

# Built Environment Journal

Faculty of Architecture, Planning and Surveying

Volume 11 No. 1

January 2014

ISSN 1675-5022

## **A Survey of Malaysian Consultants on Construction Claim Problems**

*Nor Azmi Bakhary*

*Hamimah Adnan*

*Azmi Ibrahim*

## **Relationship between Labour Productivity and Design Characteristics in High-rise Buildings**

*Ha Duy Khanh*

*Young Dai Lee*

*Soo Yong Kim*

## **Effects of Workers Motivation on Construction Productivity**

*Adebowale Oluseyi J.*

*Fapohunda J.A*

## **Study of Student Satisfaction for “Sandwiches” Delivery Approach**

*Eric Chan*

## **The Evaluation of Green Infrastructure Elements to Enhance Green Neighbourhood Park in Shah Alam, Selangor**

*Rijal Saffuan*

*Khalid Zanudin*

*Puziah Ahmad*

## **BUILT ENVIRONMENT JOURNAL (BEJ)**

### **Chief Editor**

Professor Dr Abdul Hadi Hj Nawawi, Universiti Teknologi MARA, Malaysia

### **Managing Editor**

Assoc. Prof. Datin Dr Hamimah Adnan, Universiti Teknologi MARA, Malaysia

### **Editorial Advisory and Review Board**

Professor Dr Yusoff Abbas, Universiti  
Teknologi MARA, Malaysia

Assoc. Prof. Dr Norhati Ibrahim, Universiti  
Teknologi MARA, Malaysia

Professor Albert PC Chan, The Hong Kong  
Polytechnic University

Assoc. Prof. Dr Jamalunlaili Abdullah,  
Universiti Teknologi MARA, Malaysia

Professor Dr Ir Siti Hawa Hamzah,  
Universiti Teknologi MARA, Malaysia

Professor Dr Charles Egbu, Salford  
University, United Kingdom

Professor Ir. Dr. Zuhairi Abdul Hamid,  
CREAM

Professor Dr Azmi Ibrahim, Universiti  
Teknologi MARA, Malaysia

Professor Christopher Andrew Gorse , Leeds  
Sustainability Institute

Dr Angela Guggemos, Colorado State  
University

Professor Dr Zainal Mat Saat, Universiti  
Teknologi MARA, Malaysia

Professor Dr Dasimah Omar, Universiti  
Teknologi MARA, Malaysia

Professor Dr Ismail Rahmat, Universiti  
Teknologi MARA, Malaysia

Assoc. Prof. Dr Faridah Mohd Yusof,  
Universiti Teknologi MARA, Malaysia

Professor Dr George Ofori, National  
University of Singapore, Singapore

Assoc. Prof. Dr Faisal Arain, Northern  
Alberta Institute of Technology (NAIT)

Dr Paul Chynoweth, Salford University,  
United Kingdom

Dr Zaharah Yahya, Universiti Teknologi  
MARA

Zarina Alias, Universiti Teknologi MARA,  
Malaysia

Siti Aekbal Saleh, Universiti Teknologi  
MARA, Malaysia

Copyright © January 2014 by Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or any means, electronic, mechanical, photocopying, recording or otherwise, without prior permission, in writing, from the publisher.

*Built Environment Journal is jointly published by Faculty of Architecture, Planning and Surveying and UiTM Press, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia.*

*The views and opinion expressed therein and those of the individual authors and the publication of these statements in the Built Environment Journal do not imply endorsement by the publisher or the editorial staff. Copyright vested in Universiti Teknologi MARA. Written permission is required to reproduce any part of this publication.*

# Built Environment Journal

Faculty of Architecture, Planning and Surveying

Volume 11 No. 1

January 2014

ISSN 1675-5022

1. A Survey of Malaysian Consultants on Construction Claim Problems  
*Nor Azmi Bakhary*  
*Hamimah Adnan*  
*Azmi Ibrahim*
2. Relationship between Labour Productivity and Design Characteristics in High-rise Buildings  
*Ha Duy Khanh*  
*Young Dai Lee*  
*Soo Yong Kim*
3. Effects of Workers Motivation on Construction Productivity  
*Adebowale Oluseyi J.*  
*Fapohunda J.A*
4. Study of Student Satisfaction for “Sandwiches” Delivery Approach  
*Eric Chan*
5. The Evaluation of Green Infrastructure Elements to Enhance Green Neighbourhood Park in Shah Alam, Selangor  
*Rijal Saffuan*  
*Khalid Zanudin*  
*Puziah Ahmad*



## A Survey of Malaysian Consultants on Construction Claim Problems

*Nor Azmi Bakhary, Hamimah Adnan, Azmi Ibrahim  
Universiti Teknologi MARA Shah Alam, Malaysia.  
azmi1477@gmail.com*

### ABSTRACT

*The construction industry in Malaysia is very complex as it involves multidisciplinary participants. In this environment, claims appear to cause delays and hold back the completion of a construction project. Construction contracts are rarely perfect, and claims for time extensions and additional costs often have to be made by one party on another. The extensively increasing number of construction claims indicates the need for the implementation of an effective construction claim management. This research aims at surveying the most common problems experienced by Malaysian contractors in construction project. This paper presents the survey results and main findings from the consultants' points of view which indicate that inaccessibility or unavailability of relevant documents, the lack of site staff awareness to proactively detect claims and understanding the contract itself, and conflicts arising during owner/contractor negotiation are all critical problems associated with the process of claim management. The problems observed from this research could be used to improve the contractors' claim management system.*

**Keywords:** *Construction Claims, Claims*

## INTRODUCTION

### Construction Claim

Construction claims are found in almost every construction project. They have significant effect to project cost and time (Arditi, 1989). Claims management is the process of employing and co-ordinating resources to progress a claim from identification and analysis through preparation, and presentation, to negotiation and settlement (Kululanga, 2011). The aim of the claim management process is to resolve a certain problem in an effective and efficient way. Avoiding litigation and arbitration in claim settlement is a good practice that the successful contractors must keep in mind (Hassanein, 2008).

Generally, there are 6 stages of claim process. It starts with identification followed by notification, examination, documentation, presentation and negotiation of claims (Zaneldine, 2006) Construction claim identification involves timely and accurate recognition of a change. It is the first and critically important step followed by notification to the other party of a potential problem. Time limit requirements are very crucial and critical (Levin, 1998). Normally, the contract specifies such duties to both parties. Establishing legal and factual ground on which the claim is to be based is done during examination stage. The fourth stage is the documentation. It plays a very important role in the settlement of claims.

All the supporting documents including drawings, specification, written instruction, cost breakdown, measurement records and many more should be compile together. However, the importance of record management is not realized as much as it should be (Ho, 2004). The entire completed document then will be submitted and presented to client for assessment. According to PWD form, the claim should be submitted not later than 90 days after practical completion of the works. Upon receiving the official claim, client will assess and decide the outcome. They should act fast and avoid procrastination. The final stage is the negotiation. This process concerns the process of negotiation claim to the owner, and mutual resolution of such claim (Ren, 2003). If an agreement cannot be reached and either party believes his position is correct, he should propose an alternative dispute resolution method. If this fails, the remaining choice is to take the matter to court.



Figure 1: Stages in Claim Management

## OBJECTIVES & METHODOLOGY

The Objective of this research is to identify the problems associated with the claim process experienced by the contractors from the consultant perspectives and the areas related to claim process that can be effectively improved. Questionnaire surveys was used to gather all the data and followed by face to face interview.

## RESULTS

### The Respondents

300 consultants from Selangor were selected to participate in this survey and 49 of them returned the completed questionnaires. 10 of them were willingly to be interviewed in order to strengthen the information gathered from the questionnaires.

## Current Issues in Claim Management

Table 1 shows the most common types of claim experienced by Malaysian contractors. “Changes in the scope of work” received the highest mean of 4.16 which ranked at No. 1 followed by “delay of work” and claim due to the “extension of time”.

Table 1: Common types of claim in construction

Rank	Types of claim	Mean
1.	Changes	4.16
2.	Delay	4.16
3.	Extension of time	4.04
4.	Extra works	3.92
5.	Contract ambiguity	3.61
6.	Measurement & payments	3.49
7.	Error & omission	3.08
8.	Acceleration	2.92
9.	Termination of contract	2.92
10.	Site condition	2.88
11.	Damages	2.88
12.	Suspension of work	2.73

Table 2 shows the main reason for construction claims. The most popular reason for construction claims is due to the “design changes being introduced at the post-tender stage”. Second is due to the “project being implemented in unduly short time periods with inadequate site investigation, design work, tender and contract documentation” and the third is due to “changes in client’s requirement during the construction stage”.

Table 2: Common reasons of claim in construction

Rank	Reasons for claim	Mean
1.	Design changes	3.88
2.	Short time period	3.86
3.	Requirements changes	3.78
4.	Incomplete design	3.71
5.	Inadequate specification	3.53
6.	Lack of clarity	3.45
7.	Unclear tender offer	3.29
8.	Rights awareness	3.10
9.	Competitive contract	3.08
10.	Authority changes	2.96
11.	Contract failure	2.88
12.	Claim consultant	2.86
13.	Philosophy changes	2.65
14.	Deterioration of standards	2.61
15.	Economy swing	2.49
16.	Politics factors	2.43

## Problems in Claim Process

This section presents the problems associated with the claim management process in Malaysia construction industry. It concentrates on the 5 stages of claim process; identification, notification, examination, documentation, presentation and negotiation.

### Identification Stage

As illustrated in Table 3, in relation to problems associated with claim identification, the top-ranked problem are: “insufficient skilled personnel for detecting a claim”, “lack of awareness of site staff to detect a claim”, and “poor communication between site staff and head office”. It is predictable that matters relating to skills and awareness of staff are raised to be the most severe problem in the claim identification process. Site staffs are expected to understand contract provisions as agreed and signed by the contracting parties. They need to read and value the contract condition before embarking on a new project. Usually, they will only refer to the relevant contract clauses when there are problems occur during the construction project. The lack of awareness, skills and knowledge of site personnel caused loss of chances of the right to declare a claim. Furthermore, poor communications between staff on site and at the head office worsen these problems and it needs urgent improvement.

Table 3: Problems in Claim Identification

Rank	Problems	Mean
1.	Insufficient skilled personnel for detecting a claim.	3.90
2.	Lack of awareness of site staff to notice a claim.	3.88
3.	Poor communication between site and head office.	3.73
4.	Insufficient contract knowledge by site staff.	3.69
5.	Insufficient time due to high workload.	3.67
6.	Difficulties in detecting any problems during the work due to high workload.	3.59
7.	Ambiguous line of responsibility as to who should detect a claim.	3.33
8.	Inaccessibility of documents used for identifying a claim.	3.31
9.	Ambiguous procedures in claim identification.	3.31

### Notification Stage

According to the general contract provision, the other party need to be notified in case of claims. As shown in Table 4 the order ranks illustrates that the most serious problems during claim notification are “poor communication/instruction to proceed with submitting the notice”, “inaccessibility of documents to be attached along with the notice” and “insufficient time due to high workload”. Time limit is a crucial aspect in notifying a valid claim.

Site staffs need to have good communication skill so that proper instruction can be given, received and the most important thing is understandable by all parties involved. Having accurate site records is also another critical issue facing the Malaysian contractors. It is directly contributes from the factors of employing inexperienced, poor knowledge and low skilled staff. Proper record keeping system need to be learnt and implemented. Procedures of notice preparation also need to be established and spell out clearly.

Table 4: Problems in Claim Notification

Rank	Problems	Mean
1.	Poor communication/instruction to proceed with submitting the notice.	3.63
2.	Inaccessibility of documents used for identifying a claim.	3.47
3.	Ambiguous procedures in notice preparation	3.47
4.	Insufficient time due to high workload.	3.41
5.	Ambiguous lines of responsibility as to who should prepare the notice.	3.39
6.	Queries back from the other parties due to notice ambiguity	3.35
7.	No standard form used for preparing the notice.	3.24
8.	Prescribed time in the contract is too short.	3.22

## Examination Stage

The breakdown of the contractors' responses was summarized in Table 5. For the problems related with claim examination, the most common problems are "unavailability of record used to analyze and estimate the potential recovery", "poor communication for gathering the required information to analyze a claim" and "lack of legal/contract to establish the base on which the claim stands".

Respondents indicated that record availability is very important in analyzing and estimating the expenses of claims. In this process, the contractors need to be aware of the need to check the required files and to estimate their claim's cost by presenting accurate documents to the owner. Therefore, it is advisable for the contractors to examine claims recovery and support it by providing precise related documents. Poor communication still contributes to the problems in this stage and need proper action to improve. Lack of legal/contract to establish strong reasons on which the claim stands also add to the problems in claim examination stage. Knowledge and awareness in law and contract amongst the contractors need to be highlighted.

Table 5: Problems in Claim Examination

Rank	Problems	Mean
1.	Unavailability of records used to analyze and estimate the potential recovery.	3.84
2.	Poor communication for gathering the required information to analyze a claim.	3.57
3.	Lack of legal/contract to establish the base on which the claim stands.	3.51
4.	Insufficient time to thoroughly perform examination due to high workload.	3.51
5.	Ambiguous lines of responsibility as who should evaluate the amount of recovery.	3.35
6.	Ambiguous procedures for claim examination.	3.24
7.	Unrealistic formula used for calculating damages.	3.24
8.	No standard formula used for evaluating the impacts and calculating damages.	3.22
9.	Insufficient computerized machine to facilitate the calculation.	2.69

## Documentation Stage

The results shown in Table 6 suggest that not all information and instructions given during project execution are kept in writing. Construction industry appears to be famous for commonly not documenting procedures and transactions appropriately. Instructions from the client or representative of the client are sometimes given verbally without any written supporting documents especially on urgent matters. The contractor needs to ensure that the owner gives their instructions in written form as this would provide support and verification if needed by the contractors in case of claim submission. Furthermore ineffective record keeping worsen the documentation process.

Table 6: Problems in Claim Documentation

Rank	Problems	Mean
1.	Some information/instruction is not kept in writing.	3.84
2.	Verbal instruction by owner.	3.73
3.	Ineffective record-keeping system.	3.69
4.	Inaccurate recorded information.	3.63
5.	Overdue in retrieving the needed document.	3.57
6.	Inaccessibility of documents when needed.	3.53
7.	No standard form used to record the data during construction.	3.40
8.	No computerized documentation system.	3.14
9.	High cost associated with retrieving required information.	2.78

In general, the problem of claim documentation starts from the negligence by site staff on the importance of record keeping. This contributes to bad quality of site records which in turn impacts on the contractor's ability to recover the damages when making claims.

## Presentation Stage

Table 7 shows that the main problems in preparing a claim submission are: "inaccessibility of relevant documents to submit along with the claim", "insufficient skilled staff for preparing a claim submission", and "insufficient time to thoroughly prepare due to high workload"

Table 7: Problems in Claim Presentation

Rank	Problems	Mean
1.	Inaccessibility of relevant documents to submit along with the claim.	3.71
2.	Insufficient staff skilled in preparing a claim submission.	3.65
3.	Insufficient time to thoroughly prepare due to high workload.	3.61
4.	Poor communication in presenting a claim.	3.59
5.	Ambiguous procedures in preparation of claim presentation.	3.47
6.	Ambiguous responsible person to prepare full report of claim presentation.	3.41
7.	No standard format of a claim submission.	3.24

Documentation is still the key problem in claim presentation that needs serious attention and technique to improve. The respondents agreed that some documents are still ineffectively kept because on-site staffs do not realize the importance of recording such documents. Most respondents agreed that it is impossible to submit the relevant document during the claims presentation, especially where the contractors need to support their claims with accurate formal documentation. Presenting a claim requires a knowledgeable, skilled and experienced

person to effectively organize the full detailed claim submission. Contractors face difficulties in identifying and hiring experienced staff in preparing a claim submission. This issue affects the claim presentation process, possibly causing the client to reject the claim. Due to heavy workload, they have insufficient time to fully concentrate on the preparation of claim presentation. It is also very important to recruit a specialist in claim management to deal effectively with the relevant issues.

## Negotiation Stage

In referring to Table 8, the main problems linked to the claim negotiation are “disagreement arising during negotiation”, “unsatisfactory evidence to convince other parties” and “poor negotiation skills”. It is understood that these three problems are somehow correlated. Poor negotiation skills will affect on the ability of the contractor to persuade the owner, and therefore conflicts will start to occur.

Strong evidence is very much needed during this stage in order to hold up the claim and to persuade the owner. In many situations, the contractors lose their claim as a result of the insufficient of documentation evidence as a result affecting the contractor’s position during claim negotiation. In some cases, the negotiation process could jeopardise the relationship between the contractor and the owner as a result of unsatisfactory claims preparation and negotiation. As a result of the conflict, owner may decline the claim with very modest consideration given to the contractor’s situation. Having common respect and keeping negotiations in the atmosphere of a good relationship between the two parties should be a main concern during claim negotiation.

Table 8: Problems in Claim Negotiation

Rank	Problems	Mean
1.	Disagreement arising during negotiation.	4.02
2.	Unsatisfactory evidence to convince other parties.	3.96
3.	Poor negotiation skills.	3.55
4.	Adversarial relationship with other parties.	3.49
5.	Inadequate time due to high workload.	3.35
6.	Difficult to settle without any litigation or Arbitration.	3.16

In the construction industry, the problems related with not having good negotiation skills with experienced construction workers are predictable. A lot of contractors do not have a committed unit or individual with the responsibility of managing the claims. Normally, the duty to manage the claim process is assigned to the project manager or site engineer, who may not possessed good negotiation skills. Obviously, contractors’ negotiation skills need to be improved to avoid from facing difficulties and possible arguments throughout negotiation with the client.

## Claim Resolution

Unsettled claim can lead to dispute. There are four basic settlement methods used to resolve claims in Malaysia. There are negotiation, mediation, arbitration and litigation. As provided by the survey respondents, the majority of the respondents prefer to resolved claim problems

by means of negotiation. It involved communicate and exchange proposals in an attempt to agree about the scope of conflict termination and their future relationship (Zaneldin, 2006). They are trying to keep a good relationship with the client. They are quite reluctant to go for arbitration and litigation because it will consume time and will involve high costs. They prefer to keep the disputes as private affair and the specifics of the dispute, documents, contracts, and other sensitive materials are kept out of the public eye.

Arbitration is becoming nearly as time-consuming as the litigation. In the larger and more complex cases, arbitrators frequently permit the parties to engage in a substantial amount of discovery, large document productions, depositions and the all-too-common discovery disputes. Also, coordinating the availability of multiple parties and arbitrators to schedule blocks of several days, weeks or more for hearings is often very difficult.

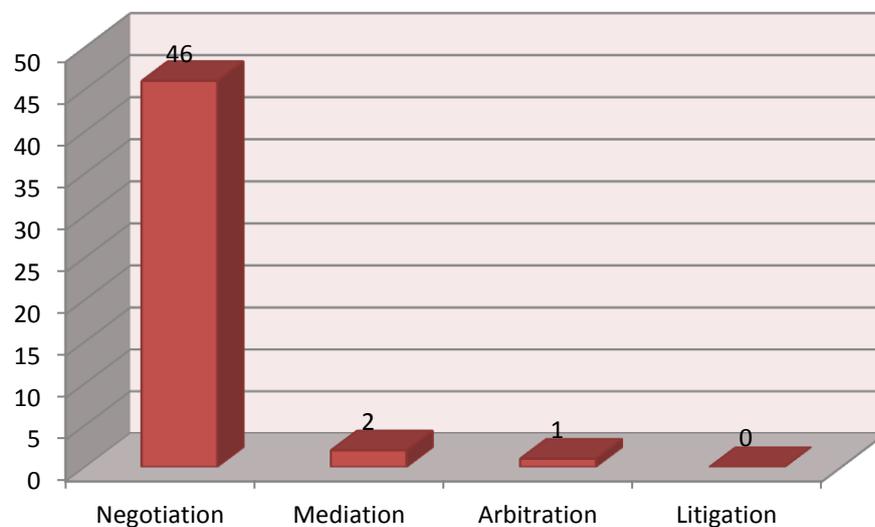


Figure 4: Preferred Claim Resolution Method

## CONCLUSION

This research aimed to explore the problems related to the process of claim from consultants' point of view by studying common procedure categories, distributed into six stages. There are claim identification, claim notifications, claim examination, claim documentation, claim presentation and claim negotiation. The findings emphasize on the need for a good documentation system with a competent site staff that can recognize a claim during project execution. These competencies must be joined so that it would allow easy accessibility to project records when needed in order to support the submitted claim. Hence, keeping appropriate project information should be observed as an essential part of project monitoring and reporting. It also appears that a standard and transparent procedure should be put in place whereby contractor's staff would be able to follow to properly prepare the claim. This procedure should highlight the importance of linking the claim to cost recovery so as not to disadvantage the contractor. In addition, it could be argued that staff awareness, training in how to document and submit a well-supported claim, and negotiations with clients are becoming a necessity.

The claim management efficiencies of the contractors can be increased their by deliberately scrutinizing the contract provisions, enhancing the cooperative atmosphere among all parties, establishing the good claim management data collection and

documentation, punctually notifying to the client the event that change the project status, and signing separate contract for the large-amounted variation order. The government can help the contractors by improving the relevant laws, regulations and standards and establishing the claim settlement organization.

## REFERENCES

- Arditi, D. and Patel, B. K., (1989). "Expert System for Claim Management in Construction Project. *Project Management*, Volume 7 Number 3 : 141-146.
- Bercovitch, J. and R. Jackson, (1997). *International conflict: A chronological encyclopedia of conflicts and their management 1945-1995*. Washington: Washington Quarterly.
- Hassanein, A.A.G. and El Nemr, W. (2008), "Claims management in the Egyptian industrial construction sector", *Engineering, Construction and Architectural Management*, Vol. 15 No. 3, pp. 246-59.
- Ho, S.P. and Liu, L.Y. (2004). "Analytical Model for Analyzing Construction Claims and Opportunistic Bidding". *Journal of Construction Engineering and Management*, 130 (1), 94-104.
- Kululanga, G. K. et al., (2011). "Construction Contractors' Claim Process Framework", *ASCE Journal of Construction Engineering and Management*, ASCE, Vol. 127, No. 4, pp. 309-314.
- Kumaraswamy, M.M., & Yogeswaran, K. (2003). Substantiation and Assessment of Claims for Extensions of Time. *International Journal of Project Management*, 21(1), 27-38.
- Levin, P., (1998). "Construction Contract Claims, Changes & Dispute Resolution". Second Edition. Boston : ASCE Press.
- Pogorilich, D. A., (1992). "The Daily Report as a Job Management Tool", *Cost Engineering*, Vol. 34, No. 2, pp. 23-25.
- Ren, Z, Anumba, C J and Ugwu, O O. (2003). "Multiagent System for Construction Claims Negotiation". *Journal of Computing in Civil Engineering*, 17 (3), 180-188.
- Zaneldin, E.K. (2006), "Construction claims in the United Arab Emirates: types, causes, and frequency", *International Journal of Project Management*, Vol. 24, pp. 453-9.

# Relationship between Labour Productivity and Design Characteristics In High-rise Buildings

Ha Duy Khanh<sup>a</sup>, Young Dai Lee<sup>b</sup> and Soo Yong Kim<sup>c</sup>

<sup>a, b, c</sup> Pukyong National University, San 100, Yongdang-dong, Nam-gu, Busan 608-739, South Korea  
hd.khanh@hotmail.com

## ABSTRACT

*Formwork installation, rebar fabrication/ installation, and concrete casting are often repetitive in high-rise building projects. Previous studies have shown that labor productivity is significantly affected by many reasons. This study aims to consider the relationship between average labor productivity and design characteristics in typical floors of high-rise building projects. Data were collected through questionnaire which was distributed to experts and experienced people in construction projects. A neural network model was developed to estimate labor productivity. The main result is the comparison between predicted and actual labor productivity for typical floors. The Mean Absolute Percentage Errors (MAPE) are less than 3.5%, and R-squared indices are greater than 85% for all three activities mentioned above. These results showed that the model developed in this study is very appropriate when predicting labor productivity in high-rise building projects.*

**Keywords:** labor productivity; high-rise building; design characteristics; artificial neural network; Vietnam

## INTRODUCTION

Labor productivity in construction industry has been long studied by many previous researchers. Kometa and Olomolaiye (1997) have conducted a work sampling at seven project sites for formwork and rebar installation activities to identify the real working days as follows: 51% for masonry team, 44% for formwork team, and 56% for rebar team. Their study has also indicated that there are three factors which mostly affect the productivity of labor team including lack of materials, inappropriate equipments, and repetitive activities. In addition, Thomas and Sanvido (2000) have considered the quantitative effect of fabrication on productivity in three cases: installation of canopy and door, erection of outside wall panel, and steel pile driving. The result was labour productivity increased respectively 16.6%, 28.4% and 56.8%. Furthermore, David and Hanna (2005) further studied the absence of workers in an electrical construction site. They have claimed that when the rate of absence is from 6% to 10%, the productivity will decrease approximately 24.4%, and when rate of absence is from 0% to 5%, there is no productivity loss. On the other hand, construction productivity has been increased approximately between 5% and 20% due to floor repetitions or successive activities as studied or reported by the United Nations 1965, Thomas *et al.* 1986, Everett and Farghal 1994, Couto and Teixeira 2005, Jarkas 2010, Stefan and Kim 2010, and Long and Hung 2012.

Unfortunately, Oglesby *et al.* (1989) stated that there is probably no standard method to measure the labour productivity due to the complexity of operations and relations in a construction site, and the labour productivity is different in each type of building structures. A few researchers have attempted to consider factors affecting labour productivity and to propose some methods for improving productivity by reducing the influence of these factors, but probably still having no consideration to factors related to building characteristics, e.g., a building designed with flat slab structure is often easy to construct than beam slab structure, or a column designed with circle shape is often easy to construct than square shape. Thomas and Yiakoumis (1987) have indicated that design factors have also effect on construction productivity involving constructability, quality of documents, specification requirements, and quality control requirements. Therefore, further research is needed to

understand more what design characteristic factors affect labour productivity in high-rise construction practice. In the past, there were few models which has been used to measure or predict the labour productivity. This study uses the activity-oriented models which were developed by Thomas *et al.* (1986) because productivities are the subject of the measurement at the activity level. Thus, productivity is measured as the ratio between man-hours and performed quantity.

Based on above discussion, this study aims to explore the relationship between labour productivity and design characteristics in high-rise construction. Three main structural activities, namely formwork installation, rebar fabrication/ installation, and concrete casting, were studied to investigate their average productivities in typical floors. Other floors were not considered due to their complexity and irregularity. The viewpoint of analysis only bases on contractor's opinions. The results directly serve the improvement in planning and managing the human resources and worker teams on site for contractors.

## Design Characteristics

In construction industry, the factors influencing the productivity have been the subject of inquiry by many researchers. In order to improve productivity, conducting a study of the factors affecting it, whether positively or negatively, is necessary. Borcharding and Alarcon (1991) have categorized the major components of productivity loss as waiting or idle, travelling, working slowly, doing ineffective work, and doing rework. In addition, Hanna *et al.* (1999a, 1999b) have found that the change orders have negatively impacted on labor efficiency for mechanical construction. Furthermore, Ibbs *et al.* (2007) have claimed that the factors affecting labor productivity such as schedule acceleration, changes in work, management characteristics, project characteristics, labor and morale, and project location/ external conditions. Enshassi *et al.* (2007) has listed and ranked factors affecting labour productivity into forty five factors in ten groups from previous studies.

Several approaches have been adopted in relation to the classification of factors affecting construction productivity. Thomas and Yiakoumis (1987) have concluded that factors affecting productivity are categorized into the board classifications of: (1) manpower-labor; (2) design features-work content; (3) environmental-site conditions; (3) management practices-control; (4) construction methods; and (5) project organizational structure. Kane et al (cited in Herbsman *et al.*, 1990) classified the factors into two main groups: technological factors and administrative factors. Heizer and Render (1990) also classified factors influencing site productivity into three groups: labor characteristic factors; project work conditions factors; and non-productive activities. However, Olomolaiye *et al.* (1996) stated that factors affecting construction productivity are rarely constant, and may vary from country to country, from project to project, and even within the same project, depending on circumstances. They further classified these factors into two categories: external factors and internal factors.

Based on the classification and conclusion by Thomas and Yiakoumis (1987), Oglesby *et al.* (1989), Zhao and Chua (2003), and Ibbs *et al.* (2007), this study aims to consider the relationship between labor productivity and design features-work content in typical floors of high-rise buildings. The four factors have been identified as follows: (1) Higher number of typical floors; (2) Higher height of typical floor; (3) type of slab structure of typical floors; and (4) type of support structure of typical floors. The description of these factors is shown in Table 1.

Table 1: Design characteristics of high-rise buildings

Code	Characteristics	Description
X <sub>1</sub>	Higher number of typical floors	It is defined from the first typical floor to the last typical floor of a high-rise building.
X <sub>2</sub>	Higher floor height	It is defined from structural level of a floor to the next upper or lower floor (within typical floors only).
X <sub>3</sub>	Type of slab structure of typical floors	It is a kind of slab structure of high-rise building including beam slab, flat slab without caps, flat slab plus caps, pre-stressed concrete slab, and others (or combined type)
X <sub>4</sub>	Type of support structure of typical floors	It is a kind of support structure of high-rise building including column, shear wall, core wall, and others (or combined type)

## ARTIFICIAL NEURAL NETWORK MODEL

The configuration of the model adopted in this study is four layer back propagation artificial neural network (ANN). The input layer has four neurons representing the four structural design features of high-rise building as mentioned in Table 1. The output layer has three neurons representing the labor productivity of formwork installation (Y<sub>1</sub>), rebar fabrication/ installation (Y<sub>2</sub>), and concrete casting (Y<sub>3</sub>). In order to develop the hidden layer, Ripley (1996) stated that the model with two hidden layers can approximate any mapping with highest accuracy. Furthermore, Liu (1998) proposed that the number of neurons in each hidden layer can be estimated in range from  $(2\sqrt{n} + m)$  to  $(2n + 1)$ . Where, n is the number of input neurons and m is the number of output neurons. Thus, the model has two hidden layers with nine neurons in each layer as shown in Figure 1.

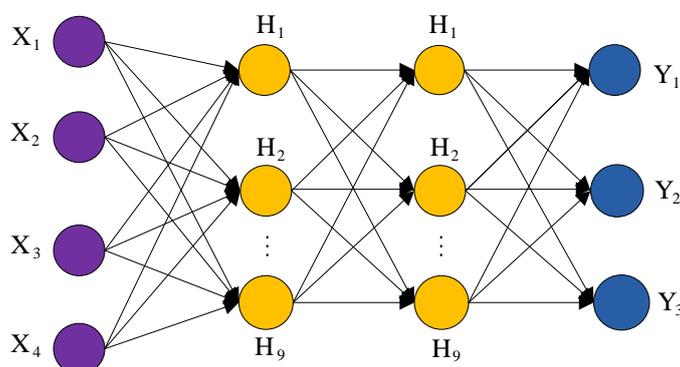


Figure 1: The configuration of artificial neural network model

SPSS version 18.0 has been used to develop ANN model. 70% of the total number of data has been used for training neural network whereas 30% has been used for testing. Number of epochs used is 1000 at which network shows maximum convergence. Learning algorithm used is gradient decent with momentum back propagation with log tangent transfer function. Learning rate and momentum factor used in the model are 0.4 and 0.9. For the purpose of assessing the prediction performance obtained by the model, the R2 index used to measure the prediction accuracy is the coefficient of multiple determinations.

The impact of the structural design features on productivity performance may be determined via an elasticity test of the input factors. This was done by perturbing each of the input neurons in the output due to the change in the independent variables was taken to reflect the influence of the variable on the output. The elasticity of the productivity with respect to the *k*-th variable, *E<sub>k</sub>*, is expressed as follows:

$$E_k = \frac{1}{n} \sum_{i=1}^n \left( \frac{\Delta P}{\Delta W_k} \right)_i \times 100\% \quad (1)$$

where:  $\Delta P$  is the change in productivity due to a corresponding with change in the  $k$ -th design feature factor,  $\Delta W_k$ , subscript  $i$  denoting the ratio obtained for the  $i$ -th data set; and  $n$  is the number of data sets considered.

## DATA COLLECTION AND ANALYSIS METHOD

Productivity data were collected in floor-to-floor from thirty high-rise projects in Ho Chi Minh, Vietnam through questionnaire. Several required documents include weekly reports, site diaries, and monthly claims. The potential construction personnel are been project managers and site mangers. Three activities were aimed to collect data including formwork installation, rebar fabrication/ installation, and concrete casting. The collected information directly related to the definition of input and output variables in ANN's configuration. Other useful information may be recorded if needed. The design characteristic factors were observed simultaneously during measurement of labour productivity at the construction sites. The non-probability sampling was applied in this study because of its certain limitations.

First, the types of effect of design characteristics on labour productivity are assessed by respondents. It may be positive influence or negative influence. Then, find mean value to see the most influence type. Next, use an ANN model to predict the labour productivity in typical floors. Finally, based on the results, this study compares the predicted value with actual value, and defines the significant factor which has the most influence on labour productivity through elasticity test.

## ANALYSIS AND FINDINGS

### Type of Effect

The respondents were requested to assess the effect of design characteristics on labour productivity. It is considered as the hypotheses of the study. The results are shown in Table 2. Higher number of typical floors ( $X_1$ ) has positive influence on labour productivity due to floor repetitions. It means that the labour productivity of upper typical floor often has an increase comparing with lower typical floor. Higher height of a typical floor ( $X_2$ ) often has negative influence on labour productivity because the working conditions for a high column decrease, e.g., the higher the column is, the more difficult the workers feel when casting concrete and installing formwork for this column. Type of slab structure ( $X_3$ ) has negative influence on labour productivity because of level of difficulty of structure, e.g., the slab designed with many beams is more difficult to install formwork than flat slab. Type of support structure ( $X_4$ ) has also negative influence on labour productivity because of level of difficulty of structure, e.g., the column designed with the circle shape is often easier to install formwork than the square shape. The mean value was analyzed to see the proportion of agreement for each factor. Most respondents agree with the hypotheses of the study. Only height of a typical floor is a fifty-fifty chance of agreement.

Table 2: Proportion of agreement for design characteristics

Code	Characteristics	Proportion of agreement	Type of effect
X <sub>1</sub>	Higher number of typical floors	100%	Positive
X <sub>2</sub>	Higher floor height	50%	Negative
X <sub>3</sub>	Type of slab structure of typical floors	91%	Negative
X <sub>4</sub>	Type of support structure of typical floors	83%	Negative

## Labor Productivity Prediction

This study has standardized each input variable before putting it in ANN model. Variable X<sub>1</sub> was treated by calculating percentage in comparison with total number of floors of building. There was no need to standardize variable X<sub>2</sub>. For variable X<sub>3</sub> and X<sub>4</sub>, the five-point Likert scale was assigned with a value being 1 to 5 for each choices, therefore, they are considered nominal variables. The average labor productivity of typical floors was calculated from floor-to-floor labor productivity, therefore, the output variables are actual man-hours spent for square meters of formwork installed (Y<sub>1</sub>), metric tons of rebar fabricated/ installed (Y<sub>2</sub>), and cubic meters of concrete casted (Y<sub>3</sub>). The results of prediction by ANN are shown in Table 3.

In order to assess the degree of accuracy of predicted model, the mean absolute percentage error (MAPE) and R-squared index will be used. The results of calculation in Table 4 show that the MAPE are quite small as follows: 2.05% for formwork, 3.36% for rebar and 2.78% for concrete; and the R-squared indices are 86.34% for formwork, 85.21% for rebar and 85.10% for concrete. These results indicate that the ANN model, which was developed by this study, is appropriate.

The comparison of measured and predicted productivity for all thirty data sets of formwork installation activity is shown in Figure 2a, and the correlation depicted as a scatter plot shown in Figure 2b. Similarly, Figure 3a and Figure 3b for rebar fabrication/ installation activity, and Figure 4a and Figure 4b for concrete casting activity. They show a relatively good fit. This could be further improved if the significant design characteristics could be identified and the model is developed with respect to these.

Table 3: Results of labour productivity prediction by ANN

Project	Input variable				Actual value			Predicted value		
	X <sub>1</sub> (%)	X <sub>2</sub> (m)	X <sub>3</sub>	X <sub>4</sub>	Y <sub>1</sub> (hrs/m <sup>2</sup> )	Y <sub>2</sub> (hrs/ton)	Y <sub>3</sub> (hrs/m <sup>3</sup> )	Y <sub>1</sub> (hrs/m <sup>2</sup> )	Y <sub>2</sub> (hrs/ton)	Y <sub>3</sub> (hrs/m <sup>3</sup> )
1	75.9	3.300	4	3	1.41	41.39	1.16	1.37	39.89	1.20
2	66.7	3.250	1	5	1.47	36.54	1.21	1.43	36.74	1.18
3	80.0	3.350	1	1	1.49	30.77	1.19	1.54	31.83	1.24
4	70.8	3.150	1	1	1.47	39.16	1.23	1.45	41.84	1.24
5	83.3	3.400	1	3	1.40	40.26	1.46	1.43	40.05	1.43
6	84.2	3.400	1	5	1.64	28.96	1.41	1.62	29.28	1.38
7	83.3	3.150	2	2	1.48	37.12	1.28	1.46	39.08	1.23
8	84.8	3.200	1	5	1.19	37.64	1.07	1.24	38.82	1.11
9	83.3	3.150	1	2	1.46	41.04	1.24	1.50	39.29	1.27
10	73.7	3.300	1	2	1.55	33.43	1.29	1.53	35.41	1.24
11	84.2	3.300	1	5	1.42	37.86	1.29	1.39	36.56	1.24
12	73.5	3.200	1	2	1.35	42.24	1.25	1.37	42.27	1.20
13	80.0	3.300	1	5	1.45	39.23	1.32	1.42	37.56	1.27
14	84.0	3.050	4	5	1.56	33.17	1.21	1.51	32.67	1.25
15	88.9	3.200	5	5	1.43	32.79	1.41	1.45	34.56	1.39
16	86.8	3.200	5	5	1.39	37.00	1.31	1.45	35.15	1.36
17	69.4	3.200	1	5	1.32	35.77	1.20	1.38	37.71	1.15
18	80.6	3.150	5	5	1.44	31.35	1.26	1.48	32.20	1.23
19	82.8	3.300	1	5	1.36	35.32	1.20	1.40	36.91	1.25
20	89.7	3.200	3	5	1.27	37.57	1.23	1.31	39.32	1.26
21	85.0	3.150	1	2	1.48	36.95	1.34	1.52	38.78	1.29
22	81.3	3.250	2	2	1.43	31.41	1.08	1.44	33.26	1.13
23	77.3	3.300	1	5	1.39	36.03	1.23	1.43	37.77	1.27
24	89.3	3.150	3	5	1.41	39.37	1.38	1.44	37.72	1.35
25	81.8	3.200	2	2	1.47	38.49	1.14	1.43	37.31	1.17
26	77.3	3.250	1	3	1.38	41.48	1.16	1.33	42.28	1.19
27	86.7	3.200	4	1	1.35	32.54	1.12	1.40	32.78	1.16
28	86.7	3.150	3	2	1.39	38.57	1.25	1.42	36.75	1.20
29	88.9	3.250	1	2	1.48	34.14	1.29	1.51	33.58	1.33
30	84.6	3.300	1	5	1.38	38.18	1.26	1.38	36.47	1.23

Table 4: Accuracy of ANN predicted model

Activity	MAPE (%)	R-squared
Formwork	2.05	86.34
Rebar	3.36	85.21
Concrete	2.78	85.10

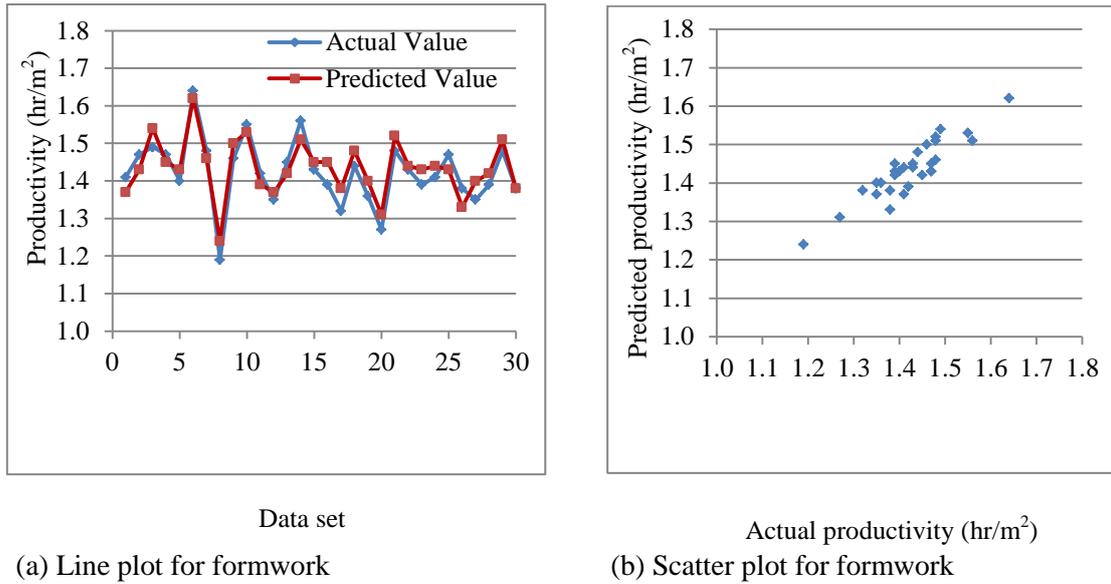


Figure 2: Comparison between predicted and actual productivity

### Identifying Significant Factor

Venkataraman *et al.* (1995) suggested that elasticity test could be done by perturbing each input factor, one at a time, by 5% change (Equation (1)). But, in this study, there are two kinds of variables including scale and nominal. Each time, the model is restrained and the reaction computed for the remaining input variables. This is done because of the highly non-linear relationships existing in the ANN model (Zhao and Chua 2003). The results of analysis are shown in Table 5. For example, a 5% increase in the number of typical floors results in nearly 0.7% change in the productivity of formwork installation.

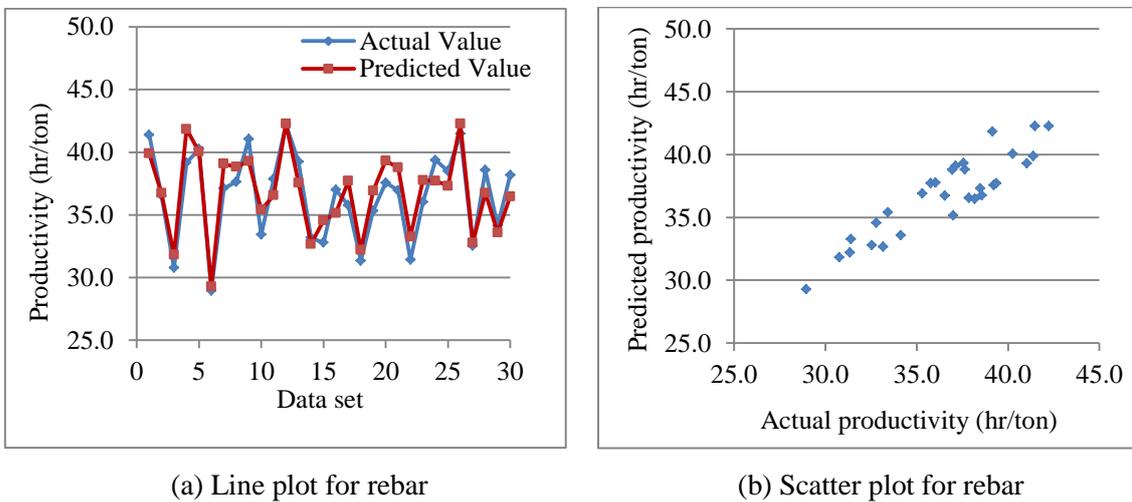
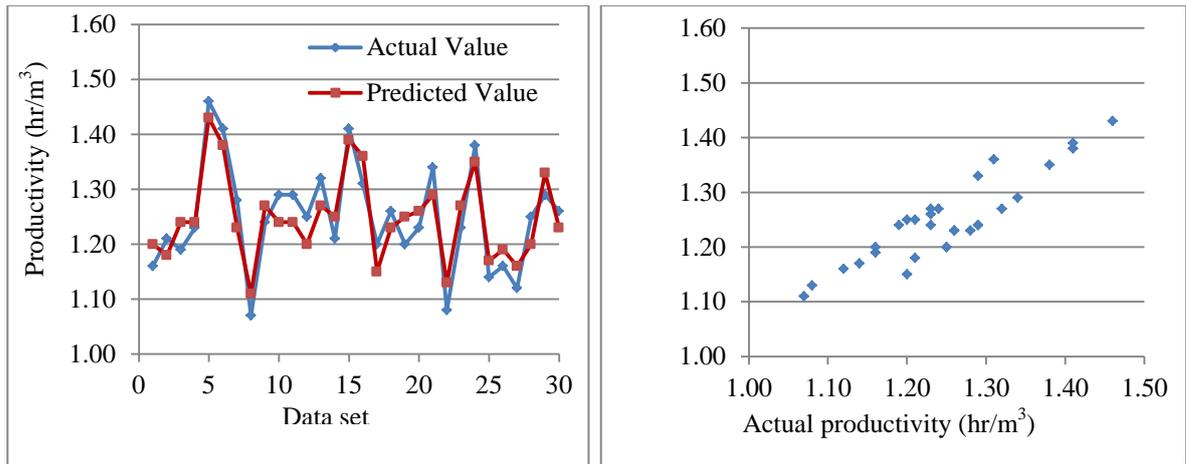


Figure 3: Comparison between predicted and actual productivity



(a) Line plot for concrete

(b) Scatter plot for concrete

Figure 4: Comparison between predicted and actual productivity

Table 5: Results of elasticity test for design characteristics

Code	Characteristics ( $W_k$ )	Elasticity ( $E_k$ )		
		Formwork	Rebar	Concrete
$X_1$	Higher number of typical floors	-0.07	-0.63	2.42
$X_2$	Higher floor height	0.16	1.82	0.02
$X_3$	Type of slab structure of typical floors	1.34	-0.54	0.80
$X_4$	Type of support structure of typical floors	1.40	-1.69	1.40

The results indicate that number of typical floors ( $X_1$ ) has the most significant relationship for concrete activity with 2.42%. A reason that can be explained for this finding is that concrete casting activity is often done by a tower crane or concrete pump truck, therefore, labour productivity of upper floor will be reduced compared with lower floor. Height of a typical floor ( $X_2$ ) belongs to rebar activity with 1.82%. A reason is possibly that rebar installation activity often meets difficulties in a typical floor if the height of this floor is too large. Type of slab structure ( $X_3$ ) belongs to formwork activity with 1.34%. One explanation for this finding is possibly that labour productivity depends on the level of difficulty of structure. It means that if slab elements are designed with complicated structure type, the productivity of formwork installation for this slab element is obviously lower than the others. Eventually, type of support structure ( $X_4$ ) belongs to rebar activity with 1.40%. The reason to explain for this finding is similar to that of  $X_3$ .

## Conclusion

This study has employed the ANN model to predict the labour productivity that is influenced by design characteristics for three activities including rebar fabrication/ installation, formwork installation and concrete casting. The main results could be highlighted that the ANN model is quite appropriate because the deviations between predicted and actual values are small. In detail, the MAPE are less than 3.5%, and the R-squared indices are greater than 85% for all three activities. To find the most significant factor, the elasticity test was adopted by perturbing each of the input factors by 5% change in one time. The results showed that number of typical floors is the most significant factor for labor productivity of concrete activity. Similarly, height of a typical floor and type of support structure belong to rebar activity, and type of slab structure belongs to formwork activity.

With above results, this study would like to recommend that the designers and contractors should know the relationship between labor productivity and design characteristics due to floor repetitions when performing a high-rise building project.

## REFERENCES

- Borcherding, J. D., and Alarcon, L. F. (1991). "Quantitative effects on construction productivity." *J. Constr. Lawyer*, 11(1), 35-48.
- Couto, J. P., and Teixeira, J. C. (2005). "Using linear model for learning curve effect on highrise floor construction." *J. Constr. Manage. and Economics*, 23(4), 355-364.
- David, A. N., and Hanna, A. S. (1997). "Planned schedule compression concept files for electrical contractors." *J. Constr. Eng. Manage., ASCE*, 123(2), 189-197.
- Enshassi, A., Mohamed, S., and Mayer, P. E. (2007). "Factors affecting labor productivity in building projects in the Gaza strip." *J. Civil Eng. and Manage., ASCE*, 13(4), 245-254.
- Everett, J. G., and Farghal, S. (1994). "Learning curve predictors for construction field operations." *J. Constr. Eng. Manage., ASCE*, 120(3), 603- 616.
- Hanna, A. S., Russell, J. S., Gotzion, T. W., and Nordheim, E. V. (1999a). "Impact of change orders on labor efficiency for mechanical construction." *J. Constr. Eng. Manage., ASCE*, 125(3), 176-184.
- Hanna, A. S., Russell, J. S., Nordheim, E. V., and Bruggink, M. J. (1999b). "Impact of change orders on labor efficiency for electrical construction." *J. Constr. Eng. Manage., ASCE*, 125(4), 224-232.
- Herbsman, Z., and Ellis, R. (1990). "Research of factors influencing construction productivity." *J. Constr. Manage. and Economics*, 32(8), 49-61.
- Heizer, J., and Render, B. (1990). *Production and operations management: strategic and tactical decisions*, Prentice Hall, New Jersey, USA.
- Ibbs, C. W., and Allen, W. E. (1995). "Quantitative impacts of project change." Source Document 108, Construction Industry Institute, Uni. of Texas at Austin, TX, USA.
- Ibbs, W., Long, D. N., and Lee, S. (2007). "Quantified impacts of project change." *J. Prof. Issues Eng. Educ. and Pract., ASCE*, 133(1), 45-52.
- Jarkas, A. M. (2010). "Critical investigation into applicability of the learning curve theory to rebar fixing labor productivity." *J. Constr. Eng. and Manage., ASCE*, 136(12), 1279-1288.
- Kometa, S. T., and Olomolaiye, P. (1997). "Evaluation of factors influencing construction clients' decision to build." *J. Manage. in Eng.*, 3(2), 77-86.
- Liu, X. (1998). An artificial neural network approach to assess project cost and time risk at front-end of projects, MSc thesis, Dept. of Civil Eng., Univ. of Calgary, Alberta, Canada.
- Long, D. N., and Hung, T. N. (2012). "Relationship between floor number and labor productivity in multistory structural works: A case study." *Constr. Research Congress, ASCE*, pp. 1520-1529.
- Oglesby, C. H., Parker, H. W., and Howell, G. A. (1989). *Productivity improvement in Construction*. McGraw-Hill, Inc., NY, USA.
- Olomolaiye, P., Kaming, P., Holt, G., and Harris, F. (1996). "Factors influencing craftsmen's productivity in Indonesia." *Int. J. Project Manage.*, 15(1), 21-30.
- Ripley, B. D. (1996). *Pattern recognition and neural networks*. Cambridge Univ. Press. ISBN 0521 46086 7, Jan. 1996.
- Stefan, C. G., and Kim, H. (2010). "The repetition effect in building and construction works: A literature review." SBI 2010:03, Danish Building Research Institute, Aalborg Univ., Denmark.
- The Constructor Civil Engineering Homepage: High-Rise Structures. Retrieved June 13, 2013 at: <http://theconstructor.org/structural-engg/high-rise-structures/5/>
- Thomas, H. R., Mathews, C.T., and Ward, J. G. (1986). "Learning curve models of construction productivity." *J. Constr. Eng. and Manage., ASCE*, 112(2), 245-258.
- Thomas, H. R., and Yiakoumis, I. (1987). "Factor model of construction productivity." *J. Constr. Eng. and Manage., ASCE*, 113(4), 626-639.
- Thomas, H. R., and Sanvido, V. E. (2000). "Quantification of losses caused by labor inefficiencies: Where is the elusive measured mile?" *Construction Law Bus*, 13, 1-14.

- United Nations (1965). "Effect of repetition on building operations and processes on site." Rep. ST/ECE/HOU/14, United Nations Committee on Housing, Building, and Planning, NY, USA.
- Venkataraman, S., Fred, M., and Woodrow, B. (1995). "Effect of roadway geometrics and environmental factors on rural freeway accident frequencies." *J. Accident Analysis and Prevention*, 27(3), 371-389.
- Zhao, Y., and Chua, D. K. H. (2003). "Relationship between productivity and non value-adding activities." in "Proc. 11<sup>st</sup> Annual Conf. Int. Group for Lean Construction, Blacksburg, VA, USA, retrieved June 13, 2013 at: [http://iglc.net/?page\\_id=99](http://iglc.net/?page_id=99)

## Effects of Workers Motivation on Construction Productivity

Adebowale Oluseyi J. And Fapohunda J.A  
Department of Construction Management and Quantity Surveying  
Faculty of Engineering, Cape Peninsula University of Technology  
South Africa.  
write2seyi@gmail.com, fapohundaJ@cput.ac.za

### ABSTRACT

*The issue of construction workers motivation becomes a subject of debate among construction project management professionals. Therefore, there are diverse opinions on whether motivation of construction workers positively impacts construction workers performance or rather adversely affects the general performance of construction labours. This brings about different motivation concepts and principle by researchers towards improvement of construction workforce performance. The paper takes into cognizance the perception of construction practitioners on motivation in relation with construction productivity towards achieving construction project objectives. In order to obtain a viable result of the study, the study adopts quantitative research approach on construction workforce motivation with project managers, contract managers, site managers, contractors, and site supervisors. Quantitative data obtained was analysed with SPSS statistical tools. The perception of construction practitioners was explored on motivation drives of construction workforce. However, it was found that motivation is important for construction workers performance, giving bonus to workers is important to improve workers efficiency and there is a need for construction workers recognition by management. The adequate application of recommendation of this study will enhance construction labour productivity, reduce wastes in construction, improve general construction performance and ultimately heightens customer's satisfaction.*

**Keywords:** Construction productivity; Construction workforce; Project management; Project objectives Workers motivation.

### INTRODUCTION

The issue of construction workers motivation has become a subject of debate among construction project management professionals. This, has consequently unveils diverse opinions on whether motivation of construction workers positively impacts construction workers performance or rather dampens the performance of general productivity of construction workforce. However, awareness of the need for workers motivation is not the ultimate for construction workers performance, but motivation strategies is more expedient to afford the expected productivity.

### AIM OF THE STUDY

- To identify the commitment of construction organisations towards motivation of construction workforce.

## LITERATURE REVIEW

### Workers motivation

Motivation is expressed as “*the characteristic of an individual willing to expend effort towards a particular set of behaviour*” (Tabassi and Abu Bakar, 2009). Apparently, the study conducted by Uwakweh, (2005) noted that workers motivation is significant to improvement of construction productivity. In a broader perspectives, Schermerhorn, Hunt, Osborn and Uhl-Bien, (2011) pointed out content and process theories of motivation. Schermerhorn et al express content process of motivation as individual need which comprises psychological needs that need to be satisfied. Similarly, process theory focuses on the thought that runs through the mind of individual workers and affects their performance. In most of the existing industries, where construction industry is not an exception, Kazaz, Manisali, and Ulubeyli, (2008) stated that productivity is related with workers motivations, while workers motivation is directly linked to construction productivity. Moreover, Kazaz et al buttress Parkin, Tutesigensi and Buyukalp (2009) that construction workers can be more productive by adopting the right system of motivation. Also, vast knowledge of construction managers on workers motivating can help construction management to develop approaches to improving construction workers motivation (Parkin, 2009:110). Besides, the quality of human performance is significantly dependent on motivation and an increased motivation brings increased productivity and vice-versa (Kazaz et al 2008). Therefore, motivation plays a significant role in the construction industry, while managers need to understand individual needs to create a better working environment for construction employees (Schermerhorn et al, 2011).

The study conducted by Olabosipo et al (2011) revealed that construction workers motivation can be in form of money, employee participation in various decision making, job security and giving bonus to employee. Irrespective of the fact that money motivates employee and improve their commitment to work, Parkin, (2009) therefore stated that the financial buoyancy of an organisation is an important factor to be considered when using money as a motivating factor. However, Tabassi and Abu Bakar, (2009) opined that construction worker recognition by the employer is a significant non-financial motivation. Obviously, every individual within an organisation have different needs which could include; team belonging or workers participation. Thus, the effectiveness of employee motivation significantly relies on management ability to devise a means of identifying the needs of individual construction worker and meet the need accordingly (Tabassi and Abu Bakar, 2009). Parkin, et al (2009) supported that individual may have a different level of propensity for growth and development. Therefore, to enable individual or group to be willing to work effectively, there must be a driving force which has to be recognised by the employers. Nonetheless, Parkin, et al (2009) argues that once a need has been satisfied, the particular need ceases to play an effective role in motivating the particular worker. Hence, there is a necessity to consistently evaluate individual need of employee at a particular time by construction managers.

## RESEARCH METHODOLOGY

Data obtained for the study was generated through design of a structured closed ended questionnaire survey. The questionnaire survey was conducted within Western Cape Province, Cape Town, South Africa. The study is a preliminary investigation as an integral

part of an on-going research towards improvement of construction workforce productivity. Through review of relevant literature, construction organisation motivation factors was explored and tested through questionnaire survey. The population of the study include; contract manager, foremen, site manager, project manager and construction clients. The questionnaire survey adopt “level of importance” on a four point scale where 1 = not important, 2 = important, 3 = Very important and 4 = extremely important. Among the questionnaires distributed for the survey, 35 % were retrieved, 4 % were invalid and 31 % valid questionnaires were analysed accordingly. Contract manager, foremen, site manager, project manager and construction clients are survey participants.

## RESULTS

Table 1: Motivation Impact on Construction Workforce Productivity

<b>MOTIVATION DRIVES</b>	<b>Sum</b>	<b>%</b>	<b>Rank</b>
Do you personally feel that motivation is important for construction workers performance?	36	90	1
Do you think giving bonus to workers is important?	31	77.5	2
How important does your organisation takes employee motivation?	30	75	3
How important is the need for construction workers recognition by management?	28	70	4
How important is reward giving to workers in your organisation?	27	67.5	5
How important is workers motivation base on individual need?	26	65	6
What is the level of general workers motivation to your organisation?	25	62.5	7
What is the level of importance of incentive to your organisation?	24	60	8
How important is workers transportation to your firm	23	57.5	9
How does your firm consider labours input in decision making?	20	50	10

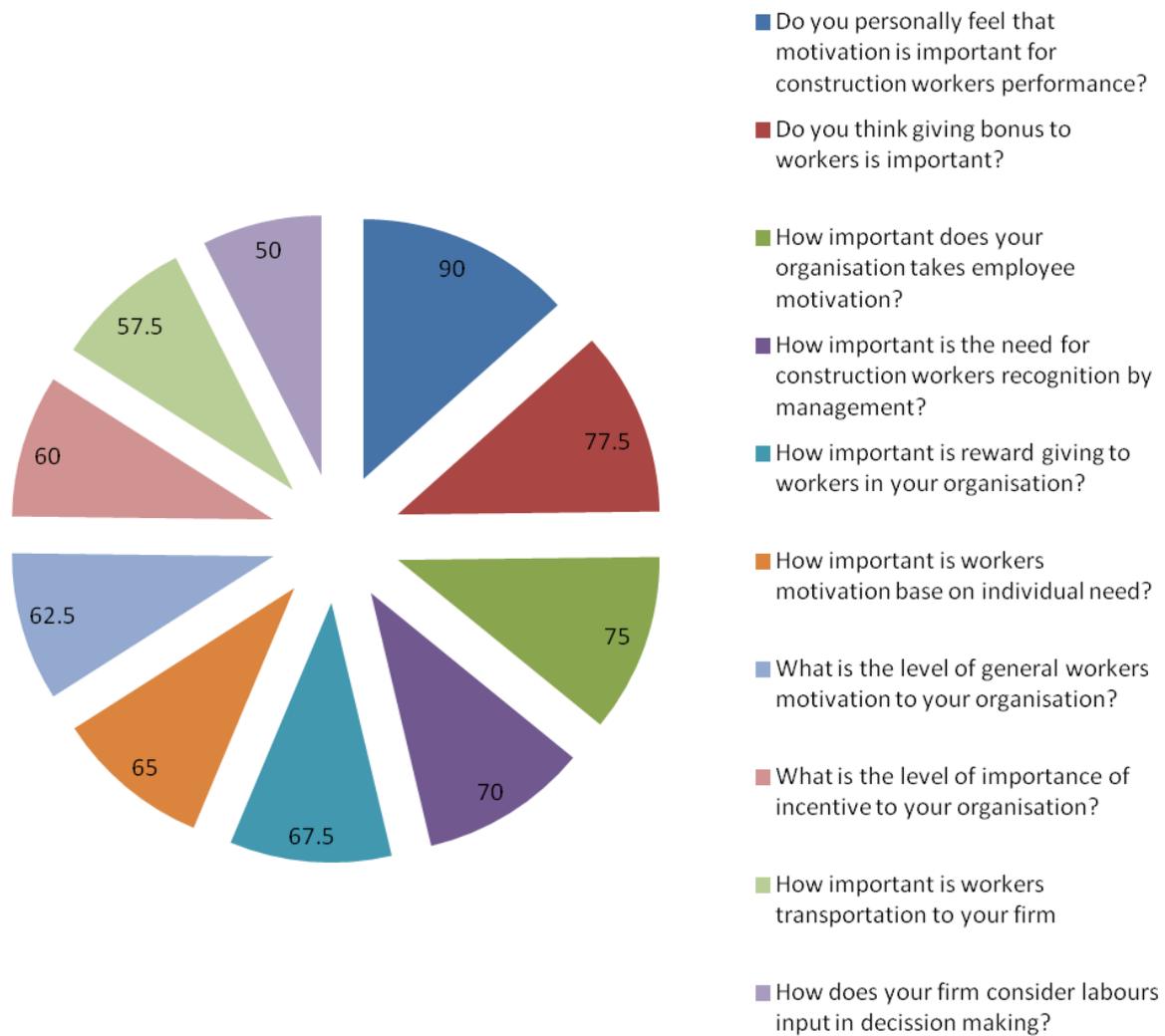


Figure 1: Motivation Impact on Construction Workforce Productivity

Table 2 presents the importance of motivation to construction workers performance. The perceptions of survey participants are tabulate, where 60 % of respondents indicated that motivation is extremely important and 40 % indicated very important. From table iii, giving bonus to construction workers is the second important factor, where 20 % of respondent indicated extremely important, 70 % indicated very important and 10 % indicated important. Table iv reveals the attitude of construction organisations to employee motivation. It was found that, 10 % of the respondent indicated that construction organisations takes employee motivation extremely important, 80 % indicated very important and 10 % indicated important. Table v presents the perceptions of respondents on the need for recognition of construction employee by management. 80 % respondents expressed employee recognition by management is very important, while 20 % respondent indicated important. From table i, the study reveals labours input in decision making and workers transportation as the least important factors to construction organisation with 50 % and 57.5 % respectively.

Table 2: Do you personally feel that motivation is important for construction workers performance?

	Frequency	Percent	Valid Percent	Cumulative Percent
Extremely important	6	60.0	60.0	60.0
Valid Very important	4	40.0	40.0	100.0
Total	10	100.0	100.0	

Table 3: Do you thing giving bonus to workers is important?

	Frequency	Percent	Valid Percent	Cumulative Percent
Extremely important	2	20.0	20.0	20.0
Valid Very important	7	70.0	70.0	90.0
Important	1	10.0	10.0	100.0
Total	10	100.0	100.0	

Table 4: How important does your organisation takes employee motivation?

	Frequency	Percent	Valid Percent	Cumulative Percent
Extremelyimportant	1	10.0	10.0	10.0
Valid Very important	8	80.0	80.0	90.0
Important	1	10.0	10.0	100.0
Total	10	100.0	100.0	

Table 5: How important is the need for construction workers recognition by management?

	Frequency	Percent	Valid Percent	Cumulative Percent
Very important	8	80.0	80.0	80.0
Valid Important	2	20.0	20.0	100.0
Total	10	100.0	100.0	

## CONCLUSION AND RECOMMENDATION

Construction workforce motivation is found to be significant to performance of construction sector. However, the level at which construction organisations reckons with motivation of their workforce does not commensurate with the significance of construction workforce motivation. Also, the input of construction labour has been ignored and consider irrelevant in decision making. Therefore, construction stakeholders should consider motivation of employee as a key factor to productivity enhancement, and give allowance for construction labour input as a means of motivation that will enable better performance.

## REFERENCES

- Kazaz, A., Manisali, E., and Ulubeyli, S. (2008). Effect of basic motivation factors on construction workforce productivity in Turkey, *Journal of civil engineering and management*, 14(2), pp. 95-106.
- Olabosipo, F., Ayodeji, O., and James, O. (2011). Factors affecting the performance of labour in Nigerian construction sites, *Mediterranean journal of social science*, Vol. 2, No. 2 pp. 251-257.
- Parkin, B., Tutesigensi, A., and Buyukalp, I. (2009). Motivation among construction workers in Turkey, *U.K association of researchers in construction management*, pp. 105-114.
- Schermernorn, Hunt, Osbon and Uhl-Bien, (2011). *Organisational behaviour*, eleventh edition, John Wiley and son, pp. 150-173.
- Tabassi, A., and Abu Bakar, A. (2009). Training, motivation and performance: The case of human resource management in construction projects in Mashhad, Iran, *international journal of project management*, pp. 471-480.
- Uwakweh, B. (2005). Effect of foremen on construction apprentice, *journal of constructionengineering and management*, Vol. 131, No. 12, pp. 1320-1327.

## Study of Student Satisfaction for “Sandwiches” Delivery Approach

Eric Chan

Deakin University, 1 Gheringhap Street, Geelong, VIC 3220, Australia  
eric.chan@deakin.edu.au

### ABSTRACT

*The summer trimester system provides students with greater flexibility to plan their study around work or lifestyle commitments, create options for students to commence a degree sooner or at a more convenient time of the year and enable students to fast track their study. There is increasing number of students enrolled in summer trimester. However, it was found that student engagement during summer is less than when those same subjects are delivered during other trimesters. This research investigates the using the “Sandwiches” delivery approach to improve the learning relationship with students. This innovative approach includes the first three weeks intensive on-campus delivery with a range of lectures and tutorials. This is followed by six weeks of on-line discussions, quizzes and self-assessment activities to strengthen the students’ knowledge and reinforce learning. The last week of summer trimester is revision to confirm theory prior to an examination. Positive responses from student reflected that this approach can be used for other subjects not only in summer trimester but also applicable in other trimesters. In fact, In order to improve course delivery, higher education providers always collect feedback and comment from students and previous research studies have used various methodologies. This paper demonstrates how to use survey plus case study to analysis student satisfaction.*

**Keywords:** Case Study, Student Survey, Student Satisfaction, Blended Learning, Higher Education

### INTRODUCTION

Since November 2008, the University in this case study has moved to a trimester system. Autumn trimester runs from the first week of March to mid-June, winter/spring trimester is offered from early-July to mid-October and summer trimester starts from mid-November to February in the following year. Due to the nature of its timeframe, many subjects offered in summer trimester employ an off-campus e-learning delivery model with less face-to-face support than other trimesters. It is believed that the trimester system will a. provide students greater flexibility to plan their study around work or lifestyle commitments, b. create options for students to commence a degree sooner or at a more convenient time of the year and c. enable students to fast track their study.

Records revealed that there is increasing number of students enrolled in summer trimester. For example, according to the case studied subject in this research, there were 55 students in autumn but only 25 in summer during 2010; 63 students in autumn and similar 57 in summer during 2011; 32 students in autumn and increased to 56 in summer during 2012.

However, despite of the high student enrolment, student retention rate in summer trimester is low. Comparing with other trimesters, the level of student engagement in the same subjects, which are also offered Trimester 3, appears relatively poor. As summer trimester is scheduled from mid-November to the end of February in the following year, there is a two-week holiday period that breaks up the trimester. Many students discontinued their study after the Christmas break. They reportedly experienced difficulties in continuing their study after coming back from holidays. Regarding the delivery methods, students’ feedback reflects a demand in more face-to-face support amongst the existing e-learning module with limited face-to-face consultation component offered in summer trimester’s subjects.

To improve students’ learning experience and increase student retention rate, there is a growing interest for the School and its educators to explore more innovative delivery strategies for summer trimester 3. Nowadays, “flexible education” has become a well-acknowledged notion influencing higher education in Australia. From student, educator and institutional perspectives, the consideration of flexibility can be categorized into five areas: time, content, access/entry requirements, pedagogy and delivery (Palmer 2011; Tucker & Morris 2011). According to Tucker and Morris (2011), students seek flexibility in the areas of pedagogy and delivery. Educators, however, are only prepared to offer flexibility in delivery. Therefore, the flexible delivery (i.e. multiple medium delivery of knowledge) is essentially the common ground where educators are willing and able to meet students’ need for flexibility in learning. Compared with other subject areas, Tucker and Morris’ study (2012) further indicates, in the discipline of built environment, both students and educators emphasize the significance of flexibility of delivery. Students want multiple mediums in knowledge delivery that allow flexibility in when and where they could learn, but have little desire to influence content or instructional approach. Therefore, the effective delivery strategies need to not only offer students the experience of flexible learning through e-learning environment, but also meet students’ demands in sufficient face-to-face support. A project is developed to explore such innovative delivery strategies and a case study of one of units offered in summer is conducted.

## **Literature Reviews**

Pedagogically speaking, teaching can be delivered by on campus (face-to-face) or virtual class (electronic supported learning). Prior to design a proper innovative delivery approach, there is a need to understand the desirable components for face-to-face and electronic support.

### **On Campus: Face-to-Face Delivery Components**

In the last decade, the paradigm of teaching and learning in higher education has changed rapidly with the advancement of information technologies and the Internet. Electronic supported learning, i.e. e-learning, has challenged the long-time dominance of face-to-face teaching mode. E-learning offers students and educators this great ability to “be both together and apart, and to be connected to a community of learners anytime and anywhere, without being time, place, or situation bound” (Garrison et al., 2004). It is also highlighted by Garrison (2011) that e-learning should be designed in supporting the nature of the transaction between and among teacher and students. Khan (2005) examines a range of issues that may affect the quality of e-learning, i.e. issues for institutional, management, technological, pedagogical, ethical, design interface, resources support and evaluation. From the pedagogical perspective, Tucker & Morris (2012) advocate that e-learning need to be informed by the specific demands of disciplinary contexts. In terms of institutional, management, technological and design interface, most contemporary e-learning activities are delivered through online learning management systems, e.g. Blackboard, Moodle, Desire2Learn, etc., which are supported by the host university. By engaging in this type of e-learning, students can easily access learning materials, participate in collaborations, communicate with teachers or peers, and disseminate their learning outputs at anytime, anywhere within the online environment (Moore et al., 2011). As for resources support, many university libraries have taken strategic steps to provide integrated support within online learning systems. In many cases, university libraries are playing a proactive role in providing immediate streamlined online resources and support to students’ learning (Boumarafi 2010; Hagel et al., 2012b). Therefore, in addition to on-campus component, the delivery approach should include online tutorial, discussion, support and resources. It is actually a blend of virtual class and face-to-face components.

### **Virtual Class: Electronic Supported Learning**

In the last decade, the paradigm of teaching and learning in higher education has changed rapidly with the advancement of ICT and the Internet. Electronic supported learning, i.e. e-learning, has challenged

the long-time dominance of face-to-face teaching mode. E-learning offers students and educators this great ability to “be both together and apart – and to be connected to a community of learners anytime and anywhere, without being time, place, or situation bound” (Garrison et al., 2004). It is highlighted by Garrison (2011) that e-learning should be designed in supporting the nature of the transaction between and among teacher and students. Khan (2005) examines a range of issues that may affect the quality of e-learning, i.e. issues for institutional, management, technological, pedagogical, ethical, design interface, resources support and evaluation. From the pedagogical perspective, (Tucker & Morris 2012) advocate that e-learning need to be informed by the specific demands of disciplinary contexts. In terms of institutional, management, technological and design interface, most contemporary e-learning activities are delivered through online learning management systems, e.g. Blackboard, Moodle, Desire2Learn, etc., which are supported by the host university/institute. By engaging in this type of electronic supported learning, students can easily access learning materials (written or multimedia), participate in/initiate collaborations, communicate with teachers or peers, and disseminate their learning outputs at anytime, anywhere within the online environment (Moore et al., 2011). As for resources support, many university libraries have taken strategic steps to provide integrated support within online learning systems. In many cases, university libraries are playing a proactive role in providing immediate streamlined online resources and support to students’ learning (Boumarafi 2010; Hagel et al., 2012a).

## **Innovative Delivery: “Sandwiches” Approach**

The blended learning mode marries the merits of e-learning flexibility and face-to-face interaction. It is the emerging concept in higher education that integrates or “blends” the flexibility of time and place that e-learning allows with the in-depth connection that face-to-face interaction creates (Poon 2012). However, it is worth noting that blended learning is not simply one plus one or “layering one on top of the other” (Garrison et al., 2004). A blended learning is about a right combination of delivery methods, i.e. an effective integration of face-to-face and e-learning experience. Most importantly, blended learning needs to suit students’ needs and improves their learning experience within a particular context, e.g. disciplinary or subject areas. It represents a quantum leap from any single dimensioned learning theory in higher education. It extends beyond delivery and technology. Hence, blended learning aims at motivating and stimulating learners (Garrison et al., 2004; Poon 2012; Sloman 2007).

Regarding pedagogy and delivery, both educators and students believe that blended learning offers greater flexibility for student learning (Poon 2012). As discussed earlier, key advantages of e-learning include allowing students to self-pace their study, form and engage in a virtual community, and make well-thought written discussions. This delivery method benefits those students who may be shy in face-to-face situation or speak English as second language. Others, however, may be disadvantaged by pure e-learning mode. They may not be computer/internet savvy or appreciate a sense of community that can only be created via face-to-face communication. With the integration of various delivery methods (both online and face-to-face based), students from different backgrounds, with different skills and expectations will be able to find a learning experience that suits them within a blended learning mode. Blended learning, therefore, can be seen as an approach to improve students’ learning experience, enhance engagement, increase retention rate and achieve graduate outcomes.

The planning and implementation of blended learning, however, can be complex. Arnold & Collopy (2009) address that the success of blended learning depends on students’ comfort level, possible team support in an online environment and an effective design. First of all, students need to be willing to participate in both online learning and face-to-face experience despite the fact they may strongly prefer one over another. Students must be motivated or equipped with skills that will allow them navigate in the online environment and participate in the face to face interaction (Poon 2012). Moreover, at the institutional level, sufficient support from different divisions (i.e. library and IT support) for both educators and students are critical to blended learning (Garrison et al., 2004). Because student who most need help often are reluctant to seek it, embedded library resources and librarianship within online learning environment can provide proactive and immediate support (Hagel et al. 2012a). Finally, blended learning is indeed about a good mix of delivery strategies that suits the

learning and teaching outcomes. The choice of delivery strategies should aid learning and allow innovation. It can range from online individual quizzes to face to face teamwork.

It is also stressed students' perceptions on learning outcomes have profound impact on the design and implementation of a blended learning (López-Pérez et al., 2011). In addition to developing and improving learning content and technical capacities, educators need to understand students' perceptions of their learning in a blended learning context. According to (Ginns & Ellis 2007), positive student perceptions of the e-learning experience and face-to-face interaction have strong links to higher grades and overall satisfaction on the blended learning. Thus, it is crucial for educators to clarify with students on the value and expectations of different delivery strategies that used in the blended learning. Since educators and students' existing skills and knowledge level will likely affect their perceptions of delivery methods, a clear communication on the available support services would reassure students and help them take the maximum advantages of the blended learning mode (Garrison et al., 2004; Poon 2012).

## Methodology

In order to improve course delivery, higher education providers always collect feedback and comment from students. For example, Allen et al. (2002) have used the meta-analysis to compare student satisfaction with distance education to traditional classrooms in higher education. Douglas et al. (2006) have measured student satisfactions at a UK university by using survey questionnaire and statistical analysis to analyse the results. Lee (2013) has conducted student satisfaction interview investigating the effects of student learning English using the collaborative online learning approach. However, Aldridge & Rowley (1998) evaluate the methodology which was developed to measure student satisfaction with significant components of the service experience delivered to students at an UK university and conclude to use a questionnaire-based survey to collect information on student satisfaction. It looks that survey plus case study are prevalent.

In fact, the student evaluation of teaching and unit survey can give all students the opportunity to give feedback of their experience of the units they study. Therefore, the proposed methodology is a survey plus case study. Yin (2009) points out that case study can be exploratory. Ideally case study research should use a multiple case study but the rationale behind the choice of a multiple case study over a single case study is to enable comparisons between the observed practices by subjects studied in order to obtain a more comprehensive understanding of the practices. Darke et al. (1998) also suggest that both single- and multiple- case designs can be adopted for exploratory research. Where explanatory research is undertaken, a single case may provide the basis for developing explanations of why a phenomenon occurs, and these may then be further investigated by applying them to additional cases in other settings.

Yin (2009) states that exploratory case study research can be performed using document, video or audio tape of interview, or surveying certain group of people about their experiences. Uma & Bougie (2010) also contend that using a combination of data collection methods such as archives, interviews, questionnaires, it can be used to provide descriptions, test theory, or generate theory.

As far as data is concerned, Saunders et al. (2007) suggest using multi-method approach, which uses both quantitative and qualitative data collection and analysis procedures that are applied either in a concurrent or in a sequential design. This approach is also supported by Creswell & Clark (2011) that researcher may collect, analyses, and mixes (integrates or connects) both quantitative and qualitative data in a single study as it fits.

The next step is to decide on what level of information is required from each question in the survey. It would seem obvious that survey questions should always relate to the aim of the survey. However it is easy to lose sight of this when drafting the questions. Since, the questions are the most important detail of the instrument, each question should be written with the target audience in mind.

Quite often when the questions are being drafted, the style is clear to the survey designers. However what it must be kept in mind is that neither teachers nor the researchers will respond to the survey. In doing so, the questions must be clearly structured and unambiguous so the students in the sample will understand what they are asking. Often, researchers build up a schema of information regarding the survey and will use that to interpret an ambiguous question which makes sense to them because they can “fill in the gaps” with what they already know. Respondents, however, do not possess a schema as rich as the researchers, therefore read the questions verbatim, because they are written. It is important to keep the aims and objectives of the survey in mind when formulating questions in order to obtain accurate data to improve course delivery in summer trimester.

For the case studied subject, originally, during summer trimester, students completed on activities including reading lecture notes, readings, pre-recorded lectures, online tutorial and discussion. When using the “Sandwich” delivery approach, lectures are delivered in face-to-face mode over a 3-week period at the beginning of the trimester. All these lectures are also recorded and made available online for review. Students are then supported for the remainder of the trimester through online tutorial activities, quizzes, and assessment guidance. One final face-to-face revision lecture will be held at the end of the trimester, prior to the examination period.

At the end of the trimester, students are asked to participate to an online survey. This is an anonymous online survey. Students can login to the University website to read through the plain language statement and consent form. Then, they can complete the online survey questionnaire. Once submitted, information cannot be identified or withdrawn. Participants are asked to respond what their opinions are as followings:

- Structure of “Sandwich” delivery
- Lecture Format: recorded online lectures and face-to-face
- Tutorial Format and Support: face-to face and online
- Learning Resources
- Support for the Assessment
- IT support and performance
- Could each delivery method be adopted in other trimesters or subjects in the School?

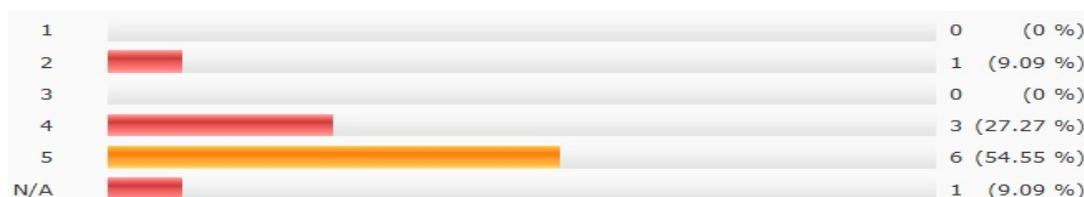
## Results and Summary of Survey

Eleven students have participated to the survey and the results are analyzed as below:

- Structure of “Sandwich” delivery



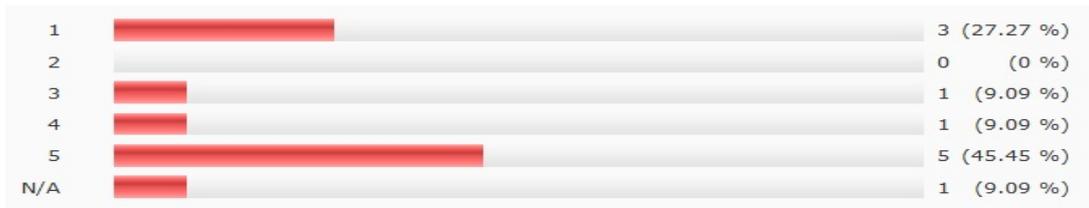
- Lecture Format: recorded online lectures and face-to-face



- Tutorial Format: face-to face and online



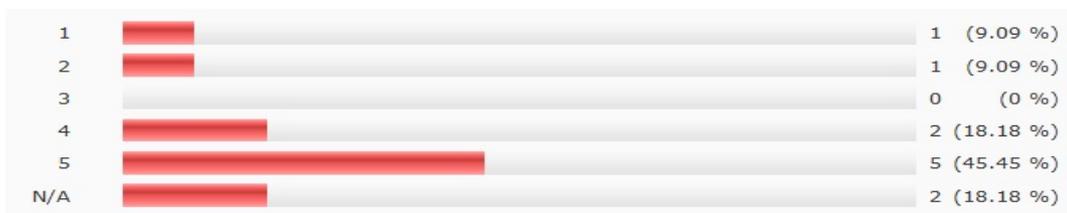
- Tutorial Support: face-to face and online



- Learning Resources



- Support for the Assessment



- IT support and performance



- Could each delivery method be adopted in other trimesters or subjects in the School?

The majority of the students agree that the “Sandwiches” delivery method can be adopted in other trimesters as it provides both face-to-face materials combined with online content. No student disagrees to adopt this approach in other trimesters or subjects.

One student comments that this method can be ‘only for subjects that have a small amount of content in lecture and two subjects require 100% face-to-face time’. Another student comments that this method is only suitable for one particular subject but without stating specific reason. A student adds that ‘tutorials need to be practical with additional support, such as industry examples’, while another student says that face-to-face lectures and online tutorials are the best way of delivering any subject. A student also recommends that this method is especially applicable for subject at advanced level but not suitable for elementary level because higher year students do not require every lecture or tutorial to be face-to-face.

- Provide any further feedback or suggestions that might have.

A student stated, ‘from a time management perspective having the intensive days is fantastic and I hope that you do try this in other subjects’. Another student added that ‘the “Sandwich” delivery is great if students are able to attend campus for the 4 days recommended classes, the subject however also need to be able to be completed successfully from a purely online perspective’.

Some students are not satisfied with the technologies and concluded that ‘With the technology available today you should be able to provide i-tutes (recordings of the face-to-face tutorials) for the online students who were unable to attend great face-to-face classes that were offered’. The delivery is very good ‘except for the quality of the recorded lectures’. For example, during the lecture, the lecturer drew things on the board as an off campus student using only recorded lectures it was not possible to see the information written. An overseas student added that ‘the recordings for were appalling at best. As a student completing the subjects from overseas, and restricted to purely online modes of communication the lectures were so quiet that with noise cancelling headphones....This should have been checked by the IT Staff’. Video at the start of the subject outlining how to get support and information are required.

Library support should also be improved. Access to online resources through the library should be much easier to manage, and updating the old study guide is needed.

Online support was not adequate and ‘tutorials need to be made clearer’. For a first time delivery of this system, it went fairly smoothly; most kinks are those which can only be resolved with time.

## Discussions

The majority of students (91%) are satisfied with the structure of the innovative “Sandwich” delivery approach, while most students (82%) are satisfied with the both recorded online and face-to-face lecturing format. Although some students (18%) are not satisfied with the tutorial format, the majority (55%) still find the face-to-face and online tutorial satisfactory. It is noted that there is one student very not satisfied with the learning resources but the majority (70%) still find it satisfactory. When two students are not satisfied with the support for assessment, only 45% them find it very satisfactory. Finally, three students are not satisfied with the IT support and performance, though three students still find it excellent.

This innovative delivery method is welcome by the students. The retention rate is greatly improved. There were 6 and 7 students discontinued during the summer trimester of 2010 and 2011, but only 4 drop-out in the summer of 2012.

In summary, students’ feedback and suggestion are positive and commendable. It provides a ‘better accessible to those students taking the subject as 100% online which is now possible with the mixed delivery option’. A student reiterated that ‘face-to-face lectures follow by online support is a

good idea’ For a first time using the “Sandwiches” delivery approach, it went fairly smooth, most defects and some entanglements, such as IT and library supports, can be rectified and fixed next time.

## Conclusion

This paper demonstrates how to use survey plus case study to analysis student satisfaction. Today, more and more people wish to pursue further development through higher education. As a result, an increasingly number of students rushes back and forth between lecture theaters and workplaces. In response to students’ demand in flexible learning, the studied university in this paper has introduced the use of e-learning and web-based tools. Study material is delivered via the Internet including audio or video files, media in the form of text, image, animation etc. Tutorials and presentations can also be conducted online. However, many students still desire face-to-face support in their learning. It is undeniable there is a demand of flexibility delivery, which needs to accelerate the studies, catch up delay and suit the individual pace in learning.

This case study recognizes the challenges, faced with educators teaching in summer trimester, in ensuring students satisfaction, improving students engagement level and increasing retention rate. It also acknowledges the disciplinary difference in educators and students’ perceptions and expectations of a successful learning in higher education. The blended learning theory is identified and selected as the theoretical foundation. It is used to explore innovative delivery strategies to enable improvements for flexibility delivery of accelerated summer trimester in the School of Architecture and Build Environment.

“Sandwiches” delivery is coined here to provide a vivid description of the blended learning delivery used in the case study: a combination of on-campus, off-campus and on-campus learning schedule, which mirrors the three-layered but integrated face-to-face, online and face-to-face delivery strategy. Most importantly, it is blended by real and academic. In the case study, most students applaud the “Sandwiches” delivery approach including both face-to-face and online components. However, improving students’ learning experience and engagement is not all about offering recordings of lecture and tutorial video online. Providing sufficient learning support includes library resources and learning resources are also essential to the success of blended learning. Due to the small number of respondents in this case study, larger scaled studies, however, will be needed to determine benchmarks for other online subject delivery in the University and School at a broader level.

## ACKNOWLEDGEMENTS

Acknowledge and thank the research input by Ms Linlin Zhao for literature review and proofread.

## REFERENCES

- Aldridge, S & Rowley, J (1998), 'Measuring customer satisfaction in higher education', *Quality assurance in education*, vol. 6, no. 4, pp. 197-204.
- Allen, M, Bourhis, J, Burrell, N & Mabry, E (2002), 'Comparing student satisfaction with distance education to traditional classrooms in higher education: A meta-analysis', *The American Journal of Distance Education*, vol. 16, no. 2, pp. 83-97.
- Arnold, JM & Collopy, RMB (2009), 'To blend or not to blend: online and blended learning environments in undergraduate teacher education', *Issues in Teacher Education*, vol. 18, no. 2, 2009 Fall, p. 85+.
- Boumarafi, B (2010), 'Strategies for the delivery of e-information services to support the e-learning environment at the University of Sharjah', *Electronic Library, The*, vol. 28, no. 2, pp. 276-85.
- Creswell, JW & Clark, VLP (2011), *Designing and conducting mixed methods research*, 2nd edn, SAGE Publications, Los Angeles, California.

- Darke, P, Shanks, G & Broadbent, M (1998), 'Successfully completing case study research: combining rigour, relevance and pragmatism', *Information Systems Journal*, vol. 8, no. 4, pp. 273-89.
- Douglas, J, Douglas, A & Barnes, B (2006), 'Measuring student satisfaction at a UK university', *Quality assurance in education*, vol. 14, no. 3, pp. 251-67.
- Garrison, DR (2011), *E-Learning in the 21st Century : A Framework for Research and Practice*, Taylor and Francis, Hoboken, <<http://deakin.eblib.com.au/patron/FullRecord.aspx?p=668750>>.
- Garrison, DR (2011), *E-learning in the 21st century : a framework for research and practice*, 2nd edn, Routledge, New York.
- Garrison, DR & Kanuka, H (2004), 'Blended learning: Uncovering its transformative potential in higher education', *The Internet and Higher Education*, vol. 7, no. 2, pp. 95-105.
- Garrison, DR & Kanuka, H (2004), 'Blended learning: Uncovering its transformative potential in higher education', *Internet and Higher Education*, vol. 7, no. 2, pp. 95-105.
- Ginns, P & Ellis, R (2007), 'Quality in blended learning: Exploring the relationships between on-line and face-to-face teaching and learning', *The Internet and Higher Education*, vol. 10, no. 1, pp. 53-64.
- Hagel, P, Horn, A, Owen, S & Currie, M (2012a), 'How can we help?' the contribution of university libraries to student retention', *Australian Academic & Research Libraries*, vol. 43, no. 3, pp. 214-30.
- Hagel, P, Horn, A, Owen, S & Currie, M (2012b), 'How can we help? The contribution of university libraries to student retention', *Australian academic and research libraries*, vol. 43, no. 3, pp. 214-30.
- Khan, BH (2005), *Managing e-learning: Design, delivery, implementation and evaluation*, Information Science Pub.
- Lee, HC (2013), 'Investigating the effects of student learning of English using COL approach based on situational theories', *Computers in Human Behavior*, vol. 29, no. 6, pp. 2211-7.
- López-Pérez, MV, Pérez-López, MC & Rodríguez-Ariza, L (2011), 'Blended learning in higher education: Students' perceptions and their relation to outcomes', *Computers & Education*, vol. 56, no. 3, pp. 818-26.
- Moore, JL, Dickson-Deane, C & Galyen, K (2011), 'E-Learning, online learning, and distance learning environments: Are they the same?', *The Internet and Higher Education*, vol. 14, no. 2, pp. 129-35.
- Palmer, SR (2011), 'The Lived Experience of Flexible Education - Theory, Policy and Practice', *Journal of University Teaching & Learning Practice*, vol. 8, no. 3, pp. 1-14.
- Poon, J (2012), 'Use of blended learning to enhance the student learning experience and engagement in property education', *Property Management*, vol. 30, no. 2, pp. 129-56.
- Saunders, M, Lewis, P & Thornhill, A (2007), *Research Methods For Business Students, 5/e*, 4th edn, Pearson Prentice Hall Financial Times, Harlow, Essex.
- Sloman, M (2007), 'Making sense of blended learning', *Industrial and Commercial Training*, vol. 39, no. 6, pp. 315-8.
- Tucker, R & Morris, G (2011), 'Anytime, anywhere, anyplace: Articulating the meaning of flexible delivery in built environment education', *British Journal of Educational Technology*, vol. 42, no. 6, pp. 904-15.
- Tucker, R & Morris, G (2012), 'By design: negotiating flexible learning in the built environment discipline', *Research in Learning Technology*, vol. 20.
- Uma, S & Bougie, R (2010), *Research Methods for Business: A skill building approach*, 5th edn, John Wiley and Sons Inc., New York.
- Yin, R (2009), *Case study research: Design and methods*, 4th edn, SAGE Publications, Thousand Oaks, California

# The Evaluation of Green Infrastructure Elements to Enhance Green Neighbourhood Park in Shah Alam, Selangor

Rijal Saffuan<sup>a</sup>, Khalid Zanudin<sup>b</sup> and Puziah Ahmad<sup>c</sup>  
<sup>abc</sup>Faculty of Architecture, Planning and Surveying, UiTM, Shah Alam, Malaysia  
rijalsaffuan@gmail.com

## ABSTRACT

*Green infrastructure is an effort of countering the negative impact caused by the climate change and urban sprawl. This green infrastructure basically consists of diverse green spaces which are interconnected and linked by the streets, waterways and drainage network in urban areas. The purpose of the study is to apply the implementation of green infrastructure concept as a medium to enhance the neighbourhood park using green infrastructure concept and principle in Section 6, Section 7, and Section 8, Shah Alam. The analysis has been done to determine the current provision of green infrastructure elements within the study area based on the concept of green infrastructure. Green infrastructure consists of several components that work and function together to maintain the green network of physical environment. The components refer to the combination of hub and links where hub is the neighbourhood park and link is the landscape and pedestrian walkways. The level of green infrastructure is assessed through site inventory on aspects of provision, maintenance, accessibility, and image/character. The outcomes of the analysis are used to evaluate the efficiency of current provision of green infrastructure in enhancing the neighbourhood park in the study area before proposing an improvement provision of green infrastructure within the study area. The findings could be used by local authority to formulate plan and guidelines in developing infrastructure and facilities that fulfill green infrastructure elements to enhance the neighbourhood park.*

**Keywords:** green infrastructure; neighbourhood park; site inventory

## INTRODUCTION

Climate change which faced by many countries nowadays has been closely related with the process of urbanisation or urban sprawl. Thus, smart growth and smart conservation have been identified as one of the approaches that can be applied in our effort to combat and counter the urban sprawl (Suzuki & Moola, 2010) of which causing imbalanced land development and distribution. Urban sprawl has been identified as the culprit for inability to conserve the green spaces, lower economical effectiveness for investment in infrastructure and other environmental and socio-economic issues. One of the smart growth and conservation approaches that can be implemented is the Green Infrastructure Network concept which is part of the green technology. It has been identified as a tool that can enhance neighbourhood park. Green infrastructure is an approach of providing improvement in infrastructure provision such as tools of networks and linkages of green spaces. This green infrastructure basically consists of diverse green spaces which may be linked and connected by the streets, waterways and drainage network in urban areas (Tzoulas, 2007).

This paper aims to exemplify an effort by a group of student doing master's coursework in evaluating elements of green infrastructure as a catalyst of green neighbourhood park development. The purpose of the study is to apply the implementation of green infrastructure concept as a medium to enhance the neighbourhood park using green infrastructure concept and principle in Section 6, Section 7, and Section 8, Shah Alam. The neighbourhood parks are lack of green elements and no linkages of landscape and pedestrian walkways in the neighbourhood park in Shah Alam. The analysis has been done to determine the current provision of green infrastructure elements within the study area based on the concept of green infrastructure which is hub and link. The data collection was done

through site inventory based on aspects of provision, maintenance, accessibility, and image/character. The assessment been made using Likert Scale based on self assessment of enumerators through non participant observation on study area. The output of the analysis is to provide connection between neighbourhood park as hub and pedestrian walkways and landscape as link.

## LITERATURE REVIEW

According to Town and Country Planning Association, UK (2010), Green Infrastructure is the sub-regional network of protected sites, nature reserves, green spaces, and greenway linkages. The linkages include river corridors and flood plains, migration routes and features of the landscape, which are of importance as wildlife corridors. Conservation Fund, 2009 defines green infrastructure as a network of natural areas and open spaces—such as woodlands, wetlands, trails and parks—that conserves ecosystems, helps sustain clean air and water and provides many other benefits to people and wildlife. Green infrastructure should provide for multi-functional uses i.e., wildlife, recreational and cultural experience, as well as delivering ecological services, such as flood protection and microclimate control. It should also operate at all spatial scales from urban centres through to open countryside. (Town and Country Planning Association, UK, 2010)

The term green infrastructure is used to improvise different approaches from the traditional conservation practices and strategies which diversify the old perception regarding the green space planning and protection. According to Benedict and McMahon (2009)'s, diversified perception of green space through this concept is “green spaces as something that we must have where protecting and restoring our environment and resource is a necessity rather than amenity”. Besides that, green infrastructure also changes the common and traditional perception regarding green space which is traditionally an isolated space to interconnected spaces that form a system of protection and management. Thus it will give ecological benefits provided to the people and the environment itself. This environmental concept also emphasized on the needs to maintain the green space actively and monitor from time to time rather than let it alone without being manage (Benedict & McMahon, 2009). Green infrastructure provide practical ways to plan the environment which can be done by recognising the significant green spaces can contribute in producing the quality of life.

Basically green infrastructure form consisted of several components that work and function together to maintain the green network of natural environment. These components are diverse in shape and size depending on the type and size of resource being protected. The ecological importance of natural features within each component determines the level of conservation required protecting these resources and simultaneously the interaction between human and his or her natural environment (Williamson, 2003). These components refer to the combination of hub and links where there can be more than one (1) hub and more than one (1) link.

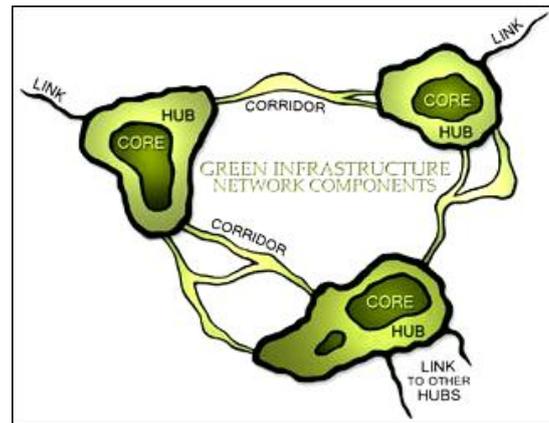


Figure 2: Conceptual green infrastructure diagram: a network of core areas, hubs and corridors  
(Adapted from Weber et. all, (2011). *Landscape and Urban Planning*, Volume 96, Issue 4, 30 June 2012)

A hub is an anchor to the green infrastructure network where this hub provides the origin and destination for wildlife and ecological process movement. A hub according to Benedict and McMahon, 2009 can be a reserved and protected area such as national park, and working lands such as farms. This includes a regional parks, parks and open spaces at all in national, state, regional, country, municipal and private level that may provide opportunity for recreation and protection of the natural resources. While links refer to connections that tie the system together and allow the green infrastructure network to worked. The links can be in various sizes and forms which include a landscape linkage of a large protected area that connect existing parks or natural areas. The connection will provide adequate space for flora and fauna to flourish while functioning as corridor that connecting ecosystem and landscape (Benedict & McMahon, 2009). Landscape linkage may also provide space for recreation use. Links also refers to the greenways and greenbelts which function as framework for development while preserving the ecosystem. Conservation corridor such as river or stream functions as biological base for wildlife besides providing the opportunity for recreational activities.

## ANALYSIS AND FINDINGS

This inventory approach focused on the provision of green infrastructure elements within the study area (Section 6, Section 7 and Section 8 Shah Alam) which contributes to the potential of green infrastructure network within the areas thus enhances the liveable community. This green infrastructure element inventory will be divided into two (2) main aspects of green infrastructure that is the hub and the link. Hub is Neighbourhood Park which whereby an assessment of provision, maintenance, accessibility, and image/ character will be conducted. Link is analysed based on the provision of landscape and pedestrian walkway, maintenance and connectivity. The Likert's scale method are based on ordered response options by Renesis Likert (1932) that will indicate the level of provision for green infrastructure in the study area. Likert's Scale refers to five (5) ordinal measurement [One (1) to five (5)] which is 1-Very Poor, 2- Poor, 3-Fair, 4-Good, and 5-Very Good that will be use to indicate the current provision of green infrastructure.

## Site Inventory of Green Infrastructure Element

An Analysis for site inventory will be based on the elements of green infrastructure concept that encourages and enhances the liveable community within the study areas. This approach will indicate whether the study areas (Section 6, Section 7 and Section 8) consist the elements of green infrastructure as a medium to liveable community as indicated by the linkages of the hub and link elements.

a. Hub of Green Infrastructure

A hub refers to an anchor to the green infrastructure network where this hub provides the origin and destination for wildlife and ecological process and movement. In these study areas the Neighbourhood Park and open spaces such as field that existed around the areas is the hub for recreation and protection of the natural resources.

i. Neighbourhood Park

Neighbourhood Park is one of the green elements that existed in any built environment as part of initiative to provide spaces for recreation and social interaction besides enhancing the balance between physical development and environment. Neighbourhood Park also provides opportunity to preserve the natural elements such as beautiful landscape, water elements or greenways which become part of the green infrastructure components. This neighbourhood park can become the hub for the green infrastructure network which functions as the origin and destination of ecological process within the study area.

Table 1: Provision Level of Neighbourhood Park around Section 6, Section 7 and Section 8

Aspects	Section 6	Section 7	Section 8
Provision	5	4	5
Maintenance	3	4	2
Accessibility	3	4	3
Image/ Character	1	1	1

- 5 – Very good (The provision level of Neighbourhood Park in term of its facilities is very good besides well maintained. The location of the Neighbourhood Park also provides good accessibility to the local people where people can walk to the park. The Neighbourhood Park also has a clear unique character and image.)
- 4 – Good (The provision level of facilities in the Neighbourhood Park is good and well maintained. The location of the park located is near to the neighbourhood and accessible by private vehicles The park also has its own image and character.)
- 3 – Satisfactory (The provision and maintenance level of facilities in the neighbourhood park is satisfactory. The location of the park provides fair accessibility level to the neighbourhood besides having a fair image of the park.)
- 2 – Poor The facilities for the park are poorly provided and maintained besides the location of the park encourage the usage of private vehicles. The park did not have a specific image or character.
- 1 – Very poor (The Park did not provided with facilities or all facilities cannot function well because of poor maintenance level. It is difficult to find and come to the park which requires people to depend on vehicles. The park also did not have a specific character or image.)

Based on the observation that has been made in Section 6, Section 7 and Section 8 Shah Alam the level of provision for Neighbourhood Park as the hub for green infrastructure network in the study areas are still lacking of facilities. This has resulted these parks are unable to attract many local people to use these spaces as the social and recreation spaces. While in term of maintenance of the park, the park in Section 8 is poorly maintained especially in term of its facilities while both in Section 6 and 7 are satisfactorily maintained and functioned.

From the observation, it can be seen that these Neighbourhood Park provide a good level of accessibility to the people where people who live nearby can come to the park by walking which will encourage more walkable environment to the neighbourhoods. Unfortunately, it can be concluded that all three (3) Neighbourhood Parks still lack of specific character and image which can provide or enhance the sense of place to the park.

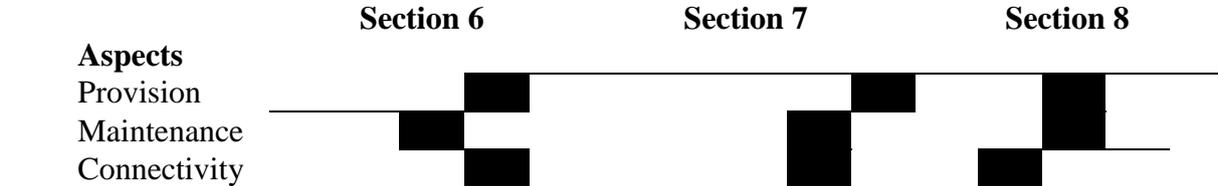
b. Link of Green Infrastructure

Links refer to connections that tie the system together and allow the green infrastructure network to work. The links can be in various sizes and forms. This includes a landscape linkage which refers to a large protected area that connect existing parks or natural areas which provide adequate space for flora and fauna to flourish and growth. At the time, acts as corridor that connecting ecosystem and landscape. The link element in the study areas refers to the link of landscape and pedestrian walkway provide around the three (3) neighbourhoods which function as linkages that connect between neighbourhood parks.

i. Landscape

Landscape is defined as visible features of an area of land, including the physical elements of landforms, water bodies such as rivers, lakes and the sea, living elements of land cover including indigenous vegetation, human elements including land uses, buildings and structures, and transitory elements such as lighting and weather conditions. Landscape also includes the vegetation and flora elements that provides in the neighbourhood particularly along the road network. Landscape elements are closely related with pedestrian network where both elements can encourage more walkable environment and reduce the dependency of vehicles. This condition meets one of the objectives of the livable city (community).

Table 2: Provision Level of Landscape around Section 6, Section 7 and Section 8, Shah Alam



- 5 – Very good (The provision of landscape is adequate which able to encourage walkable environment in all or most of the area. The maintenance of landscape is in a very good condition and it is able to enhance the visual aesthetic of the area. The provision of landscape is able to form a connection of network.)
- 4 – Good (The provision of landscape is able to encourage walkable environment in majority of the area. The maintenance of landscape is able to enhance the visual aesthetic value to the area. The provision of landscape is able to form a connection in most of the area.)
- 3 – Satisfactory (The provision of landscape satisfactorily encourages walkable environment in the study area. The maintenance of landscape satisfactorily enhances the visual aesthetic value to the area. The provision of landscape is able to form a connection in some part of the area.)
- 2 – Poor (The provision of landscape unable to encourage walkable environment in most of the study area. The maintenance of landscape is unable to provide the visual aesthetic value to the area. The provision of landscape is unable to form a connection in most of the area.)
- 1 – Very poor (The provision of landscape cannot encourage walkable environment in the study area. The maintenance of landscape did not provide or enhances the visual aesthetic

value to the area. The provision of landscape is unable to form a connection in whole study area.)

Based on the inventory of green infrastructure element around Section 6, Section 7 and Section 8 Shah Alam, in term of the landscape provision it can be described that the level of provision in all three (3) neighbourhoods are satisfactory although landscape provision in Section 7 is better in term of its maintenance and provision. While Section 8 provided has the lowest level of landscape provision compared with other two (2) sections. Therefore, it can be seen that people tend to walk within Section 7 and Section 6 compared to Section 8 as Section 8 has much lesser landscape and lack of maintenance.

ii. Pedestrian Walkway

Pedestrian walkway is an important element in a built environment especially in urban area in order to encourage more walkable environment and reduce the dependency of private vehicle. The provision of pedestrian walkway is one of the initiatives to reduce the traffic movement on the road which become one of the objectives for liveable city. In this study, the linkage of landscape has been closely related with the linkage or network for pedestrian in order to identify the potential link component for green infrastructure network.

Table 3: Provision Level of Pedestrian Walkway around Section 6, Section 7 and Section 8

	Section 6	Section 7	Section 8
<b>Aspects</b>			
Provision	■	■	■
Maintenance	■	■	■
Connectivity	■	■	■
5 – Very good	(The provision of pedestrian is adequate enough to encourage walkable environment in all or most of the area. The maintenance of pedestrian walkway is in a very good level which able to enhance the visual aesthetic of the area besides able to form a connection of network.)		
4 – Good	(The provision of pedestrian is able to encourage walkable environment in most of the area. The maintenance of pedestrian walkway is good which able to provide the visual aesthetic to the area besides able to form a pedestrian network to most of the area.)		
3 – Satisfactory	(The provision of pedestrian is satisfactorily enough to encourage walkable environment in some part of the area. The maintenance of pedestrian walkway is satisfactorily less likely to provide the visual aesthetic to the area plus unable to form a pedestrian network to the study area.)		
2 – Poor	(The provision of pedestrian walkway unable to reduce the dependency of private vehicle within the study area. The maintenance of pedestrian walkway cannot provide visual aesthetic value to the area. The provision of pedestrian walkway is unable to form a connection in most of the study area.)		
1 – Very poor	(The provision of pedestrian is unable to encourage walkable environment in most of the area. The maintenance of pedestrian walkway is very poor which unable to provide the visual aesthetic to the area besides failing to form a pedestrian network to the overall study area.)		

In term of the pedestrian walkway provision in all three (3) study areas, it can be concluded that pedestrian walkway provided was adequate in both Section 6 and Section 7 compared with Section 8. It can be seen that both Section 6 and Section 7 generate more pedestrian movement as these areas well are connected and linked satisfactorily through the pedestrian walkway. While for the maintenance of the pedestrian walkway, based on the observation that has been made, it can be said that the maintenance level of pedestrian around these study areas is satisfactory where not all part of

the areas are provided with proper pedestrian walkway which indirectly influenced influence the connectivity between area through pedestrian walkway.



Figure 2: Green Infrastructure Components in Section 6, Section 7 and Section 8, Shah Alam

## CONCLUSION

Every state and local government has a park management plan. At the same time, local communities also have detailed plans for improving the facilities and infrastructure for the neighbourhood park. Green infrastructure plans provide a blueprint for sustainable management plans and create a framework for future growth and at the same time ensure significant natural resources will be preserved for future generations. Green Infrastructure can provide many social, economic and environmental benefits close to where people live and work including space and habitat for wildlife with access to nature for people and improved health and well being of people especially places for outdoor relaxation and play. Green Infrastructure also acts as catalyst to economic growth by attracting investment to business and tourist. It's also saving environmental cost by improved air quality, reduces the urban heat island effect, filters diffuse pollution and helps to manage flood risk.

## REFERENCES

- Benedict. M, et al (2009). Green Infrastructure: Smart Conservation for the 21<sup>st</sup> Century. Sprawl watches clearinghouse monograph series, Island Press UK. Retrieved 6 October 2013, from [www.dnr.mo.gov/env/wpp/stormwater/documents/gi.../gi-appendixb.pdf](http://www.dnr.mo.gov/env/wpp/stormwater/documents/gi.../gi-appendixb.pdf)
- Suzuki & Moola (2010). Using smart growth to combat urban sprawl in Canda. Retrieved 6 October 2013, from <http://www.straight.com/news/david-suzuki-using-smart-growth-combat-urban-sprawl-canada>
- Tzoulas, (2007). Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review, Landscape and Urban Planning, Volume 81, Issue 3, 20 June 2007
- Weber et. all (2011). Landscape and Urban Planning, Volume 96, Issue 4, 30 June 2012
- Williamson. K.S (2003). Growing with Green Infrastructure, GI, Heritage Conservancy, Doylestown PA. Retrieved 6 October 2013, from [www.greeninfrastructurenw.co.uk/resources/Growing\\_with\\_GI.pdf](http://www.greeninfrastructurenw.co.uk/resources/Growing_with_GI.pdf)

The Evaluation of Green Infrastructure Elements to Enhance Green neighbourhood park in Shah Alam,  
Selangor

Winchester City Council (2010). Green Infrastructure Study 2010, Winchester City Council Website.  
Retrieved 6 October 2012, from <http://www.winchester.gov.uk/planning-policy/evidence-base/environment/green-infrastructure-study-2010/>

## NOTES FOR CONTRIBUTORS

### SUBMISSION

All materials submitted for publication must be original, unpublished work and are not under consideration for publication elsewhere.

Papers may be submitted by e-mail to **bej.fspu@gmail.com**. Alternatively, 2 copies of the manuscript together with a full version on CD may be submitted to the Editorial Board.

#### **Address:**

Assoc. Prof. Datin Dr. Hamimah Adnan  
Managing Editor  
Built Environment Journal (BEJ)  
Faculty of Architecture, Planning and Surveying  
Universiti Teknologi MARA  
40450 Shah Alam  
Selangor, Malaysia.

Editors reserve the right to edit/comment on the content of the manuscript. If major or substantial amendments are recommended by the editors the authors will be given the option to accept or reject the recommendations (and withdraw participation).

### MANUSCRIPT PREPARATION

#### **Language**

The manuscript must be submitted in British English.

#### **Length**

The manuscript should be within the range of 5000 – 7500 words in Times New Roman font, 12 point type. Authors are requested to state how many words their paper contains. The manuscripts should be typed and single spaced on one side of A4 paper only, with 4 cm margins on the sides, the top and the bottom. All text should be set aligned justified throughout. The pages should be numbered in order.

#### **Title Page**

The first page of the manuscripts must contain the full title, name of author(s), designation(s) of affiliation(s), highest academic qualification and the present address(es) with the telephone/fax/e-mail contact information listed.

#### **Abstract and Keywords**

The abstract must not exceed 250 words and should summarise the paper including the main conclusions. There shall be not more than 5 keywords.

#### **Text**

The order when typing manuscripts: Title, author(s), highest academic qualification, Affiliations, Abstract, Keywords, Main Text (Aim, Problem Statement/Issues, Methodology and Analysis), Conclusion and Recommendations, References, Acknowledgment and Appendix (if any). Simple language, short sentences and a good use of headings are encouraged. Headings should

be numbered and the use of more than three levels of heading should be avoided. Headings and paragraphs should be separated by two carriage returns. Text following a heading should not be indented.

#### **Illustration**

Photographs, diagrams and charts should be referred to as “Figure(s)” and numbered in the order in which they are referred to in the text. Maps and diagrams should be submitted in a form ready for reproduction, all in legible digital format. Please note that illustrations in the journal shall be printed in black-and-white or grey-scale.

#### **Units**

All measurements and data should be given in metric units or, if other units are used, then the metric equivalent should be given in parentheses.

#### **Reference**

The Harvard system is used. The reference is referred to in the text by the following manner:

- Onojafe D, Ukpere WI (2009). *Partnership and the e-commerce initiative of small businesses. African Journal Business Management*, 3(12): 855-861.
- Shahimi, N. (2006). *A Study on The Achievement of Class F Contractors. Shah Alam: Department of Quantity Surveying, Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA Malaysia.*
- Swan W, Khalfan MMA (2007). *Mutual Objective Setting For Partnering Projects in the Public Sector. Engineering, Construction and Architectural Management*, 14(2): 119-130.
- Stevens, R. (2004). “*Partnering, Environmental & Risk Management*”, *International Construction Conference 2004. CIOB Malaysia.*
- CIDB (2011), *Construction Industry Development Board, Malaysia, www.cidb.gov.my.*

### COPYRIGHT

Once published in the Built Environment Journal, the copyright including electronic copyrights of the article is automatically invested with UiTM. The copyright covers the exclusive use of rights to reproduce and distribute the article, including reprints, photography reproductions, microfilm, electronic publication or any reproduction of a similar nature and translations. Permission to publish illustrations must be obtained by the author before submission. Any acknowledgements should be included in the figure captions.

