

The Essential Characteristics of Open Building System (OBS)

Zuhairi Abd. Hamid¹, Kamarul Anuar Mohamad Kamar¹, Mohd Khairolden Ghani¹, and Ahmad Hazim Abdul Rahim¹,

¹ Construction Research Institute of Malaysia (CREAM), Kuala Lumpur

1.0 Introduction

The government of Malaysia has agreed to expand the method of Industrialised Building System (IBS) in construction sector and endorsed the content of IBS Roadmap 2003-2010 to guide the mission. One of the main objectives is to introduce Open Building System (OBS) concept by the year 2010. The introduction of OBS will not only re-engineer our construction process (supply-chain, trades, design, etc.) but will transform the way of doing business in construction. Despite all the attention, OBS concept is still under-charted territory in Malaysia. Thus, this paper discusses the essential characteristics of OBS and provides recommendations to expedite the development of OBS concept in Malaysia.

2.0 Definitions

Open Building — Open Building (OB) is an innovative approach to design and construction that enhances the efficiency of the building process, while increasing the variety, flexibility and quality of the product. In the OB perspective, the building is viewed as a well-organized combination of systems and sub-systems, each of which can be carefully coordinated to ensure a better process and product for the homeowner and a parallel positive outcome for the building professionals (Bensonwood, 2003). OBS has been known as a building concept characterized by an explicit customer focus, modular pre-engineered product system, and a sequential process structure (Vrijhoef, 2002). OBS advocates a concept of modularity, which includes the separation of different levels of decision-making, and the decoupling of building parts within a modular system (Vrijhoef, 2002). According to Dekker (1998) the basic idea of Open Building is a principle of organizing the building process along independent levels of decision making, corresponding to the structure of technical subsystems in order to create maximal flexibility and variety of the object, while keeping the process systematically organized. OBS is also based on the principal of using several different subsystems to reach a high flexible total structure responding to user needs. (Kendall, 1999) (Cited at Vriethoff, 2007). Easkhout (2007) defined OBS as a creation of sub-system in building construction where interference with other system is minimized. OBS also defined as a system which is designed components or sub-systems that are interchangeable with other building elements (Answer.com). "Open Building" is a strategy to design, construct and operate the built environment the user can relate to and is willing to maintain and defend. Therefore the built environment needs to reflect the way it is controlled. In order to

prevent serious misfits it needs to be adaptable to changing needs (Lean construction, 2007). OBS is the idea of distinct Levels of intervention in the built environment, such as those represented by 'support' or 'base building, and 'infill' or 'fit-out', or by urban design and architecture. It also defined as the idea that users / inhabitants may make design decisions as well as professionals (CIB reports, 2004)

3.0 Modularity

In Open Building, the building is seen as a potentially well organized combination of available systems and subsystems and the basic aspect of Open Building is the modularity of the building system into subsystems and parts. Modularity has been defined as 'a particular pattern of relationships between elements in a set of parameters, tasks or operators/people, a nested hierarchical structure of interrelationships among the primary elements of the set' (Baldwin and Clark 2000).

4.0 OBS vs. Closed System

A closed system can be classified into two categories, namely production based on client's design and production based on precaster's design. The first category is designed to meet a spatial requirement of the client's, that is the spaces required for various functions in the building as well as the specific architectural design. In this instance, the client's needs are paramount and the precaster is always forced to produce a specific component for a building. On the other hand, the production based on precaster's design includes designing and producing a uniform type of building or a group of building variants, which can be produced with a common assortments of component. Nevertheless these types of building arrangement can be justified economically only when the architectural design observes large repetitive element and standardisation. In respect to this, a novel prefabrication system can overcome the requirement of many standardised elements by automating the design and production process and sufficient demand for a typical type of building such as school so that a mass production can be obtained. The beauty of the system is to allow openness in its structure supplier where everybody can bid to produce lower price. In addition, the precaster and erectors will look for cooperation models that will create benefit for both. OBS also provide a high degree of design flexibility but required a maximum coordination between the designer and precaster (Thanoon, 2003). OBS also allows the precaster to produce a limited number of elements with pre-determined range of product and at the same time maintaining architectural aesthetic value. Moreover, OBS is permitting hybrid application and adaptable to standardization and Modular Coordination (IBS, 2003).

5.0 Efficiency in OBS

OBS offers real time control of construction process, reduction in term of time efficiency and potential cost reduction or cost efficiency (Herves, 2007). Open building manufacturing is an attempt to bring some of the salient features of efficient

manufacturing to the construction sector. This should allow for significant savings in construction and maintenance costs, fewer errors and rework, more choices and value to the customer, new products and services that can be configured and assembled in mobile factories at construction sites (Kazi *et. al*, 2007).

6.0 Integration in OBS

The major systems include the building site, the structural envelope, the division of space inside the building, the plumbing, wiring, heating/cooling, and the cabinets, furniture and other stuff that people put inside the building. By disentangling the systems and sub-systems from each other, opportunities are increased for better organization, increased consistency, quality and more control and flexibility for the homeowner (Bensonwood, 2003). The key aspect of open building system is dimensional coordination to allow flexibility in form of construction, and the capacity to deal with differences in dimension and tolerance (Thomson, 2007). In order to obtain an optimal result, a high degree of coordination must exist between various relevant parties such as designer, manufacturer, owner, and contractor. This is achieved through an integrated system in which all these functions are performed under a unified authority (Warszawski, 1999) (Cited in Thanoon, 2003). Therefore the subdivision of the building process needs to reflect the lines of decision making and the definition of responsibilities between the parties. This subdivision can then be translated into specifications for connections between building parts. (Cuperus, 1996) (cited at Cuperus, 2007)

One of the most important aspects of any organization is its communication structure. Good communication among a team of architects and builders who have clearly defined roles is a rarity in the building industry today. The person who designs a building often never meets the electrician or plumber with the result that each piece of a home is built without considering the whole picture. In the building industry good communication has remained difficult to achieve because of the fractured nature of both the industry and any given project. Information technology can take a significant part of development by providing a better communication channel.

7.0 Barriers on OBS

Other manufacturing sectors such as aerospace and automotive sectors in comparison primarily rely on standardised components that can be configured and assembled to provide a specific product or service. Nevertheless, in construction industry the implementation faced shortcomings due to its characterization as a craft-based producing

one of a kind products and services (Kazi *et. al*, 2007). Some important barriers for as industry wide exploration and take up of OBS, which are the following:

1. Sector specific: a very diverse group of stakeholders; which can have very different objectives and requirement; disagreement between stakeholders. (Hervas, 2007)
2. Radical change is needed; traditional sector like construction is reluctant or even resistant to change due to attitude, strong regulation and lack of support for innovation (Hervas, 2007)
3. Lack of successful global recognize project, using material and product on available widely on open market (Hervas, 2007)
4. Not guaranteed the aesthetics demanded by the end users. (Hervas, 2007)
5. Its adoption experience one major setback, joint and connection problem. It occur when two element from different system are fixed together. The standardization of joint and connection detail is needed. (Thanoon, 2003)
6. The adaptation required an extensive transfer of knowledge, skills and technology in order to reorient change in business process (Alshawi *et. al*, 2007)
7. The market situation where some markets seem ready for OBMS but whilst other none.
8. The existing structure and legal regulation of construction industry
9. Market monopolize by big manufacturing company of close system.

8.0 Recommendations

Steps proposed for the successful introduction of OBS:

1. It is important to promote the development of a philosophy that meets the expectation of the sectors. An important way to get to know and understand that expectation of the sector is to involve stakeholders (architect, construction companies, developers and public administrators) from the beginning, gathering and analyzing the requirement (Hervas, 2007).
2. Open Building System needs Life Cycle methods in order to state the requirement and consider user needs, to be able to design for required performance and life cycle, and to be able to make decisions between alternative option, for instant, Life Cycle Assessment and Life Cycle Costing (Hakkinen *et. al*, 2007).
3. An improved understanding of end-users and their needs, flexibility and multifunctional requirement through consideration of activity spaces and integration is also the key for OBS (Thomson, 2007). Parametric components to create individuality rather than component designs defining what is possible
4. Increase customer-orientation, survey and investigation to catch customer needs and priorities; or marketing orientation (Martinez, 2007)
5. Logistics; manufactures and site shall adopt just in time technique, optimization of handling devise and tools and automation method to achieve cost reduction

6. ICT tools; development of software tools in order to help users for the selection of adequate option, for instance, a dynamic catalogue (Hervas, 2007)
7. Standardisation can be a good tool to speed up the implementation of the principle of open building in the building market in order to assure the reliability of the element, component and modules manufactured e.g. ISO and EUROCODES.
8. Malaysian standard joints for IBS (wet or dry) must be designed and made available for use by the industry (Hamid, 2007)
9. Open Building System must be competitive in terms of cost, performance and quality as compared to Proprietary system and conventional methods in order to be sustainable in the construction market (Hamid, 2007)
10. A complete comprehensive study on IBS solutions encompassing the entire value chain will ensure its success. These shall include verification, validation and certification of process on IBS components, fabricator, factory, erector and related skills of specialization (Hamid, 2007)
11. Soft issues related to IBS such as marketing, social impact, involvement of Bumiputera contractors in vendor development program as highlighted in the roadmap should be taken on board right at the early stage (Hamid, 2007)
12. Considerable investment for training, education and technology transfer (Alshawi et. al, 2007). The training must equip the professionals with timely and relevant skills.
13. OBSM has to harmonize its approach, model and tools with the legal regulation and standard.
14. To harmonize OBS with Lean Production. Lean Production strives towards zero inventory and just-in-time logistics (Womack et al. 1990).

9.0 Conclusions

Malaysian construction need to strengthen its foundation. First, the industry through government bodies like CIDB and SIRIM needs to develop Malaysian Standard Joint for IBS components. It is significant because of two prefabricated parts only fit on the building site if their dimensions and connections are well coordinated. Current developed joint are used in closed system protected by patent. They are specifically design to fit the pre-caster prefabricated component and it is not supporting holistic concept of openness in OBS. At present, CIDB through their research arm, Construction Research Institute of Malaysia (CREAM) has been collaborated with JKR to develop the standard joint that look into the strength, stiffness, ductility and stability of the connection. The Malaysian Standard Joints will be unveiled by the end of 2007.

On the other hand, OBS can be success by introducing client-orientation approach. It can be materialized by targeting and penetrating the upper market and high-end urban development. The customers at this level are keen on the aesthetical products and practical design space of the building and OBS provide variety of available finishes and design concepts. Marketing OBS concept to this target group will give a huge and

profitable market since the supplier will only be motivated to invest in new products and innovation solution if they can foresee enough sales.

Based on IBS Roadmap, the year 2009 is the most challenging period of OBS. In this year alone, CIDB will published OBS Roadmap, introduce OBS Steering Committee, to conduct OBS international seminar, publish OBS catalogue and to use OBS as a main criteria to judge the contender for Malaysian Construction Industry Excellent Award (MCIEA) (CIDB, 2003). IBS Roadmap also keen to produce more bumiputra contractor to be as a manufacture or erector in the near future Let's hope that OBS will not only improve performance and quality in construction, minimize the dependency of unskilled foreign labours but also giving the values to customers by providing aesthetical, practical option and flexibility to construction products