Green Approach in Road Construction

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Abstract

Formation of road network involves various construction activities which may include deforestation that gives impact to the environment. Therefore road construction has indirectly affected the environment in countless ways and also has increased the destruction of the natural environment. As the environmental impacts of road construction activities become more apparent, green approach in road construction moves forward and gaining its momentum. A green approach can be defined as a process of planning, design and constructing using technology and concept at low cost in minimizing environmental impacts on communities and natural habitat. However, in the current road project, green approach is still new and sometimes contractors do not take this matter seriously. In this paper, the readiness and acceptability of contractors towards a green approach in road construction is studied. The data for this study was obtained through a set of questionnaire to targeted respondent and was analyzed by using SPSS software. From the study, it was found that green approach in road construction is being accepted and widely understood by a majority of main players in the construction industry but the implementation of the green approach has been found to be not widely carried out. From the analysis that has been carried out, the result reveals that the government should come out with the strategies to improve the implementation of green approach.

Keywords: sustainable development; sustainable construction; green approach; readiness; green road

1.0 Introduction

Nowadays sustainable issues have been widely discussed especially in construction industry. Malaysia is now striving to upgrade the country, including its construction industry, by committing towards Vision 2020 where one of the basic visions that emerged is for the country to be ecologically sustainable. Even though the issue of sustainable development has emerged as one of the top issues since Eight Malaysia Plan (2001 – 2005), at present there is still as hot issue in sustainable construction industry.

Sustainable development is a main issue in order to meeting the environmental objectives and fulfils the demand of the large infrastructure projects due to increasing numbers of population growth and urban density (Rooshdi, Rahman, Baki, Majid, & Ismail, 2014). Construction road network is one of the infrastructure projects. Normally, road construction involved various construction activities which may involve deforestation which gives impact to the environment (Qing & Cheong, 2009). Road is a "way", with a defined alignment and a fixed centerline. Roads also can be defined as a thoroughfare, route, or way on land between two places, which typically has been paved or otherwise, improved to provide a means for vehicles to move along without sinking into the surface. According to Lee, Cheong, & Daud (2010) road is to provide the platform and sustainability for economic activities and growth. In constructing the road pavement, concrete or tar is used and these activities will mostly engage a larger quantity of quarry materials (Qing & Cheong, 2009). Zakaria et al. (2013) stated highways development involve massive earthwork and conversion of land used in it construction. Therefore road construction has indirectly affected environment in countless way and also increased the damage of the natural environment. The impacts of road on energy consumption and environment will reduce as a sustainable development brings together a vast array of practice and technique.

Sustainable development can be one of the factors that can minimize the impacts of the road to the environment. According to Malaysia Highway Authority (2010), the main concept of sustainable development is to ensure the natural resources last forever and preserved from being destroyed. To achieve sustainable development, green technology can be applied. Green technology is part of sustainable development. Green technology is the application of the environmental science to conserve and recycle the natural environment and resources in order to address the negative impacts of human activity (Malaysia Highway Authority, 2010). According to Abidin and Jaapar (2008), sustainable construction aims to produce structures that enhance the quality of life and protect the

environment efficiently and profitably. Sustainable construction is all about maintaining a balance between the human need for buildings for shelter and business operations and infrastructure for higher quality of well-being at one hand, while preserving natural resources and ecosystems, on which we and future generation depend at the other hand.

According to Abhiman and Babarmahal (2009), green road approach is proving to be a sustainable way of constructing roads which it address the needs of sustainable development approach. It can be define the green approach in road construction is a sustainable ways of constructing road by using environmentally friendly techniques in minimizes harmful effect on the environment. Green road is the road practicing or using a green approach in the construction. It is deliberately called "green road', which also applies to the terminology of sustainable road, green highways and environmentally friendly road. Bryce (2008) said "green highways" is the practice of creating and using healthier and more resources- efficient models. While according to Ash (2011), a green highway is a road way construction as per a relative new concept for road way design that integrates transportation functionality and ecological sustainability. An environmental approach is applied throughout planning, design, and construction. In other words, green road was pointing to those environment friendly roads with zero consumption of energy or resources. Green road also can use the terminology of sustainable road, green highways, environmentally friendly road and so on. This green approach is introduced to reduce burden on mother earth (Lee et al., 2010). Therefore, the green road is road using a green approach in constructing the road.

According to Abhiman & Babarmahal (2009), the green road approach considered both environments, social and economic issues of the country. The green road adopt the mass balancing as the environment friendly approach and more importantly it utilizes the various soil bioengineering techniques to ensure stability of slope and control of the erosion. Currently, in Malaysia, there is still no local index that relevant to the green road or green highway development. There are essential needs to establish a code or guideline in Malaysia that can be referred by local highway designers in the planning, design and construction stage of Green Highway infrastructure (Zakaria et al., 2013). According to Zakaria et al. (2013) in comparison to the green building initiatives, green road or green highway is considered a new concern for the implementation in Malaysia.

Green approach in road construction is still new so there are uncertainties in some technology that may not be suitable. A study based on sustainable concept awareness in Malaysia construction practices reveal that a lot more efforts are necessary to enhance the level of environmental awareness and civic consciousness among the people to build sustainably in the future because the dissatisfaction with the outcome of construction and the irresponsible actions by contractors and developers relating to environmental protection is still occurred (Abidin & Jaapar, 2008). As cited by Esa, Marhani, & Yaman (2011), the key to moving forward to going green is challenging amongst all parties, including the government, owners, designers and contractors would need to embrace the concept to make it work. However, not many developers and designers are willing to moving forward to going green even though there are many support from the government and global wide awareness on environmental issues. In addition no competent local energy specialist to provide useful data and advice on green building systems and concepts also become as a barrier towards going green (Esa et al., 2011).

Many countries have adopted incentives in promoting green road but conventional road remain unchanged. Challenges and barrier to implementing green approach in road construction arise throughout the development process. According to Us Epa (2012) many parties involve are reluctant to integrate green road into their capital projects or policies because of they suspect that green road will cost more in the short term or long term. Which is the concern is about the design and construction cost will be higher for green approach than for the conventional approach in the short term and maintenance requirements and cost are unknown in the long term (Us Epa, 2012). Other than that, unknown performance also come as reluctant factor because the limited of projects which use green approach in road construction complicated in measuring performance of green road (Us Epa, 2012). According to Mohamed (2014) the construction industry and other stakeholders are accused of being resistant to change and seemingly focused on profit and bare regulatory compliance. In addition, it has been argued that lack of understanding and awareness in sustainable development has become the main hindrance to pursue sustainability (Mohamed, 2014).

The purpose of this work is to investigate the implementation of the green approach in the road construction industry. To achieve the aim of study, the readiness and acceptability contractor toward a green approach in road construction was investigated.

2.0 Methodology

A questionnaire was prepared and distributed by hand and email among contractor class A, B, C, D, E and F that has been selected for this study, 120 respondents were targeted and 74 respondents responded whereby these feedbacks representing 62% of the total number. The respondent in this study was targeted to the professional area where it used simple random sampling technique. The collected data has been analysed using Statistical Package for Social Sciences (SPSS) and Microsoft Excel. The survey used Likert's scale of four ordinal measures to investigate the readiness and acceptability contractors toward implementation of green approach in road construction.

3.0 Results and Discussion

3.1 Questionnaire Analysis

Table 1 show that most of the respondents were male, which contribute 62% of the respondent and another 38% is females. According to the table below, majority of the respondents have been working within the construction industry more than 10 years (40%). This is followed by respondents who have been working for 5 to 10 years where they contribute 38%. Finally, respondents who have been working for less than 5 years in the construction industry have contributed the least amount of respondents, which is only as much as 22% of them. Last but not least, according to the Table 1 below, most of the respondents were from contractor class A and class F it seizes 30% and 14% of the respondents were from contractor class D. While another 11% is from class E and 8% of them were contractor class B and class C.

Table 1: Demographic Profiles of Respondents

	Description	Percentage of Respondents (%)
Gender of Respondent	Male	62%
	Female	38%
Working Experience of Respondent	< 5 years	22%
	5-10 years	38%
	>10 years	40%
Designation Field of Respondent	Class A	30%
	Class B	8%
	Class C	8%
	Class D	14%
	Class E	11%
	Class F	30%

3.1.1 The readiness and acceptability contractor toward a green approach in road construction

a) Readiness of Contractor

The readiness of contractor toward a green approach in road construction was look at into physical readiness and attitude readiness.

i) Physical Readiness

From the Table 2, the analysis shows levels of physical readiness of respondent toward the implementation of green approach in road construction in terms of class of contractor. The total mean results show that respondent looking to improve environmental performance (2.41) and green approach is relevant to the respondent's organisation principle (2.32) indicate a mean below than 2.50. This shows that the level of physical readiness is fair.

Only lack of time show mean (2.51) above 2.50 which mean the respondent are agreed on the lack of time or resources are the main barrier to implement green approach. From the overall organisation is not ready physically to implement this approach.

Table 2: Respondents' class of contractor and physical readiness of implementation green approach in road construction.

Physical Readiness	**Are you looking for ways to improve environmental performance?**	**Does lack of time or resources prevent from implementing in your organisation?**	**Does green approach relevant with your organisation principle?**
Class of Contractor	Mean	Mean	Mean
A	2.64	2.45	2.64
B	3.00	3.00	2.67
C	2.33	2.33	2.33
D	2.40	2.60	2.20
E	1.75	3.25	1.75
F	2.27	2.18	2.18
Total	**2.41**	**2.51**	**2.32**

ii) Attitudinal Readiness

Based on the respondents' age, Table 3 shows that the majority of the respondents have a good level of attitudinal readiness toward the implementation of green approach. The totals mean results show that all criteria of attitudinal readiness indicate a mean of more than 2.50. This shows that the level of attitudinal readiness of respondents is agreed. For respondents with working experience 5 – 10 years and above 10 years, improving the performance of road structure is ranked 1, which is the most agreed by respondent. But for respondents with working experience below 5 years minimize creation of construction waste takes the first rank. The lowest rank level of attitudinal readiness is shown to be different between the respondents' working experience where for those respondents working experience below 5 years and above 10 years the reduce demand for raw material is chosen as the lowest rank. While for respondent with working experience between 5 – 10 years, the willingness to implement green approach is selected to as the lowest rank of readiness. From the responses it's shown the respondent is ready in term of attitude to implement green approach in their road construction.

Table 3: Respondents' experience and attitudinal readiness of contractor

Attitudinal Readiness	**Length of Experience (years)**						**Total**	
	< 5	Rank	5 – 10	Rank	> 10	Rank	**Mean**	**Rank**
Reduce environment impact	2.58	2	2.88	2	3.00	2	**2.78**	**3**
The willingness to implement green road	2.44	6	2.13	7	2.80	5	**2.55**	**5**
improving performance of road structure	2.47	5	3.00	1	3.37	1	**2.89**	**1**
Lower cost of road construction	2.56	3	2.75	4	2.73	6	**2.65**	**4**
Reduce raw material demand	2.42	7	2.63	5	2.57	7	**2.50**	**7**
Minimise construction waste	2.81	1	2.50	6	2.90	3	**2.81**	**2**
Improve company competitiveness	2.50	4	2.88	3	2.83	4	**2.53**	**6**

b) Acceptability of Contractor

From the analysis shown below, all respondents are accepting to implement this new approach. In the questionnaire given, respondent agreed that Malaysia should practice using green road in the construction (2.64) this same to another two statements which is green approach would lead to a more sustainable development (2.61) and green approach usage will minimize harmful effects on the environment (2.54). Lastly respondents are agreed that Malaysia is ready to implement green approach in road construction (2.54).

Table 4: Respondents' class of contractor and acceptability of contractor

Physical Readiness	**Practicing Green Approach**		**Lead to Sustainable Development**		**Minimise Environment Impact**		**Malaysia is Ready**	
Class of contractor	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
A	2.73	2	2.91	1	2.64	3	2.55	4
B	3.33	1	3.00	4	3.33	2	3.33	3
C	3.00	2	2.83	4	3.17	1	3.00	3
D	2.80	2	3.00	1	2.60	4	2.60	3
E	2.38	1	2.00	2	2.25	2	1.88	4
F	2.27	3	2.18	4	2.45	1	2.37	2
Total	**2.64**	**4**	**2.61**	**2**	**2.66**	**1**	**2.54**	**3**

For respondents' contractor class A and D, they agreed that green approach would lead to a more sustainable development in Malaysia (Rank 1). But for class C and F, the road constructs using a green approach will minimize harmful effects on the environment takes the first rank. While for contractor class B and E they agreed on Malaysia's road should practice green approach in the construction as first ranking.

Acceptability is clearly shown in Table 4; where all respondents are agreed green approach should be practicing in current road construction. This is shown the contractors are willing to adept green approach in their road construction as green approach is leading to sustainable development which is given more benefit to the construction industry and also environment including human.

Thus the overall findings to the readiness and acceptance of the contractor for the implementation show that, the contractor is ready and willing to accept the implementation of a green approach in road construction.

4.0 Conclusion

From the study done, we can identify a green approach in road construction is being accepted and widely understood by majority main player in the construction industry. Yet the implementation is not being widely carried out. This green approach is still new in the industry but has been used widely in the industry before. This approach is announced by the government to further emphasize the use and benefit also as environmental support. The level understanding and acceptance of green approach in road construction is high but poor in the implementation. This study will support the implementation of green approach in road construction and able to assist the concerned parties within the construction industry in leading to sustainable development in minimizing environment impact.

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