CSCE Annual Conference
Growing with youth – Croître avec les jeunes

Laval (Greater Montreal)
June 12 - 15, 2019

OPPORTUNITIES AND CHALLENGES FOR MODULAR CONSTRUCTION IN DEVELOPING NATIONS: A CASE STUDY IN THE NEPALESE CONSTRUCTION INDUSTRY

Krishna P. Kisi[1], Nirajan Mani[2], Namhun Lee[3], K. Joseph Shrestha[4], Kishor Shrestha[5], and Rujan Kayastha[6]

[1] Assistant Professor, Central Connecticut State University, USA, e-mail: kkisi@ccsu.edu
[2] Assistant Professor, Fitchburg State University, USA; email: nmani@fitchburgstate.edu
[3] Associate Professor, Central Connecticut State University, USA, e-mail: leen@ccsu.edu
[4] Assistant Professor, East Tennessee State University, USA; email: shresthak@etsu.edu
[5] Assistant Professor, Montana Tech of University of Montana, USA; email: kshrestha@mtech.edu
[6] Operation Manager, GreenTech Pvt. Ltd, Nepal; email: rujan.kayastha@gmail.com

Abstract: After the earthquake on April 25, 2015, in Midwestern Nepal, thousands of residential and commercial buildings were damaged. Subsequently, building owners started repairing and reconstructing their damaged buildings. Most of the reconstructed buildings in the cities are reinforced concrete frame structure, but such traditional construction technique is time-consuming and can be costly. Thus, owners and construction companies adapted modular construction as a suitable alternative. While there are benefits of the modular construction, there are challenges that could hinder the wider adaptation of the technique. This study identified and ranked the opportunities and challenges associated with the modular construction technique in developing countries like Nepal. The opportunities and challenges were first identified based on literature review, and a questionnaire survey was developed to rank them based on the perspectives from contractors, architectures, engineers, and manufacturers/distributors that have direct or indirect experience and/or knowledge about modular construction in Nepal. Forty-two validated response were analyzed for this study. The top opportunities identified from this study include a reduction in the construction time; improved productivity; and reduced rework. The top challenges include the competition with the traditional construction techniques; the lack of information about modular construction in the society; and the lack of skilled workers. The findings are expected to aid the modular construction stakeholders in better understanding the opportunities and challenges that they can investigate. Such investigation can further lead to the identification of the solutions to the challenges and hence wider adaptation for the modular construction in developing countries like Nepal where the concept of modular construction is still new.

1. INTRODUCTION

The assembling of ready-cut building components during the construction process has been adopted since the 17th century (Musa et al. 2016). The Aladdin, a Michigan based company, started selling the earliest house kits in 1906. According to Sears archive, Roebuck and Co., the best seller of early kit-home, sold more than 75.000 homes between 1908 and 1940. General Houses Inc. and American Houses also have a significant contribution to the development of American prefabricated house since its establishment in 1932 (Davies 2005). Following the brilliant ideas of Foster Gunnison, American Houses relaunched prefabricated home product “Motohome” in 1935 (Davies 2005). In 1938, Gunnison Housing Corporation was established and started to build prefabricated homes on a large scale. The construction of kit-home and the prefabricated house became a foundation for the development of modular construction.

Since the development of the concept of modular construction in the 1940s during the World War II for soldier's accommodation (Musa et al. 2016), the technique has been widely adopted in the construction of residential and commercial buildings in the developed countries after World War II because of high demand of housing. Musa et al. (2016) defined modular construction as a method of building construction using three-dimensional modular units by assembling and producing in a factory with proper coordination, planning, and integration. With the invention of the offsite fabrication approach, this technique was further adopted by developed and developing countries and is regarded as a modern construction technique (Aziz & Abdullah 2015). Modular construction is an emerging technology that uses light steel framing in factory-produced units that can be assembled on-site to form parts of, or even complete, residential and commercial buildings (Gorgolewski et al. 2001). Morton (2011) mentions that modular construction uses prefabricated elements for as many building components as possible such as everything from walls and mechanical systems to painting and carpet can be completed on the assembly line. The prefabricated elements are assembled on-site to either construct parts of or entire residential and commercial buildings. In contrast, the traditional concrete construction with brick walls in Nepal takes a considerable amount of construction time and space as it requires a stockpile of raw materials on site and most of the works are performed on site.

Several advantages of prefabricated construction includes rapid installation on site, reduced overall construction costs, low self-weight leading to the structural saving, reduced disruption in the vicinity of the construction site, and better quality control (Gibb & Isack, 2003; Goodier & Gibb, 2007; Gorgolewski et al. 2001; Hsieh, 1997; Pasquire et al., 2005). The benefits and applicability of modular construction have been demonstrated in various projects such as the construction of a prefabricated 30-story building in two weeks and a 15-story building in one week (Laylin 2012, Wang 2010). Because of the benefits of the modular construction techniques – specifically the rapid construction and reduced cost – it has gained popularity in Nepal after the earthquake in April and May of 2015. The earthquakes damaged a significant number of buildings in several towns of Nepal and people were desperate to build new residential buildings as soon as possible. The increased demand for modular buildings in Nepal presented an increased opportunity for modular home builders and prefabrication companies. However, construction professionals and prefabrication business owners are also facing several challenges in the Nepalese construction industry that could limit the use of modular construction. Thus, to aid the modular construction industry and obtain the maximum benefits of the modular construction technique, it is essential to understand the opportunities challenges that the modular construction industry is facing in Nepal. Thus, this study explores the opportunities and challenges of modular construction in Nepal that can benefit the manufacturing industries, distributors, architects, and engineers.

2. LITERATURE REVIEW

The benefits of prefabrication can be categorized broadly into three dimensions of sustainability: a) economic, environmental, and social (Bhattacharjee et al. 2016). The economic aspect includes various benefits such as reduced construction cost, the social dimension includes benefits such as reduced labor hours of construction and labor productivity gain, and the environmental benefits include benefits such as reduced rework by reducing material waste. Jaillon and Poon (2008) conclude these benefits of modular construction techniques compared to the conventional construction methods are substantial. Further, the modular construction technique results in reduced waste in the construction site (Tam et al. 2007).

The modular construction technique could be a better choice depending upon the building form factor, site location, and the client and planning requirements (Gorgolewski et al. 2001). Some scenarios when it would be preferred over the traditional construction techniques include (Bhattacharjee et al. 2016, Gorgolewski et al. 2001, Jaillon et al. 2009, Pan et al. 2007):

- Regular or cellular building shapes with a high degree of repetition where the economy of scale in design and manufacturing can be achieved,

- Construction in congested cities,
- Construction sites where noise and other pollution need to be minimized during the construction,
- Extensions to existing buildings, and
- Construction projects where some degree of relocation or extension is envisioned in the future.

A review of the literature shows that modular construction has many barriers and challenges. For example, Rahman (2014) groups the barriers into eight major categories: cost, skills and experience, motivation and culture, tools and standards, a market of a modern method of construction, industry, interface, and flexibility, and projects. Further, modular construction project:

- Requires high startup costs (Chiang et al. 2006, Jaillon and Poon 2010, Pan et al. 2011);
- Requires highly skilled labor (Jaillon and Poon 2010, Pan et al. 2011);
- Lacks design standardization (Nadim and Goulding 2011, Pan et al. 2011);
- Owns smaller market demands (Pan et al. 2011);
- Requires effective communication between parties involved (Wong 2000, Salama et al. 2018);
- Lacks experienced contractors in applying modularization concepts (Salama et al. 2018);
- Requires early design and production of parts and modules (Wong 2000); and
- possesses high transportation cost to transport larger modules to the site (Jaillon and Poon 2010, Pan et al. 2011)

There is a gap in the literature of what are the opportunities and challenges of modular construction in a developing country. This paper explores and adds some information to fill the gap. The study also contributes to the body of knowledge in construction engineering and management by providing information that can further lead to the identification of the solutions to the challenges and hence wider adaptation for the modular construction in developing countries like Nepal where the concept of modular construction is still new.

3. METHODOLOGY

Although modular construction technology has been around for decades, the technology is relatively new in the Nepalese construction industry. This study conducted an extensive literature review followed by a questionnaire survey. The literature review focused on identifying a list of opportunities and challenges of the current modular construction techniques. The findings were used in developing the survey questionnaire. Subsequently, the experts representing manufacturers, contractors, and the modular construction industry were surveyed and interviewed to understand the perceived importance rank of each of the opportunities and challenges identified from the literature review.

3.1 Questionnaire Design

The questionnaire used for the survey and the interview consisted of multiple choice questions to collect answers based on the respondent's knowledge and experience. The questionnaire was divided into two sections. In the first section, the respondents were asked to rank the opportunities of modular construction in the Nepalese construction industry; in the second section, they were asked to rate the challenges. They were asked to respond on the 5-point Likert scale: 1 (strongly disagree) and 5 (strongly agree.) The 5-point Likert scale type question is well recognized as the most appropriate instrument for obtaining information about respondents' perceptions (Baker 2003, Sekeran 2000).

3.2 Survey and Interview Sampling

Most of the manufacturing companies, distributors, consultants, and contractors are headquartered in Kathmandu Valley (about 220 square miles) of Nepal. Eighty-five companies/personnel were identified as potential targets for the survey. The stakeholders were contacted, and the questionnaire survey and interviews were conducted by setting up a meeting and visiting their headquarters. This method of survey and interview was preferred because of the easy access to the respondents (because of the geographically concentrated distribution of the stakeholders) and high probability of a low response rate of internet-based surveys in Nepal.

Out of 85, researchers obtained completed responses from 42 stakeholders which were further analyzed for this study. The responses consist of 12 (29%) responses from contractors, 10 (24%) from architectures, 14 (33%) from engineers, and 6 (14%) from manufacturers/distributors who are involved directly or indirectly in the modular construction in Nepal. Some of the respondents were focused in traditional construction at the time of survey and interview but had knowledge about modular construction technique to provide opportunities and challenges of the technique compared to the traditional techniques that they are focused on.

4. ANALYSIS AND DISCUSSION

The respondents were asked to rate the challenges and opportunities on a scale of 1 to 5, a weight of 1 for ‘‘strongly disagree”, 2 for ‘‘disagree”, 3 for ‘‘neutral”, 4 for ‘‘agree,” and 5 for ‘‘strongly agree”. The frequencies for each challenge of modular construction received from overall respondents are listed in Table 1. These scores were then transformed to relative importance index (RII) based on the formula as shown in Eq.1 (Kometa et al., 1994, Tam et al., 2000) to determine the relative ranking of the factors.

[1] Relative importance index = $\frac{\sum W}{AN}$

Where W is the weight given to each factor by the respondent, ranging from 1 to 5 scale, A is the highest weight (i.e., 5 in the study) and N is the total number of samples. The RII ranges from 0 to 1, closer to 1 being the significant (Tam et al., 2000). For each opportunities and challenges, the RII value is calculated. For example, 0 respondents strongly disagreed the reduction in construction time resulting from fewer labor hours of construction as an opportunity for the modular construction in Nepal, 0 disagreed, 9 were “neutral”, 16 agreed, and 17 strongly agreed. Therefore, the RII for the factor is = (0x1+0x2+9x3+16x4+17x5) / (5x42) = 0.838. Subsequently, based on their RII values, the opportunities were ranked from 1 to 11, 1 being the top. The rank function in excel spreadsheet is used to rank each opportunities in order.

Table 1 shows the opportunities for modular construction in Nepal. RII was calculated for all the opportunities based on overall responses and then ranked from 1 to 11, 1 being the top. The results of this analysis show that the reduction in construction time is the top-rated opportunity (RII = 0.838) while improved productivity was ranked second (RII = 0.829). Similarly, the third most important factor was the reduction in rework (RII=0.824), fourth was the creation of more standardized and environmentally sustainable products (RII=0.786), and fifth was the cost saving because of the reduced scaffolding requirement (RII = 0.686). The three dimensions of sustainability stated in Bhattacharjee et al. 2016, were reflected in the top opportunities in the modular construction in Nepal. The reduced cost and time are associated with economic sustainability. The reduced time and increased productivity can lead to the reduced exposure of the workers with possible occupational hazards that is related to the social aspects of sustainability. Finally, reduced rework and hence reduced waste is related to environmental sustainability.

The analysis shows that the top challenges of the modular construction in Nepal, presented in Table 2, are: a) competition with conventional construction (RII = 0.805), b) less information integration of modular construction to the society (RII = 0.795), c) lack of qualified workers (RII = 0.790), and d) less suitability for small construction projects because of design and cost (RII = 0.776) (Table 2). While some of those factors may not have a direct and easy solution (such as the competition with the traditional construction), other challenges can be overcome by taking some steps to improve the situation. For example, the companies and the government of Nepal can provide organize training sessions to the interested construction workers, initiate more collaboration between modular stakeholders and outside organizations, disclosing cost and schedule savings studies and optimization due to modular construction.

Table 1: Modular construction opportunities in Nepalese construction industry

Opportunities in Modular Construction	Frequency					Overall	
	1	2	3	4	5	RII	Rank
Reduces construction time (fewer labor hours of construction)	0	0	9	16	17	0.838	1
Labor productivity gain in short time	0	0	8	20	14	0.829	2
Reduces rework since they are designed and planned early	0	2	3	25	12	0.824	3
Creates more standardized and sustainable products to environment	0	5	9	12	16	0.786	4
Popular when conventional construction is not possible due to time or location	0	5	9	20	8	0.748	5
Reduces construction cost through minimizing wastage	0	0	22	11	9	0.738	6
High potential of market share	2	5	3	28	4	0.729	7
Minimizes material wastes due to accurate precut studs and prefabricated panels	0	0	20	18	4	0.724	8
Reduces chance of accidents related to occupational hazards (since there are less labors present on the jobsite)	0	7	10	21	4	0.705	9/10
Creates safe work environment for workers since they are trained	0	12	7	12	11	0.705	9/10
Less scaffolding cost by utilizing crane and equipment efficiently	2	6	14	12	8	0.686	11

Table 2: Modular construction challenges in Nepalese construction industry

Challenges in Modular Construction	Overall Frequency					Overall	
	1	2	3	4	5	RII	Rank
Competition with conventional construction	0	1	12	14	15	0.805	1
Less information integration of modular construction to the society	1	1	6	24	10	0.795	2
Lack of qualified workers (experience and skills)	0	1	8	25	8	0.790	3
Less suitability for small projects because of design and cost	1	3	10	14	14	0.776	4/5
Limited market demand compared to conventional construction	0	0	18	11	13	0.776	4/5
Higher transportation cost (distance from factory to site)	0	4	12	12	14	0.771	6
Market protection from traditional suppliers	0	3	16	8	15	0.767	7
Fewer codes/standards available compared to conventional construction	3	0	6	26	7	0.762	8
Poor integration and interface performance with traditional method	0	0	16	19	7	0.757	9
Inadequate coordination: design, engineering, procurement, supply chain, site management	0	5	10	19	8	0.743	10
Limited capacity of existing manufacturers	1	4	5	29	3	0.738	11
Difficulty in obtaining finance, because of higher initial cost	0	3	14	21	4	0.724	12/13
Less flexibility when there is changes in design as compared to conventional construction	0	2	20	12	8	0.724	12/13
Lack of quality assessment tools and accreditation	4	6	3	19	10	0.719	14
Higher initial cost compared to conventional construction	0	9	7	20	6	0.710	15
Time consumed in designing, planning, and fabricating	1	11	6	17	7	0.686	16
Unavailability of equipment for installation	0	5	24	4	9	0.681	17
Clients skepticism/suspicious about performance	0	5	9	20	5	0.676	18
Site-specific constraints and logistics, e.g., access limitations	3	4	21	5	9	0.662	19
Less customizable and compatible with renovation/addition	1	15	14	9	3	0.590	20

To better serve the understanding of challenges from different stakeholders' perspectives, the RII and rank analysis was performed. Table 3 shows the rank of all the challenges of modular construction in Nepal based on responses from manufacturers/distributors, contractors, architects, and engineers. The tied ranks are given the same ranking. The total respondents show "problems raised as being in competition with conventional construction" as a top challenge (refer to Table 2), which reflects in contractor's response. However, manufacturers/distributors think "market protection from traditional suppliers" as a top challenge, architects think "less suitable for small projects because of design and cost," and engineers think "Less information integration of modular construction to the society" as a top challenge. Likewise, manufacturers/distributors ranked "unavailability of equipment for installation" and "clients skepticism/suspicious about performance" as second and third most challenges, whereas contractor ranked "limited market demand compared to conventional construction" and "Inadequate coordination: design, engineering, procurement, supply chain, site management", architects ranked "lack of quality assessment tools and accreditation" and "difficulty in obtaining finance, due to high initial cost", and engineers ranked "fewer codes/standards available compared to conventional construction" and "Lack of qualified workers (experience and skills)" as the top second and third challenges respectively.

Table 3, thus, provides information about the different perspective of looking at challenges of modular construction in Nepal as being part of project stakeholders. This perspective also serves as a guide to address problems related to their business so that overall difficulties could be minimized.

Table 3: Ranking of modular construction challenges by stakeholders

Challenges in Modular Construction	Distributer Rank	Contractor Rank	Architect Rank	Engineer Rank
Less flexibility when there is changes in design as compared to conventional construction	9	11	14	10
Higher initial (capital) cost compared to conventional construction	12	13	11	8
Less suitability for small projects (design and cost)	16	8	1	6
Higher transportation cost	10	9	8	4
Lack of qualified workers (experience and skills)	7	4	16	3
Limited capacity of existing manufacturers	16	13	5	5
Poor integration and interface performance with traditional method	5	12	4	10
Time consuming in designing, planning, and fabricating	20	13	6	12
Site-specific constraints and logistics, e.g., access limitations and space for large loads	15	18	11	16
Fewer codes/standards available compared to conventional construction	7	19	6	2
Less customizable and compatible with renovation and addition	12	13	19	20
Unavailability of equipment for installation	2	19	16	16
Clients skepticism/suspicious about performance	3	10	20	13
Market protection from traditional suppliers	1	6	11	15
Less information integration of modular construction to the society	12	7	10	1
Lack of quality assessment tools and accreditation	16	4	2	19
Difficulty in obtaining finance due to high initial cost	11	17	3	13
Inadequate coordination: design, engineering, procurement, supply chain, site management	16	3	14	8
Limited market demand compared to conventional construction	3	2	8	16
Competition with conventional construction	5	1	16	6

Similarly, to better serve the understanding of opportunities from different stakeholder's perspective, the RII and rank analysis was performed. Table 4 shows the rank of all the opportunities of modular construction in Nepal based on responses from manufacturers/distributors, contractors, architects, and engineers. Table 4 shows that many of the stakeholders had similar thoughts on the opportunities. For example, their priority of looking at the top opportunities is that modular construction reduces construction time, improves labor productivity in a short time, and creates more standardized and sustainable products to the environment.

Table 4: Ranking of modular construction opportunities by stakeholders

Opportunities in Modular Construction	Distributer Rank	Contractor Rank	Architect Rank	Engineer Rank
Reduces construction cost through minimizing wastage	9	6	9	5
Minimizes material wastes due to accurate precut studs and prefabricated panels	8	10	4	8
Reduces rework since they are designed and planned early	7	4	1	1
Labor productivity gain in short time	4	3	1	3
Reduces construction time (less labor hours of construction)	1	1	7	2
Popular when conventional construction is not possible due to time or location	1	8	8	6
Reduces chance of accidents related to occupational hazards (since there are less labors present on the jobsite)	11	11	4	7
Creates safe work environment for workers since they are trained	10	6	11	3
Less scaffolding cost by utilizing crane and equipment efficiently	4	8	10	11
High potential of market share	6	5	4	9
Creates more standardized and sustainable products to environment	1	1	1	9

5. CONCLUSIONS

The conventional construction techniques in Nepal such as reinforced concrete frame structure with brick walls takes significantly more time and extra construction space compared to the modular construction technique. Despite the benefits of the modular construction techniques, most people in Nepal reconstructed their houses using traditional methods such as reinforced concrete frame structure with brick walls. Wider adoption of modular construction is challenging in Nepalese construction industry despite their well-documented benefits. This study investigated and identified the top five significant opportunities and challenges in the modular construction market in Nepal. The top five opportunities are: a) reduction in construction time, b) increased labor productivity, c) reduction in rework, d) development of more standardized and environmentally sustainable products and e) better suitability for projects with time and space constraints. The top five challenges identified are: a) competition with conventional construction techniques b) less information integration of modular construction to the society, c) lack of qualified workers, d) less suitability for small projects because of design and cost, and e) limited market demand compared to conventional construction. These findings are expected to aid prefabrication and modular construction companies in understanding and to solve the challenges and to improve the business performances. These findings could eventually lead to growth in the modular construction market in Nepal. Further, the results will help people in developing countries to familiarize the modular construction technique.

Acknowledgements

The authors would like to acknowledge the assistance from the International Green Developers Pvt. Ltd and Valley Plus Pvt. Ltd. The authors would like to express special gratitude to the contractors, architects, and engineers for providing valuable inputs to this research via the questionnaire survey.

References

Aziz, S. and Abdullah, M. R. 2015. Modular construction system in Malaysia: Issues for research in sustaining an affordable home project. *Proceedings of Postgraduate Conference on Global Green Issues (Go Green)*, Malaysia.

Baker, M. J. 2003. Data Collection - Questionnaire Design. *The Marketing Review*, **3**(5): 343-370.

Bhattacharjee, S., Pishdad-Bozorgi, P., and Ganapathy, R. 2016. Adoption of Pre-Fabrication in Construciton to Achieve Sustainability Goals: An Empirical Study, *Construction Research Congress* ASCE, Reston, VA, 1050-1060

Chiang, Y. H., Chan, E. H. W., and Lok, L. K. L. 2006. Prefabrication and barriers to entry—A case study of public housing and institutional buildings in Hong Kong. *Habitat International*, **30**(3): 482–499.

Davies, C. 2005. *The Prefabricated Home*. Reaktion Books Ltd, London, UK

Gibb, A., & Isack, F. (2003). Re-engineering through pre-assembly: client expectations and drivers. *Building Research & Information*, **31**(2): 146-160

Goodier, C. and Gibb, A. 2007. Future opportunities for offsite in the UK. *Construction Management and Economics*, **25**(6): 585-595

Gorgolewski, M.T., Grubb, P.J. and Lawson, R.M., 2001. Modular Construction Using Light Steel Framing: Design of Residential Buildings. *Steel Construction Institute*. Silwood Park, Ascot, UK

Hsieh, T.-Y. (1997). The economic implications of subcontracting practice on building prefabrication. *Automation in construction*, **6**(3): 163-174.

Jaillon, L., and Poon, C. S. 2008. Sustainable construction aspects of using prefabrication in dense urban environment: A Hong Kong case study. *Construction Management and Economics,* **26**(9): 953–966.

Jaillon, L., Poon, C. S., and Chiang, Y. H. 2009. Quantifying the waste reduction potential of using prefabrication in building construction in Hong Kong. *Waste Management*, **29**(1): 309–320

Kometa, S.T., Olomolaiye, P.O. and Harris, F.C. 1994. Attribute of UK construction clients influencing project consultants' performance. *Construction Management and Economics,* **12**(5): 433–443

Morton. J. 2011. Modular Construction: Alternative Building in a Tough Economy, Buildings. https://www.buildings.com/article-details/articleid/13275/title/-modular-construction-alternative-building-in-a-tough-economy (accessed: 2/16/2019)

Musa, M. F., Yusof, M. R., Mohammad M. F., and Samsudin, N.S. 2016. Towards the adoption of modular construction and prefabrication in the construction environment: A case study in Malaysia. *Journal of Engineering and Applied Sciences*, **11**(13): 8122-8131.

Nadim, W. and Goulding, J. S. 2011. Offsite production: A model for building down barriers—A European construction industry perspective. *Engineering Construction and Architectural Management*, **18**(1): 82–101

Pan, W., Gibb, A. G. F., and Dainty, A. R. J. 2007. Perspectives of U.K. house builders on the use of offsite modern methods of construction. *Construction Management and Economics*, **25**(2): 183–194

Pan, Y., Wong, F. K. W., and Hui, E. C. M. 2011. Application of industrialized housing system in China: A Chongqing study. Modeling risk management in sustainable construction, computational risk management, D. D. Wu, ed., Springer-Verlag, Berlin, 161–168

Pasquire, C., Gibb, A. and Blismas, N., 2005. What Should You Really Measure If You Want to Compare Pre-fabrication with Traditional Construction? *13th International Group for Lean Construction Conference*: Proceedings (p. 481). International Group on Lean Construction.

Rahman, M.M., 2014. "Barriers of Implementing Modern Methods of construction." *Journal of Management in Engineering,* **30**(1): 69–77

Salama, T., Moselhi, Osama., and Alhussein, M. 2018. Modular Industry Characteristics and Barrier to its Increased Market Share. *Modular and Offsite Construction (MOC) Summit @ World of Modular: 22-25*

Sekeran, U. 2000. Research Methods for Business: A Skill Building Approach. 3rd ed. John Wiley and Sons, Inc., USA.

Tam, C. M., Deng, Z. M., Zeng, S. X., & Ho, C. S. 2000. Quest for continuous quality improvement for public housing construction in Hong Kong. *Construction Management and Economics*, **18**(4): 437-446

Tam, V.W. Y., Tam, C. M., Zeng, S. X., and Ng,W. C. Y. 2007. Towards adoption of prefabrication in construction. *Building Environment*, **42**(10): 3642–3654.

Wong, W. M. (2000). Prefabricated construction in Hong Kong. Constr. Contract News, 3.