17,818 square kilometers area.

Kuwait is a rich country that has one of the highest per capita incomes in the world. It is a developing, rich Arab Gulf country; though, the economy of the country is dependent on the oil industry (Crichton, Nicol&Roaf, 2009). Kuwait owns almost 10% of the oil reserves in the world, where increasing oil prices contributed on the economy. The main revenue source is petroleum products, which represent nearly 50% of GDP, 95% of government earnings and 95% of total export earnings (AlSanad, 2015).

The industry of building construction plays a key role in Kuwait economy where it consumes 2% of Kuwait economic and shares 4.7% of non-oil sector in 2008 as recorded by the Kuwait Central statistical Office to be the second measure of Kuwait investment after the oil sector. The industry of public and private construction projects provides the foundation for Kuwait national power's military economic and elements. However, there is rising awareness and concern of sustainability and environmental issues in Kuwait within researchers, professional bodies and construction companies (AlSanad, 2015).

In Kuwait, the green measure is still in its beginning, with mostly sustainable projects at the founding stage. Only one construction project has therefore far has achieved the LEED Gold rating from the U.S. Green Building Council (USGBC) under the core and shell rating system. LEED is one of the most common employed assessment tool used globally and between GCC countries to rate and classify Green Building. But, the project was later cancelled because of the financial crisis. In comparison with the other GCC countries, Kuwait has the lowest engagement with green construction projects (Poston, Emmanuel & Thomson, 2010; Ding, 2008; Retzlaff, 2009).

3. METHODOLOGY

The primary data of this study were extracted by developing a checklist that was focusing on the Sustainability performance of infrastructure projects, where the main items of this checklist were derived from the studies of Amiril et al., 2014 and Shen, Wu & Zhang (2010). The following are the items that were common in both studies as listed in table (1) below:

Table1: checklist items for sustainable performance (Amiril et al., 2014; Shen, Wu & Zhang, 2010)

Group	Indicator
Economical aspect	Analysis of market supply and demand
	Technical advantage
	Project budget
	Project financing channels
	Project investment planning
	Life-cycle cost
	Life-cycle benefit/profit
	Financial risk
	Payback period
	Internal return ratio (IRR)
	Fit for purpose & quality
	Minimize maintenance & operation cost
	Completion on time
Social aspect	Effects on local development
	Provision of employment opportunities
	Project function
	Scale of serviceability
	Provision of ancillary amenities to local
	Public acceptance
	economic activities
	Public safety
	Public sanitation
	Land use and its influence on the public
	Protection to culture heritage
	Promotion of community development
	Open & transparent community involvement
Environmental aspect	Ecological effect
	Effect on land pollution
	Effect on air quality
	Effect on water quality
	Noise effect
	Waste generation
	Influence on public health
	Environment protection measures in project design
	Energy savings
	Protection to landscape and historical sites
Engineering/Resource utilization	Enhancement of infrastructure life span
	Achievement of project objectives
	Long-lasting & high quality products
	Saving maintenance cost
	Uninterrupted material supply
	Cost reduction
	Increase design innovation
	Completion on time
	Minimization waste

The checklist was distributed on (50) construction managers who worked or still working in the largest infrastructure projects in Kuwait that were reported in 2015. The answers to the checklist were in the form of (positive) or (negative).

3. DISCUSSION AND CONCLUSIONS

The following table shows the answers of the sample based on the mean and standard deviation of the (positive) answers for the checklist.

Table 2: results of the four sustainable aspects

Economical aspect	Mean	Std. deviation	Social aspect	Mean	Std. deviation	Environmental aspect	Mean	Std. deviation	Engineering/Resource utilization	Mean	Std. deviation
Analysis of market supply and demand	4.32	0.79	Effects on local development	4.34	0.67	Ecological effect	3.75	0.51	Enhancement of infrastructure life span	4.1	0.68
Technical advantage	4.19	0.71	Provision of employment opportunities	4.18	0.65	Effect on land pollution	3.74	0.58	Achievement of project objectives	4	0.73
Project budget	4.13	0.84	Project function	4.11	0.77	Effect on air quality	3.27	0.87	Long-lasting & high quality products	3.9	0.69
Project financing channels	3.98	0.81	Scale of serviceability	4.07	0.73	Effect on water quality	3.9	0.65	Saving maintenance cost	3.7	0.89
Project investment planning	3.97	0.80	Provision of ancillary amenities to local	3.89	1.01	Noise effect	3.8	0.72	Uninterrupted material supply	3	1.06
Life-cycle cost	3.21	1.04	Public acceptance	4.1	0.68	Waste generation	3.77	0.84	Cost reduction	4.1	0.68
Life-cycle benefit/profit	3.13	0.89	economic activities	4	0.76	Influence on public health	3.68	0.57	Increase design innovation	3.98	0.64
Financial risk	2.57	0.81	Public safety	3.9	0.67	Environment protection measures in project design	3	0.79	Completion on time	3.66	0.76
Payback period	4.17	0.79	Public sanitation	3.9	0.73	Energy savings	3.72	0.8	Waste minimization	3.63	0.50
Internal return ratio (IRR)	4.11	0.78	Land use and its influence on the public	3.9	0.73	Protection to landscape and historical sites	3.64	0.98	**Total**	**3.78**	
Fit for purpose & quality	4.07	1.02	Protection to culture heritage	3.87	0.59	**Total**	**3.62**				
Minimize maintenance & operation cost	4.06	0.88	Promotion of community development	3.76	0.54						
Completion on time	3.91	0.95	**Total**	**4.00**							
Total	**3.83**										

The analysis of the data was conducted, several results were obtained. It was found that there was a high concern in analyzing the market supply and demand in order to be in accordance with the customer demands (Whelan, Msefer& Chung, 2001). The technical advantage is another indicator that infrastructure projects in Kuwait are following the sustainable direction where construction managers are aware of the advantages of using the latest technologies in such projects. While there was a low consideration of the financial risk and life-cycle benefit/profit, which can be attributed to the fact that the financial supply is not an issue to the construction managers in Kuwait where the budgets for such projects are high. This result can be attributed to the fact that most of the large infrastructure projects are conducted by the public sector, where the financial control is less managed compare with the private sector (Ehlers, 2014; Blanc-Brude&Makovsek, 2013).

On the social aspect, the local development and providing employment opportunities were the main indicators of the sustainable direction in infrastructure projects in Kuwait. Moreover, the protection of culture heritage was not the main priority in infrastructure projects in Kuwait. The environmental assessment showed that concerning about water quality and noise was compared with air quality where most of construction projects producing massive amount of pollution to the air. This result is attributed to the lack of effective techniques that contribute on minimizing air pollution in construction projects (Morledge& Jackson, 2001; Lawrence, 2015).

On the Engineering/Resource utilization aspect, cost reduction and enhancement of infrastructure life span are the main features of the sustainable performance of the infrastructure projects under study, while uninterrupted material supply and waste minimization.

In general, it was noted that the sustainable performance of infrastructure projects in Kuwait is in a high level, with a great interest in the social and economic aspects. However, it was noticed a setback in the environmental aspects.

4. RECOMMENDATIONS AND FUTURE WORK

Further studies have to be conducted on studying the most suitable sustainable performance measures that suits the Kuwaiti context. Moreover, more contribution should be made on each field of infrastructure projects since each type own its specific requirements and nature. On the other hand, local authorities, environmental and social bodies should be involved in the planning process of infrastructure projects.

REFERENCES

[1] Ali, H. H., & Al Nsairat, S. F. 2009.Developing a green building assessment tool for developing countries–Case of Jordan. Building and Environment, 44, 5, 1053-1064.

[2] AlSanad, S. 2015. Awareness, drivers, actions, and barriers of sustainable construction in Kuwait. Procedia engineering, 118, 969-983.

[3] Amiril, A., Nawawi, A. H., Takim, R., &Latif, S. N. F. A. 2014.Transportation infrastructure project sustainability factors and performance. Procedia-Social and Behavioral Sciences, 153, pp. 90-98.

[4] Andreas, G., Allen, J., Farley, L., Kao, J. K., &Mladenova, I. 2010. Towards the development of a rating system for sustainable infrastructure: A checklist or a decision-making tool?. Proceedings of the Water Environment Federation, 2, 379-391.

[5] Blanc-Brude, F., &Makovsek, D. 2013.Construction risk in infrastructure project finance. Research, EDHEC Risk Institute

[6] Bradley, R. S. 2001. Climate change–past, present and future: a personal perspective. GAIA-Ecological Perspectives for Science and Society, 10, 4, 266-269.

[7] Chan, A. P., & Chan, A. P. 2004.Key performance indicators for measuring construction success. Benchmarking: an international journal, 11, 2, pp. 203-221.

[8] Crichton, D., Nicol, F., &Roaf, S. 2009. Adapting Buildings and Cities for Climate Change. Routledge.

[9] Ding, G. K. 2008. Sustainable construction—The role of environmental assessment tools. Journal of environmental management, 86, 3, 451-464.

[10] Ehlers, T. 2014. Understanding the challenges for infrastructure finance.

[11] Fay, M. &Toman, M. Infrastructure and Sustainable Development.2010. Korea-World Bank High Level Conference on Post-Crisis Growth and Development, co-organized by the Presidential Committee for the G-20 Summit and the World Bank with the support of the Korea Institute for International Economic Policy (KIEP).

[12] Fay, M., Toman, M., Benitez, D., &Csordas, S. 2011. Infrastructure and sustainable development. Postcrisis Growth and Development: A Development Agenda for the G, 20, pp. 329-382.

[13] Griffiths, K. 2007. Project sustainability management in infrastructure projects. In 2nd International Conference on Sustainability Engineering and Science.

[14] Handayani, F. S., Setyawan, A., Pramesti, F. P., & Wibowo, M. A. 2017.Strategy toward sustainable local road network infrastructure.In MATEC Web of Conferences (Vol. 138, p. 07007). EDP Sciences.

[15] Lawrence, M. 2015. Reducing the environmental impact of construction by using renewable materials. Journal of Renewable Materials, 3, 3, pp. 163-174.

[16] Lim, S. K. 2009. Framework and processes for enhancing sustainability deliverables in Australian road infrastructure projects (Doctoral dissertation, Queensland University of Technology)

[17] Litman, T. 2017. Developing indicators for comprehensive and sustainable transport planning. Transportation Research Record: Journal of the Transportation Research Board, 10-15.

[18] MEW, Statistical Year Book: Electrical Energy. 2011. State of Kuwait: Statistics Department and Information Centre. Ministry of Electrical and Water

[19] Morledge, R., & Jackson, F. 2001.Reducing environmental pollution caused by construction plant. Environmental Management and Health, 12, 2, pp. 191-206.

[20] Poston, A., Emmanuel, R., & Thomson, C. 2010. Developing holistic frameworks for the next generation of sustainability assessment methods for the built environment. In Proc. Of the 26th Annual ARCOM Conference (pp. 1487-1496).

[21] Retzlaff, R. C. 2009. The use of LEED in planning and development regulation: an exploratory analysis. Journal of Planning Education and Research, 29, 1, 67-77.

[22] Shen, L. Y., Li Hao, J., Tam, V. W. Y., & Yao, H. 2007. A checklist for assessing sustainability performance of construction projects. Journal of civil engineering and management, 13, 4, pp.273-281.

[23] Shen, L., Wu, Y., & Zhang, X. 2010.Key assessment indicators for the sustainability of infrastructure projects. Journal of construction engineering and management, 137, 6, pp.441-451.

[24] Ugwu, O. O., &Haupt, T. C. 2007.Key performance indicators and assessment methods for infrastructure sustainability—a South African construction industry perspective. Building and Environment, 42, 2, pp. 665-680.

[25] Umer, A., Hewage, K., Haider, H., &Sadiq, R. 2016.Sustainability assessment of roadway projects under uncertainty using Green Proforma: An index-based approach. International Journal of Sustainable Built Environment, 5, 2, 604-619.

[26] Vanegas, J. A. 2003. Road map and principles for built environment sustainability. Environmental science & technology, 37, 23, 5363-5372.

[27] Vanegas, J. A. 2003. Road map and principles for built environment sustainability. Environmental science & technology, 37, 23, pp. 5363-5372.

[28] Whelan, J., Msefer, K., & Chung, C. V. 2001.Economic supply & demand. MIT.