Technical Report

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Abstract

The Construction Industry in Malaysia has had a very chequered history in terms of innovation and adoption of new technologies. Reliance has been placed instead on low skilled foreign workers to device the industry with catosprophic effects on productivity and a huge underutilized resource during economic down turns. The need to modernize using industrial building systems concepts is critical if the industry is to move forward. This paper sets out the options available to make such development a reality drawing on worldwide experience.

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EXECUTIVE SUMMARY

The construction industry is one of the key drivers of the economy, more so during an economic downturn. However the industry is more commonly known for its low productivity, questionable quality and delayed delivery. This problem has been further worsened by foreign labour repatriation in recent times. With the current state of on site working conditions and the poor image of the industry, Malaysians are persistently shunning away from the industry making recruitment difficult. This problem is not peculiar to Malaysia but also in the developed economies. The need for change is therefore urgent and well recognised. The Eighth Malaysia Plan envisages an allocation of 312,000 units of houses for the public sector and 303,000 units of houses for the private sector[1]. This planned building programme could be mobilised as the biggest opportunity to modernise the industry through technology innovation and industrialisation of the housing delivery process.

The Industrialised Building System (IBS) concept is essentially the injection of a techno-based mind-set into the construction industry 'hardware' aspects and incorporation of the highly successful manufacturing concepts as the driving 'software'. The factory based production is the only sure way to gain high productivity, assured quality of products, essential safety standards and timely delivery of the finished product. The experience of the developed countries confirms that IBS has attracted a more talented workforce. At present there are pockets and elements in the industry that could become the basic ingredients for the industrialisation process through the IBS concept. With over fourty years of laissez faire implementation in Malaysia, IBS has not become widely accepted or used. Experiences in countries like Singapore, Denmark, Norway etc. indicates a strong Government intervention is needed for change in the construction industry and a successful implementation of IBS.

The greatest boon for implementing IBS would be two-folds. Firstly, the establishment of a building component vendor programme along the lines of the national car industry.

The displaced Bumiputra entrepreneurs and workers resulting from the new technology adoption can be easily trained and absorbed into the manufacturing of standardised and modularised components (structural and non-structural elements) like the columns, beams, lintols, door frames and windows etc. The second dimension to the development is the enhancement of existing or new entities along the lines of Proton's development in terms of technological, management, financial capacity building suitable for exporting the housing delivery industry.

MIGHT will use its neutral capacity as part of the Prime Minister's office to identify projects on a national scale across individual ministries which can be year marked for the use of this new technology. MIGHT should be promised delivery of a substantial building/housing stock over a 5 year period. An entity to manage this housing stock should be identified with a clear and finite goal to change the construction delivery process to one dominated by manufactured components within a five year period. With CIDB support using JKR's technical input and designs, the new vendors will then feed into a guaranteed programme of works. These will ensure that the investment required by the vendors will be realised over a 2-3 year window so that the viability of the business model is assured. The success of this programme will provide the impetus and example for a migration of the traditional in situ based industry to one where the supply of components will form the basis of construction delivery. Such a development in time, will also encourage the migration of small manufacturers to larger and more sophisticated facilities and to full system build approaches. With such an overall impetus the possibility of creating a new dimension to the construction industry has never been better. The target would be to have all Government building starts (for teachers, for the armed forces, for schools) to be completely modular and constructed with 70% assembled components by the year 2008.

1. PREAMBLE

This document is prepared by MIGHT at the behest of the YAB Prime Minister of Malaysia during the Special Briefing to the Patron (closed-door session) on 24th December, 2002. During the given 3-month period, inputs were gathered and analysed from various key stakeholders in the construction and housing industry including the professionals, industry associations, IBS contractors and academia.

2. OBJECTIVES

The main objective of this report is to further promote the industrialisation of the construction and housing industry through the Industrialised Building System (IBS) concept. The successful implementation of the IBS based on the recommended framework will achieve the objectives of increasing quality, participation of Bumiputra contractors and SMIs in the construction and housing industry.

3. BACKGROUND

The construction industry is labour intensive and therefore manpower is the most important and critical resource for a construction project to be successful. In the year 2002, the local industry received a major blow due to the repatriation of foreign workers imposed by the Government. The situation clearly highlighted the vulnerability and dependency of the local construction industry on foreign workers. The employment of foreign labour originally considered a stop gap measure has become a national security issue. The construction industry needs to overcome these difficulties by the use of technology to increase productivity. One such option is to move towards industrialisation and that is by implementing the Industrialised Building System (IBS) approach to construction. With industrialisation, most of the components of a building will be made off-site and manufactured in a factory and brought into site to be assembled. The use of the Industrialised Building System will result in increased production capacity, higher

productivity achieved with lower manpower requirements, shorter turnaround times, improved quality, relatively low building cost and improved competitiveness in the building industry. The concept of Industrialised Building System is not something new to the local construction sector. The effort to introduce such systems started in the late 60's when Government launched two pilot projects to build high rise low cost flats, i.e Pekeliling Flats, Kuala Lumpur and The Riffle Range Flat in Penang[2]. After four decades, the percentage of usage of IBS in Malaysia is still merely only 10% to 15%. Several reasons can be considered relevant to why such technology led construction has not taken off. These include:

1) Inappropriate application of foreign technology not suited to local conditions.
2) The sheer cost of investment and the inadequacy of market size.
3) The lack of skilled workers trained in IBS.
4) The lack of professionals able to design and contribute to IBS development.

The need to rethink the approach to IBS is now critical if the industry is to move forward and this paper provides a basis for such consideration.

4. THE MALAYSIAN CONSTRUCTION INDUSTRY

4.1 Current Status and Impact of Industry

The Malaysian construction industry is generally divided into two broad areas i.e. general construction and special trade works. In the category of general construction can be included residential construction, non-residential construction and also civil engineering construction[3]. The special trade works include activities such as plumbing, sewerage and sanitary works, metal works, electrical works, refrigeration and air-conditioning works, painting works, carpentry, tiling and flooring works and glass works. Due to the extensive linkages with the rest of the economy, the construction industry provides a strong push factor and remains a major contributor to the sustainable growth of the national economy. The construction industry transcends all industries and serves to provide the vital infrastructure support for mining, manufacturing, agriculture, transport and support utilities and services such as health, education and tourism. This is illustrated in Figure 1 where the growth trend of the construction industry follows that of the GDP but with more volatility. Even though the industry remains one of the oldest sectors in the country, little improvement has been made in terms of technology application and improvement in the quality of construction, though some remarkable exception, like for instance the construction of the Petronas Twin Towers should be noted.

Currently the industry is organised along labour intensive lines with concrete being the primary structural element. The bulk of the work is undertaken in-situ i.e a combination of formwork preparation, ready mixed concrete usage and extensive sub-contracting. To increase efficiencies particularly with the larger contracts, different elements of this process are being undertaken with precast elements. A good example of this is the use of hollow core slabs, on precast beams or half slabs used as

permanent forms and then finished on site with in-situ concrete. These developments have made their impact on large projects but in general are limited in their usage. It is this area of development which can be extended to the delivery of Government accomodation if the right impetus and incentives can be identified.

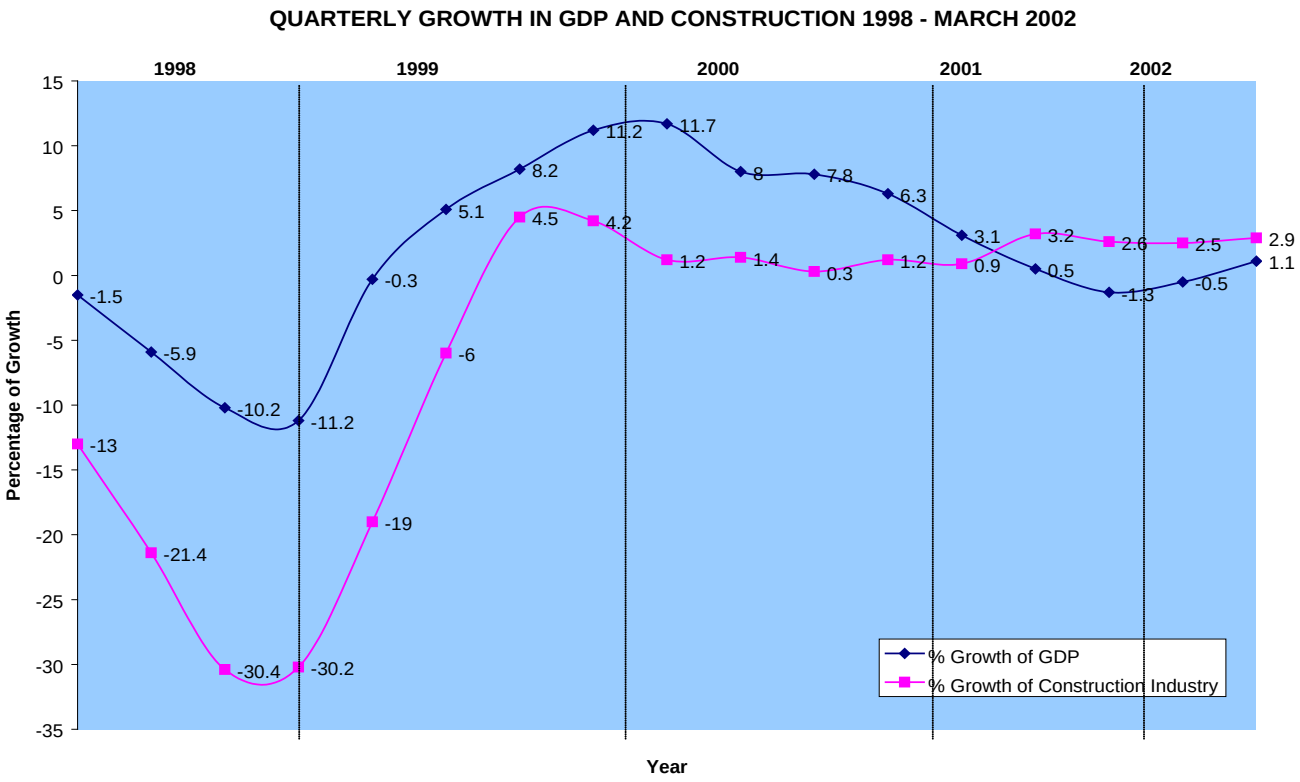

Figure 1: Quarterly Growth in GDP and Construction 1998 – March 2002 (Source: Construction Industry Development Board)

In common with the strategy of many countries, the construction industry is often used by the Government to stabilise the economy during economic downturns. This currently presents itself as an opportunity for the Industrialisation of construction to contribute to a sustained growth coupled with an appropriate foreign labour policy.

4.2 Industrialising the Construction Process

4.2.1 Definition of Industrialised Building System (IBS)

IBS can mean different things to different industry players. What is clear however is that there is a continuum of IBS availability which starts from simple components to full systems delivered to site to cater for part of a project to full systems which are highly complex and requires large investments to manufacture (refer figure 2).

Several definitions of IBS have been developed but perhaps the most comprehensive definition of IBS was clarified by Junid (1986). He mentioned that an IBS in the construction industry includes the industrialised process by which components of a building are conceived, planned, fabricated, transported and erected on site. The system includes a balanced combination between the software and hardware components. The software elements include system design, which is a complex process of studying the requirement of the end user, market analysis, development of standardised components, establishment of manufacturing and assembly layout and process, allocation of resources and materials and definition of a building designer conceptual framework. The software elements provide a prerequisite to create the conducive environment for the industrialised building system to expand.

The hardware elements are categorized into three major groups. These include frame or post and beam system, panel system, and box system. The framed structure is

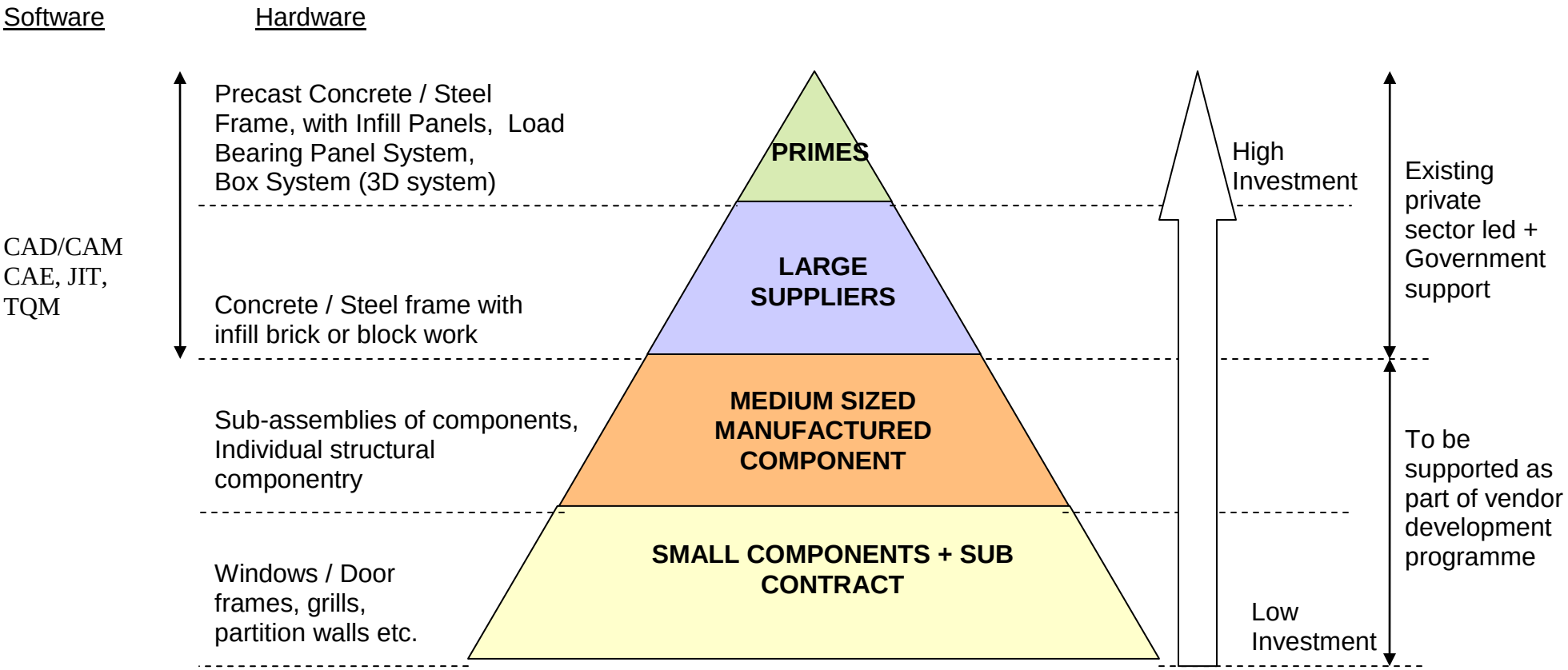

Figure 2 : INDUSTRIALISED BUILDING SYSTEM (IBS) AS CONTINUUM OF SCALE

defined as that structure that carries the loads through the beams and girders to columns and to the ground whilst in panel system loads are distributed through large floor and wall panels. The box systems include those systems that employ three-dimensional modules (or boxes) for fabrication of habitable units that are capable of withstanding load from various directions due to their internal stability. A subset of this is the supply of individual building components delivered to site and assemble to fit into standard modular design.

4.2.2 The future of IBS – The Required Approach

In the Malaysian context, five common types of fully developed IBS have been identified as shown in Figure 3.

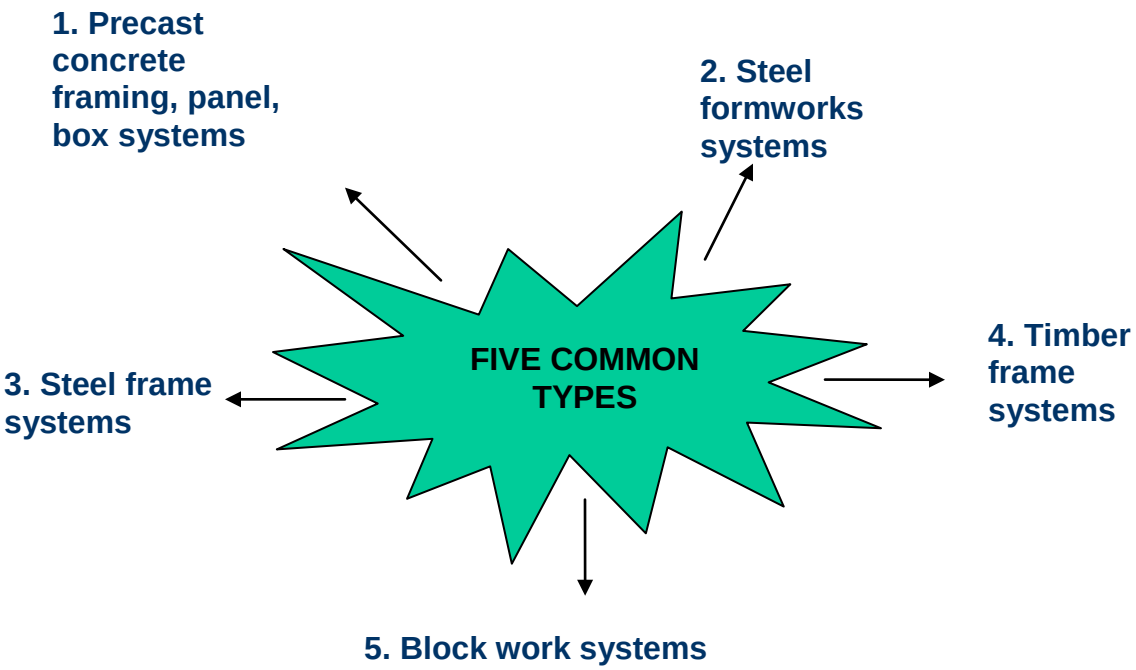

Figure 3 : Types of IBS (source : CIDB)

As discussed above, the delivery of individual factory made components can be considered another element of this industry. It is this latter sector which is of considerable interest at this stage of the development of IBS in Malaysia.

The large system built technologies as discussed above which are already available in the country generally require significant investment and are confined to the large industry players. In this category, private sector led developments have made some in

roads. It is not the purpose of this paper to develop a support infrastructure to promote these large IBS systems. Rather the development of a vendor system to promote the manufacturer of individual componentry using open and non-proprietary designs for specific Government housing and schools projects in the first instance is the focus of the approach for urgent consideration.

5. APPROACH TO IMPLEMENTATION

5.1 Re-engineering

The industry requires **re-engineering** to attract fresh players, improve image and overcome the problem of labour through a new mindset of techno-based solutions within the latest manufacturing paradigm. The basic elements for this development are readily available within the industry. What is required is a national orchestrated effort to lead these individual elements into a new construction delivery mechanism. The impetus for such a dramatic change is to be provided by MIGHT to coordinate the relevant Governmental arms within a sustained and coherent policy.

MIGHT will use its neutral capacity as part of the Prime Minister's office to identify projects on a national scale across individual ministries which can be year marked for the use of this new technology. MIGHT should be a promised delivery of a **substantial building/housing stock over a period of 5 year**. An entity to manage this housing stock should be identified with a clear and finite goal to change the construction delivery process to one dominated by manufactured components within a five year period. With CIDB support using JKR's technical input and designs, the new vendors will then feed into a guaranteed programme of works. These will ensure that the investment required by the vendors will be realised over a 2-3 year window so that the viability of the business model is assured. The success of this programme will provide the impetus and example for a migration of the traditional in situ industry to one where the supply of components will form the basis of construction delivery. Such a development in time will also encourage the migration of small manufacturers to larger and more sophisticated facilities and to full system build approaches.

5.2 Benchmarking

5.2.1 Parallels to the National Car Industry

Benchmarking is a management tool which can help the construction industry to understand how their performance measures up to their competitors and drive improvement up to 'world class' standards. In this context benchmarking construction to the manufacturing industry and in particular to the development of the car industry could provide a basis to move forward. The setting up of the national car company, Proton in the 80's provided the basis for the development of a significant vendor development programme. Within a short space of time, 30 to 40 % of the vehicle components were locally produced by vendors specifically identified and set up to feed the national car industry. The component designs, quality control requirements and productivity targets were specifically set by the client and the vendors were driven to comply with the carrot of guaranteed business.

In developing a buildings component vendor programme similar processes need to be borrowed and set up to drive this development to success. The general manufacturing process of clean working environments, efficient use of resources and open source designs can be readily mirrored in the construction vendor development programme.

In Japan for example, the Toyota Group have already captured this concept by venturing into the housing business by using their existing knowledge and technology in the automotive sector. Toyota's manufactured house is based on the "Skeleton & Infill"

approach whereby it incorporates high level automobile technology in the production of the manufactured house[4].

5.2.2 Production of Building Components

There is no reason why construction's approach to component production should be radically different from what is used by today's leading manufacturers of consumer products. It should include planning, management and sustained improvement of the production process to eliminate waste and ensure the right components are produced and delivered at the right time, in the right order and without defect. In this respect, the construction industry has a great deal to learn about effective logistics management; particularly from the experience of the retail and distribution and vehicle manufacturing.

To make an impact on the construction industry, the following should be an integral part of the building component production process[5]:

a) Detailed engineering design of components and sub-assemblies
b) Planning, management and continuous improvement of the production process.
c) Development of a range of standard components which are used in most projects.
d) Production of components or sub-assemblies to achieve 'right first time' quality.
e) Management of the delivery of components and sub-assemblies to come exactly when needed.

f) Measurement of the performance of completed component and systems.

g) Learning from experience about product performance, durability and life cycle costs.

h) Innovation in the design of components to improve construction products.

Component production must also include a commitment to innovation and design. By working closely with the product development team, component manufacturers can push forward the boundaries of client aspiration and become continually relevant to improvement in productivity and quality.

5.3 Development of the Vendor Programme

5.3.1 Introduction

Several ingredients will need to be in place for the development of a national vendor programme. These include identifying national vetting agencies to maintain standards and ease legislative problems, and getting CIDB to focus on manpower development to support this sector.

5.3.2 National Accreditation

To provide the necessary basis, the following will need to be identified and set-up.

Existing agencies such as CREAM, MAHSURI, SIRIM (refer Appendix 1 & 2) will need to be developed as accrediting bodies to

provide a vetting service to control uniformity of design and quality of the components produced by the vendors.

These agencies will need to work in tandem to ease legislative problems that hinder the full usage of industrialised components in construction projects. This can work by way of a ‘kite mark’ which once given to the products will represent acceptability not only in terms of quality and design, but also in terms of load capacity, fire resistance etc.

5.3.3 Investment requirements

It can be seen from the summary in Appendix 3, that the investment requirements for setting up a factory to manufacture components for the housing industry will be up to 1.25 million (excluding land) depending on the type of components to be produced. This level of investment is within the reach of the SME’s and it can be envisaged that the displaced segment of small contractors which can result due to industrialisation and mechanisation will be the beneficiaries of the new technology development.

5.4 International Development in IBS

5.4.1 Overview

Industrialised Building System is not new in building industry. It was started in 1942 in England to provide temporary housing for fishing fleet. Industrialisation of housing industry in countries such as Britain, Denmark, Sweden, Finland, Netherlands, and Japan took place after the end of World War Two up to late 60's and early 70's[2].

The evolution of industrialised housing in Europe occurred in three stages as follows:

a. *First Stage - 1940's and 1950's.*
Traditional construction methods were supplemented and attempts were made to raise the level of technology and production scale.

b. *Second Stage - 1950's and early 1960's*
Successful systems were given additional support by Government's where some were consolidated and refined.

c. *Third stage – late 1960's*
Concerted effort was made to apply scientific methods to engineering design, production, distribution, and erection with the intention of lowering cost below that of conventional methods.

5.4.2 Industrialisation of Housing Industry in Denmark

It was started in Denmark due to urban migration in line with the prospering manufacturing sector in the post war years. The sudden increase in urban population triggered a large demand for housing. The increased demand could not be met merely using traditional building methods because there was a shortage of skilled labour.

The first industrialised housing project in Denmark was built in 1950 on the outskirts of Copenhagen. Starting off from that, industrialised housing rapidly grew in Denmark. During the 1970's some 80 – 90 % of all high rise developments in Copenhagen were built using Industrialised Building System.

The current industrialised housings in Denmark are largely based on the open industrialisation. The housing scheme created by this concept are mainly low rise high density housing that pay a greater emphasis on the creation of quality living and environmental friendly neighbourhoods. The reasons for the success of industrialisation in Denmark are due to the following factors:

a. Active support by the Government.

b. The national building regulation has been developed on the basis of performance specification and not based on descriptive specifications. This fuelled innovation and development for new materials and techniques for industrialised construction.

c. The requirement to use modular coordination was made compulsory nationally.

d. The Government developed a long term housing supply plan that ensured some continuity and stability in the construction industry's production systems that encourage manufacturers to invest into production of construction components.

e. Construction professionals were trained in the principles of modular coordination and design.

5.5 Design Standards

5.5.1 Housing Sector for the Eighth Malaysian Plan

In the Eighth Malaysian Plan, efforts to expedite housing development in order to meet the increasing demand is strongly emphasised. The Government is committed to providing housing for public sector employees, particularly those in the essential services and those who are working in major towns, border areas as well as in remote areas. In the Eighth Malaysian Plan, Government has allocated an estimated amount of RM 2,018 million to meet the housing target of 62,000 units for the Institutional Quarters and Staff Accommodation Housing Programmes in the Public Sector. The Government is also committed to providing the necessary support policies and programmes to ensure the delivery of adequate, affordable and quality housing to the masses.

In line with this commitment, research and development in housing design and technology is given priority in an effort to research alternative designs, building materials and components as well as Industrialised Building System (IBS).

5.5.2 New Designs for Government Quarters Programme – A JKR Initiative

The National IBS Strategic Plan puts much emphasis on industrialised building components and modular coordination as the main agenda to industrialising the construction industry. As the lead agency in the implementation of Government development projects, Jabatan Kerja Raya Malaysia (JKR) is in full support of this national initiative and thus, has embarked on a programme - **New Designs for Government Quarters Programme,** to develop new designs for Government quarters for projects expected to be implemented in the 8th Malaysia Plan.

The main objectives of the programme are as follows:

- To produce various design alternatives for all categories of Government quarters with emphasis on the use of modular coordination in design. The application of modular coordination in the new quarter's designs is to facilitate the standardisation of various building components.

- To encourage the use of industrialised building components in the new designs. Systematic planning throughout the design process enables optimisation of building components in the various designs.

5.5.3 JKR's New Quarters Design – Design Scope

JKR has developed a total of 24 design alternatives comprising designs of various types such as bungalows, semi-detached, single storey and double storey houses, low rise and high rise apartments

as well as mixed types apartments for all categories of public officers and staffs (refer Appendix 4).

These designs have incorporated the current design trends and concept of sustainable design and development where possible. Designing with flexibility and adaptability by adopting modular coordination in design and building components has become the main criteria in the design brief of these new quarters.

5.5.4 Standardised Components

With the application of modular coordination as the dimensioning rule in the new designs, the design teams have developed various categories of standardised components which can be used interchangeably between the new designs with ease. The use of standardised components where appropriate in the designing process has resulted in a more coordinated and streamlined design process, improvement in the quality and production time of working drawings and optimum use of standard components in the new designs. The development of a typical high rise apartment is shown in diagram 1 & 2 (refer Appendix 5).

There are five main categories of components developed by a dedicated design team for the new designs i.e. Architectural Component, Structural Component, Electrical Component, Mechanical Component and Water Works Component. Each category of components is developed by the respective discipline in the department under the purview of a steering committee. The team works closely together to develop and integrate these components into the whole building system.

The main categories of components as shown in diagram 1 & 2 (refer Appendix 5) are further divided into elements as follows:-

i) Architectural Component

1. Opening (Doors, Windows and Grilles)
2. Partition Wall
3. Railing
4. Toilet Layout and Fittings
5. Built-ins
6. Finishes

Diagram 1 (refer Appendix 5) illustrates an isometric view of application of the different types of Architectural Components in a typical housing unit.

ii) Structural Component

1. Wall
2. Floor Slab
3. Staircase
4. Beams
5. Columns
6. Shear Walls

Diagram 2 (refer Appendix 5) illustrates the process of constructing high-rise apartment with precast concrete components.

iii) Electrical Component

1. Switch Board
2. Switch Gear
3. Lightning Protection

4. Light Fittings
5. Wiring Conduit for Electrical, Telephone and MATV
6. Cable Trays
7. Generator

iv) Mechanical Component

1. Lift Shaft
2. Fire-Fighting
3. Hose-reel
4. LPG system
5. Booster Pump
6. Kitchen Hood/Flu

v) Water Works Component

1. Sanitary Layout
2. Water Storage Tank
3. Water Supply System
4. Sewerage System
5. Rain Water Harvesting System

The component designs are compiled into a designer's guide which is useful as a reference document to assist designers in the selection of the appropriate components to be used in their designs. The use of the component designs are not limited to the new quarter's designs but can be extended to other repetitive designs such as schools, offices and health clinics.

The compiled document however is not exhaustive and can be improved and upgraded in the future to include new designs, technology and new category of components whenever necessary.

The current rapid growth of the construction industry necessitates a shift in the mindset of the construction industry players in order to be competitive in today's market. The New Quarters Design Programme is a JKR initiative to meet the challenge of leading the industry towards industrialisation. The promotion of this new quarters design can be the catalyst for the development of a competitive building components industry through a vendor development programme as envisaged in this paper.

6. RECOMMENDATIONS AND CONCLUSION

i. The construction industry requires re-engineering and must reinvent itself to attract new players, improve image and overcome the problem of labour by innovative application of technology.

ii. Industrialising construction by way of manufacture of building components and delivery on site exactly when needed is considered an effective way to achieve productivity gains and to make the industry more attractive for new entrants.

iii. A vendor development programme modeled along the lines of the development of the national car industry should be established to target delivery of building components for the construction of modular walk up apartments, teacher's quarters, schools and armed forces housing.

iv. The selected vendors are to be provided training, seed capital and component design (from JKR) and selected private sector consultants to start up production factories. The expected investment requirement of 1.25 million is considered within the reach of SME's and small contractors displaced by the new technology.

v. The vendor programme is to be accredited by existing agencies such as CREAM, MAHSURI and SIRIM who can provide a vetting process not only to guarantee consistent quality but also the achievement of structural capacity, fire rating etc.

vi. MIGHT as an appointed agency is to identify projects over a five year period on a national scale across individual ministries which can be designated for the implementation of this new technology. With CIDB as the lead agency for implementation, using JKR design, the new vendors

will then feed into a guaranteed programme of work which will ensure recovery of investment.

vii. The economies of scale is to be created by designating that within five years, 70% of Government institutional housing will be built using the component based Industrialised Building System.

viii. A ‘Kite Mark’ system is to be developed such that building components accredited will be given green lane approval such that all technical and non-technical legislation that hinders implementation of the new technology will be removed.

xi. A system of innovation and the design of components to improve construction products are to be encouraged and rewarded. Just in time delivery and ‘right first time’ quality to be encouraged coupled with strengthening planning and management techniques to improve productivity and limit waste.

xii. A systematic gradual reduction of foreign labour policy must also be in place to support the progress of migration from traditional based construction to component based construction that requires less labour.

xiii. The prelim presentation prepared for MIGHT is given in Appendix 6.

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Appendix 1

CREAM: CIDB's Research And Development Initiative

The Mission Statement of CREAM, the **Construction Industry Research Institute of Malaysia**: "To be the leading R&D establishment in Malaysia that focuses on the development of the Construction Industry."

CREAM is the resulting initiative that has its origins from CIDB's Research and Development Programs.

The 2 key functions of CREAM involve those of:

- Undertaking research from Concept to Commercialization
- Research Management

CREAM: Undertaking Research – From Concept to Commercialization

CREAM will be a dedicated institution that will undertake research on specific **core themes** within the Construction Industry. Present core themes include the development of:

- local substitutes to imported materials, services, plan tools and technology
- alternative materials designed with sustainability, environmental and human-friendly aspects in mind
- technologies that feature significant potential for industrialization with an emphasis on quality, reduced labour intensiveness and higher productivity
- technologies that focus on enhancing coordination and integration

Research Management at CREAM

Key areas for Research Management include:

- **promoting and coordinating research** for the Construction Sector in order to instill a focused interest and a positioning of R&D as a main key consideration for both the Industry and the nation.

- facilitating the **collection of data** and problems faced by the Construction Industry that warrants research and ensuring the availability of research results for the Industry

- maintaining access to a wide spectrum of funding for R&D activities. Potential sources of funding are obtained from CIDB itself, IRPA and contract research. CIDB's role in this area will be one of sourcing and allocate this public sector R&D funding.

- establishment of **Centres of Excellence**

- **keeping abreast** with the latest developments in R&D through networking and collaboration efforts with local and international R&D authorities.

No	MS Number	Title
1	MS 1532:2002	thermal insulation - Determination of steady - State thermal transmission properties - Calibrated and guarded hor box (ISO 8990: 1994, mod)
2	MS 1553 : 2002	Code of practice on wind loading for building structure
3	MS 1525	Code of practice on energy efficiency and use of renewable energy for non-residential buildings
4	MS 544 : Part 11 : Section 2	Code of practice for the structural use of timber : Part 11 : Recommended span tables and their calculations : Section 2 : Ceiling joists
5	MS IEC 60838-2-1	Miscellaneous lampholders : Part 2 : Particular requirements - Section 1 : Lampholders S14
6	MS IEC 60238	Edison screw lampholders
7	MS 1472	Code of practice for fire precautions in the design of buildings - smoke control in protected escape routes using pressurisation.
8	MS IEC 364-4-482	Electrical installations of buildings : Part 4 : Protection for safety : Section 48 : Choice of protective measures as a function of external influences : Section 482 : Protection against fire
9	MS IEC 364-7-704	Electrical installations of buildings : Part 7 : Requirements for special installations or locations : Section 704 : Construction and demolition site installations
10	MS 1314 : Part 2	Specification for precast concrete piles : Part 2 : Special design small precast concrete piles
11	MS IEC 364-5-537	Electrical installations of buildings : Part 5 : Selection and erection of electrical equipment : Chapter 53 : Switchgear and controlgear : Section 537 : Devices for isolation and switching
12	MS IEC 364-5-551	Electrical installations of buildings : Part 5 : Selection and erection of electrical equipment : Chapter 55 : Other equipment - Section 551 : Low-voltage generating sets
13	MS IEC 364-7-709	Electrical installations of buildings : Part 7 : Requirements for special installations or locations - Section 709 : Marinas and pleasure craft
14	MS IEC 364-5-51	Electrical installations of buildings : Part 5 : Selection and erection of electrical equipment : Chapter 51 : Common rules
15	MS IEC 364-4-443	Electrical installations of buildings : Part 4 : Protection for safety : Chapter 44 : Protection against overvoltages - Section 443 : Protection against overvoltages of atmospheric origin or due to switching
16	MS IEC 364-4-442	Electrical installations of buildings : Part 4 : Protection for safety : Chapter 44 : Protection against overvoltages - Section 442 : Protection of low-voltage installations against faults between high-voltage systems and earth
17	MS IEC 364-4-41	Electrical installations of buildings : Part 4 : Protection for safety : Chapter 41 : Protection against electric shock
18	MS IEC 364-3	Electrical installations of buildings : Part 3 : Assessment of general characteristics
19	MS IEC 364-1	Electrical installations of buildings : Part 1 : Scope, object and fundamental principles
20	MS 1404 : PART 4	Fire detection and alarm system for building : Part 4 : Specification for control and indicating equipment

Appendix 2

SIRIM's Building standards

No	MS Number	Title
21	MS 1498	Specification for tampered glass.
22	MS ISO IEC TR 6371	Information processing - Interchange practices and test methods for unrecorded instrumentation magnetic tape
23	MS 1246 Pt. 6	Strength and stability of furniture : Part 6: Methods for determination of stability of tables and trolleys
24	MS 1313	Code of practice on large prefabricated panels.
25	MS 1314; Pt.1	Specification for precast concrete piles : Part 1 : Standard design precast concrete piles
26	MS 1193; Pt.2	Specification for devices without moving parts for the prevention of contamination of water by backflow : Part 2 : Specification for type B air gaps
27	MS 1064; Pt.13	Guide to modular coordination in buildings : Part 13 : Coordinating dimensions for stairs and stair openings
28	MS 1462	Specification for steel frame scaffoldings
29	MS 822	Specification for sawn timber foundation piles
30	MS 524	Specification for asbestos cement symmetrically corrugated sheets (first revision)
31	MS 472 : Part 2 : Sec. 2.1	Specification for testing and approval of household and similar electrical appliances : Particular requirements for ranges
32	MS 416	Code of practice for the use of structural steel in building
33	MS 282 : PART 1 TO 9	Code of practice for building operations code : Part 1 : Demolition : Part 2 : Excavation work : Part 3 : Welding and cutting : Part 4 : Piling : Part 5 : Handling and storing material : Pt.6: Blasting : Part 7 : Scaffolds : Part 8 : +Ladders : Pt 9 : Temporary floors, stairs, railings and to the boards
34	MS ISO 877	Plastics - Methods of exposure to direct weathering, to weathering using glass-filtered daylight and to intensified weathering by daylight using Fresnel mirrors
35	MS 1224	Specification for fibre cement symmetrically corrugated sheet and fittings
36	MS 1296	Specification for fibre-cement flat sheets
37	MS 1183 : Part 2	Code of practice for fire precautions in the design and construction of buildings : Part 2 : Shops

Appendix 3

Investment Requirement

a) Simple Casting Yard

Steel
Mould
Cost

Walls/half slabs 30 nos. X 3 m x 12 m x 600 RM/m2
= 648,000.00
20 nos. X 7.5 m x 1.25 m x 400 RM/m2
= 75,000.00

locally-made lattice girders machine (for half slabs)
= 400,000.00

sub-total = 1,123,000.00
misc = 150,000

Not including :

Batching plant (use RMC)
Vibrating table (use pokers)
Robotic plotter (use manual)
Overhead cranes (net mobile cranes)
Covering structures (open air)
Movable mould tables (static moulds)
Cam (just cad – draughting)
Column moulds (assuming in-situ columns, as per most (new) jkr design)
Bar-bending/cutting machine (use cut-to-size bars)

Total set-up : **about 1.25 million** (excluding land)

b) Fully CAD-CAM Factory

RM12 – 15 million investment (excluding land)

Appendix 4

Types of JKR's New Quarters Designs

The designs developed for the various categories of quarters are as shown in the table below:

Name		Type of Quarters
Class B		
1	Class B2 (Banglo Zamrud)	double storey bungalow
Class C		
2	Class C5 (Pangsapuri Intan)	4 Storey walk-up apartment
3	Class C6 (Banglo Permata)	double storey bungalow
4	Class C7 ((Mutiara)	double storey semi detached
Class D		
5	Class D8 (Pangsapuri Cemara)	4 Storey walk-up apartment
6	Class D9 (Banglo Angsana)	double storey bungalow
7	Class D10 (Jati)	double storey semi detached
Class E		
8	Class E13 (Pangsapuri Purnama)	4 Storey walk-up apartment
9	Class E14 (Banglo Suria)	double storey bungalow
10	Class E15 (Kejora)	double storey semi detached
Class F		
11	Class F16 (Pangsapuri Nuri)	3 Storey walk-up apartment
12	Class F17 (Pangsapuri Serindit)	5 Storey walk-up apartment
13	Class F18 (Pangsapuri Merpati)	10 Storey apartment
14	Class F19 (Cenderawasih)	single storey semi detached
15	Class F33 (Pangsapuri Jelatek)	5 Storey walk-up apartment
Class G		
16	Class G25 (Pangsapuri Gemilang)	4 Storey walk-up apartment
17	Class G26 (Pangsapuri Harmoni)	11 Storey apartment

18	Class G27 (Sentosa)	Townhouse
19	Class G28 (Pangsapuri Damai)	4 Storey walk-up apartment
Class H		
20	Class H29 (Pangsapuri Indera)	5 Storey walk-up apartment
21	Class H38 (Pangsapuri Kesuma)	8 Storey apartment
Mix Development		
22	Class C11 & D12 (Pangsapuri Anggerik)	4/5 Storey walk-up apartment
23	Class F23 & G24 (Pangsapuri Dahlia)	4/5 Storey walk-up apartment
24	Class G30 & H31 (Pangsapuri Seroja)	5 Storey walk-up apartment

Appendix 5

JKR's new quarters design

DIAGRAM 1 – ISOMETRIC VIEW OF A TYPICAL HOUSING UNIT

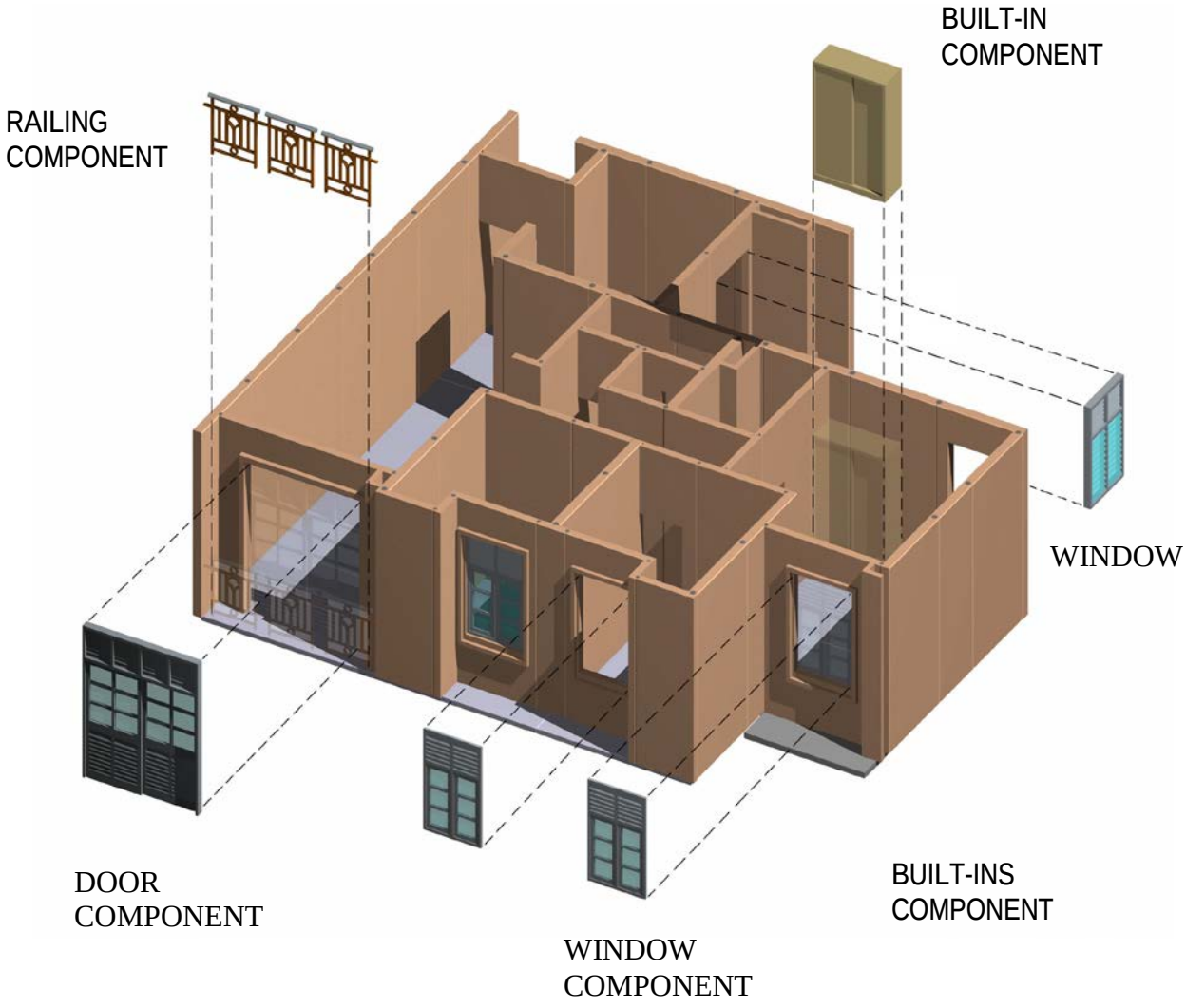
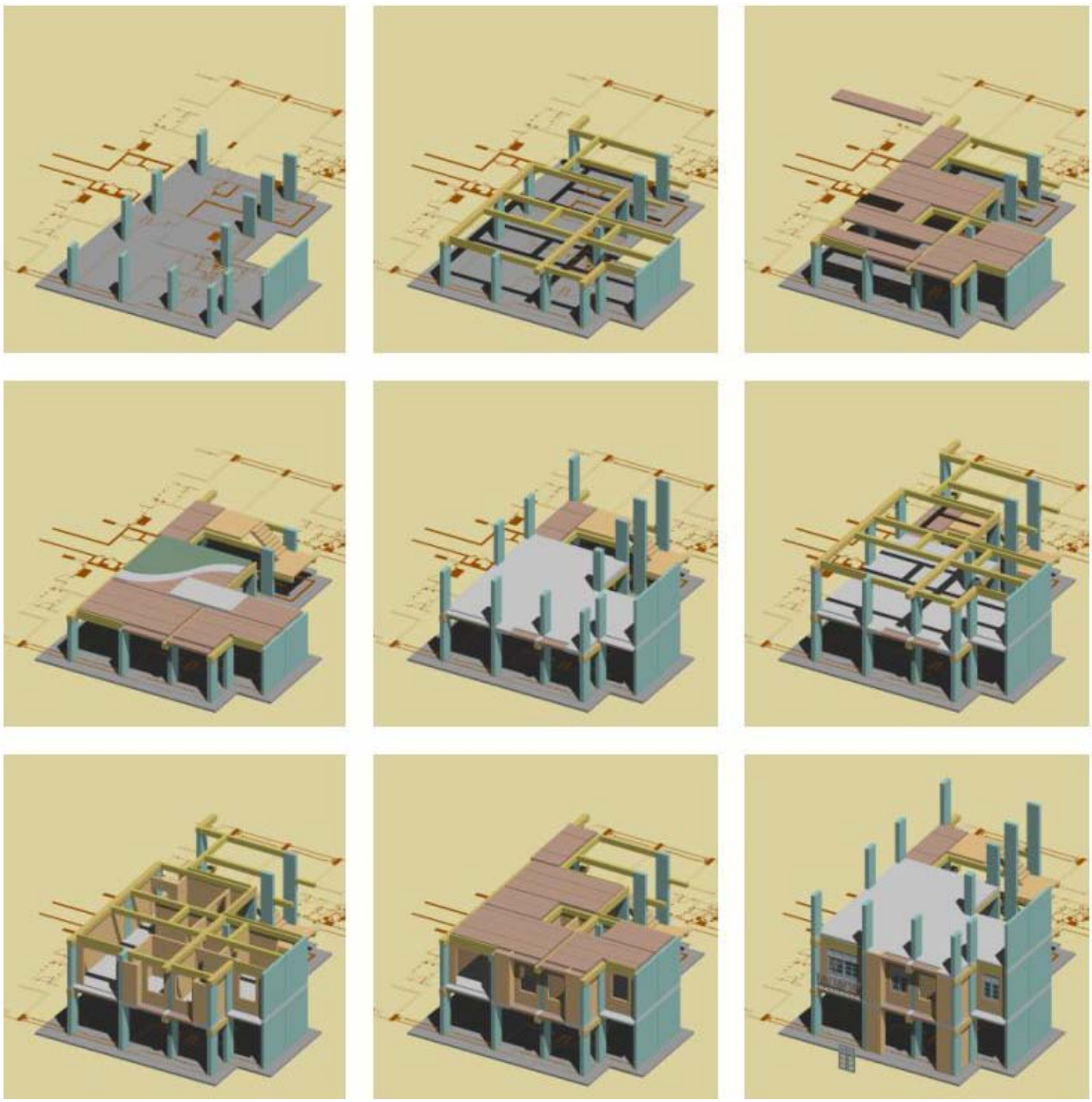


DIAGRAM 2 – DIAGRAMATIC VIEW OF CONSTRUCTION PROCESS OF A HIGH RISE APARTMENT USING PRECAST



Pictures of JKR's new quarters

G 27

B 2

H 38

E 14

C 6

G 25

G 28

G 26

E 13

F 17

Appendix 6

1st Draft Might Presentation

MiGHT

1st Draft

INDUSTRIALISED BUILDING SYSTEM DIALOGUE

PRESENTED BY:
Malaysian Industry – Government Group
For High Technology (MIGHT)

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OVERVIEW

- One of the oldest sector
- Tremendous contributions (Economy, job sector, regional development, etc)
- Little improvement (technology application, quality, etc)
- Current features, viewed as amongst other :
  - Labour intensive (dependent on foreign workers)
  - Low productivity
  - Questionable quality
  - Delayed delivery
  - Sub-contracting industry
  - Unattractive working site (deters local workers)
- Need initiatives to modernise (Industrialised Building System, Modular Coordination, E-Submission, etc.)

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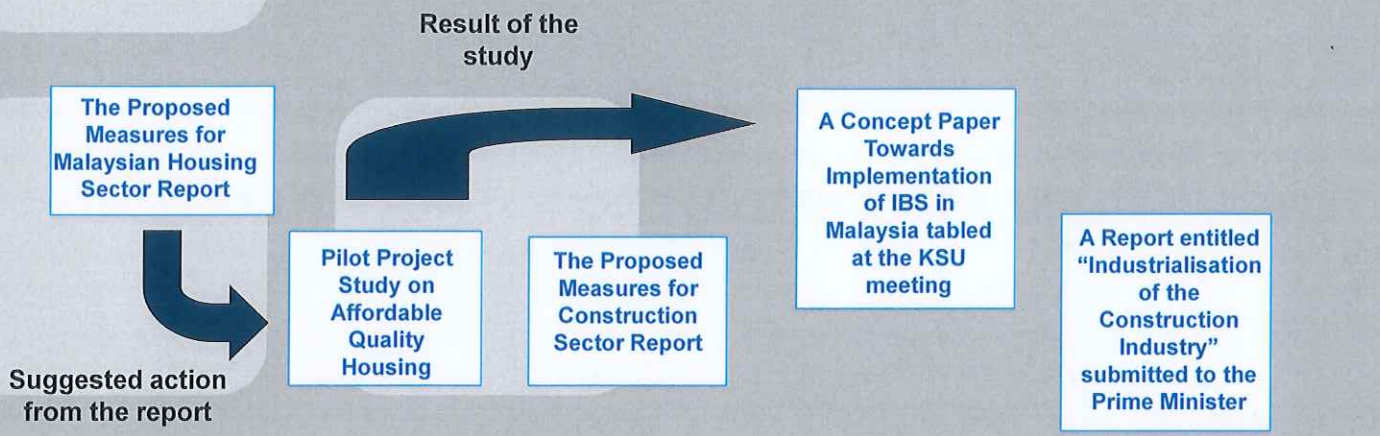
MIGHT's initiatives



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Construction Industry Value Chain

CONCEPTION → DESIGN → PROCUREMENT → CONSTRUCTION → OPERATION & MAINTENANCE

The process of identifying and specifying broad base needs (macro)	The process of translating business/social needs to knowledge products	The process of securing the best price for transforming the k-product to built environment	The process of transforming the k-product to a built environment	The process of utilizing the built environment to meet the business/social needs
-Developer/client -Architect	- Developer/Client - Architect - Engineer - Quantity Surveyor - Regulatory authorities - Manufacturer - Contractor - Financiers	- Developer/Client - Architect - Engineer - Quantity Surveyor - Contractor - Manufacturer	- Developer/Client - Architect - Engineer - Quantity Surveyor - Regulatory authorities - Project Manager - Contractor - Skilled & unskilled workers - Suppliers - Plant operators /suppliers - Financiers	- Developer/Client - Management Corporations - Regulatory authorities - Consumers

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PILOT PROJECT STUDY ON AFFORDABLE QUALITY HOUSING

Background:

- **Officially launched on the 2 July 1999 by the joint chairmen, Ybhg. Dato' Seri Dr Zainul Ariff Hj Hussain, Director General, Implementation Coordination Units, JPM and Ybhg. Dato' Khalid Hj Husain, the then Chief Secretary, Ministry of Housing and Local Government**

- **To apply some of the recommendation from a technical report 'The proposed Measures for Malaysian Housing Sector – 1998'.**

- **Sunway Group offered its own project at Semenyih for the purpose of the pilot project study and MIGHT act as facilitator and coordination of the project.**

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PILOT PROJECT STUDY ON AFFORDABLE QUALITY HOUSING (cont'd)

Objectives:

To adopt and apply some of the recommendations proposed by MIGHT Interest Group in Construction and Housing namely:

- ✔ **To expedite the implementation of Industrialised Building System using modular coordination concept**

- ✔ **To study on the approval process of**
  - Land conversion
  - Layout Plan
  - Building Plan

- ✔ **To provide a venue to test, evaluate, validate the appropriate building system**

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Findings from the Study

No.	Approval Process	Date Submitted	Date Approved	Total Duration
1	**Land Conversion**	16 October 1996	31 March 1999	**29 ½ months**
2	**Layout Planning**	26 April 1999	3 April 2000	**12 months**
3	**Precomp Plan**	Majlis Perbandaran Kajang planning dept 4 April 2000	Majlis Perbandaran Kajang planning dept 12 April 2000 Endorsed by Hulu Langat Land office 23 May 2000	**1 month**
4	**Land Premium**		Paid on 23 May 2000	
5	**Traffic Impact Assessment**		12 October 2000 Presentation made to JKR	
6	**Building Plan**	7 September 2000	12 December 2001	**15 months**
7	**Tendering**	31 May 2001	Technical bid closed on 30 August 2001 Financial bid closed on 12 October 2001	**6 months**
TOTAL DURATION				**63 ½ months**

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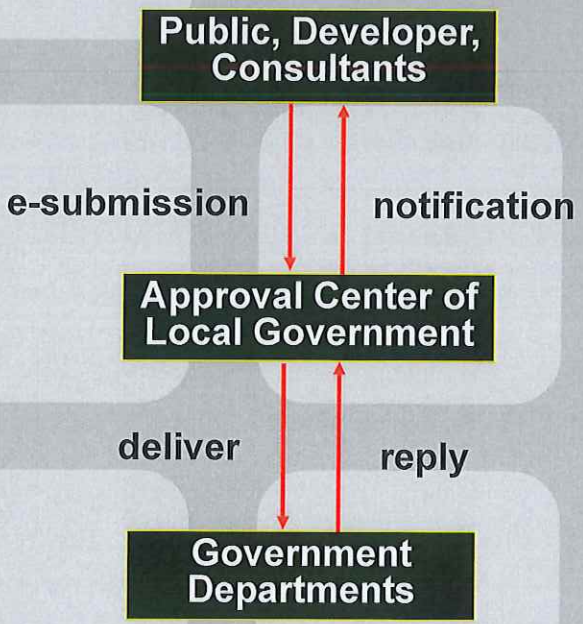
WORKFLOW FOR APPROVAL SUBMISSION



Requirements :

- web-based enabled
- digital signatures
- project tracking
- electronic payment
- approved plans and communications

- system operation
- data storage and backup
- messages

- digital signatures
- comments and anntations

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Conclusion

- The country needs to progress and to do so rapidly.
- Most of the policies, strategies and plans are in place for the country however
- There exists a gap between the decision making and implementation.
- Continuous consultation between parties concerned are criritcal.
- At each consultation the latest information is the key to making speedy decisions.

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Concept Paper 2002

- This concept paper is prepared based on the requirement to increase the level of technology application in the construction and housing (C&H) industry.
- It was prepared with the inputs and support of the various key stakeholders in the C&H industry including the professionals, industry associations, IBS contractors and academia.
- The experience gained through the conduct of a Pilot Project Study on Affordable Quality Housing proved useful in preparing this concept paper.
- With this initiative, the industry will become more technology based and less dependent on foreign workers.

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OBJECTIVES

- To promote Industrialised Building System as a technology application in order to achieve :

  - *Speed of Construction*
  - *Saving in Labour*
  - *Optimizing Material Use*
  - *Better Quality Houses*
  - *Better Site Management (Environmental cleanliness & considerations)*

- Focus on identifying the most appropriate IBS, identifying the lead agency, creating economies of scale, and most importantly, to find a formula which will benefit all the stakeholders, including the buyers.

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DEFINITION

"Industrialised Construction System or Industrialised Building System is a system which uses industrial production techniques either in the production of components or assembly of the building or both"

(Farid Wardi, 1997)

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GLOBAL SCENARIO (cont'd)

- Industrialisation of Housing industry in Britain started due to

  Severe shortage of skilled workers such as brick layers and carpenters.

- Industrialisation of Housing industry in Japan was driven by

  The huge demand for housing created by the migration of rural population to urban areas coupled with shortage of skilled workers in construction industry eventually triggered industrialisation in Japan's housing production

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GLOBAL SCENARIO (cont'd)

- Industrialisation of Housing Industry in Denmark owed its success to :
  - Active support by the government
  - The national building regulation was developed on the basis of performance specification and not based on descriptive specifications
  - The requirement to use modular coordination was made compulsory nationally
  - The government developed a long term housing supply plan
  - Construction professionals were trained in the principles of modular coordination and design

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Industrialisation of Housing in Malaysia

1966 - The Malaysian government launched 2 pilot projects using industrialised method of construction to build high rise low cost flats; Pekeliling Flats, Kuala Lumpur and The Riffle Range Flat in Penang.

1978 - The Penang State Government used another industrialised method using partially precast concrete system to build additional high rise flats low cost flat.

1980- The Ministry of Defense builds large number of high rise flats in its new navy base in Lumut, Perak also using the large panel precast system.

2000 - The current percentage of IBS used in the overall construction industry is in the range of 15-30%

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Why IBS is not so popular ?

- IBS introduced are designed for temperate countries and not for tropical condition.
- Types of industrialisation introduced are alien to the local population's living style and culture. (eg. use of bathroom)
- Most of the designs from those industrialised countries are tailored for small-size families averaging with 2 children.
- The kitchen in those units are made for western style of dry cooking which is very different from Asian style of wet cooking.
- Available IBS are closed systems
- No real incentives are given to IBS

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CONCLUSION

- Economies of Scale

  To designate a Government Quarters to be Modular Coordinated. The initial start-up for an open building system requires an extensive amount of capital to be laid out in order to implement the system. Initial estimated suggest 10,000 units is viable for a start.

- Lead Agency

  The current situation in the construction suggest that the implementation of IBS is quite fragmented. A key success factor in the implementation of IBS in many developed countries is that it have a lead agency. Therefore it is suggested that a leading body should be appointed for the implementation of IBS to the industry in Malaysia.

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2003 MIG IN CONSTRUCTION & HOUSING

- The MIG in Construction & Housing is chaired by YBhg. Datuk Eddy Chen Lok Loi and have held its first meeting on the 24 January 2003.

- The members for the committee comprises of the following :

– CIDB	- ISM
– JKR	- PKNS Engineering & Construction
– REHDA	- Baktian
– MBAM	- Setia Precast
– PAM	- Sunway Precast
– IEM	- Sunway Construction
– ACEM	- JTK Consult
– CIOB	- UPM

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AIM OF THE MIG CONSTRUCTION & HOUSING

To submit an implementable policy paper to the Prime Minister to endorse the following:

SHORT TERM

i) Establishment of Building Technology Research Centre

ii) To adopt localized Industrialised Building System

- a) Formwork system
- b) Panel system
- c) Block system
- d) others

iii) To have special "legislative pass" for implementation of the adopted system as (ii) in a housing project of each having a minimum of 100 units

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AIM OF THE CONSTRUCTION & HOUSING (cont'd)

MEDIUM TERM

i) To change existing legislation for IBS friendly regime

ii) To increase share of IBS in housing by 70% within 5 years (2003 – 2007)

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AIM OF THE CONSTRUCTION & HOUSING (cont'd)

LONG TERM

i) To develop the capability in exporting the construction industry and participate in the global market.

ii) The change over of the construction industry will be in tandem with the vision for a fully industrialised country in 2020.

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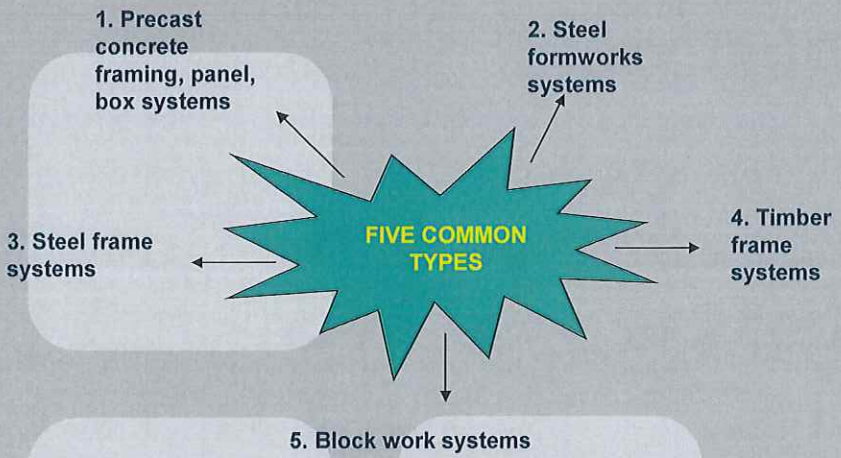
Types of IBS



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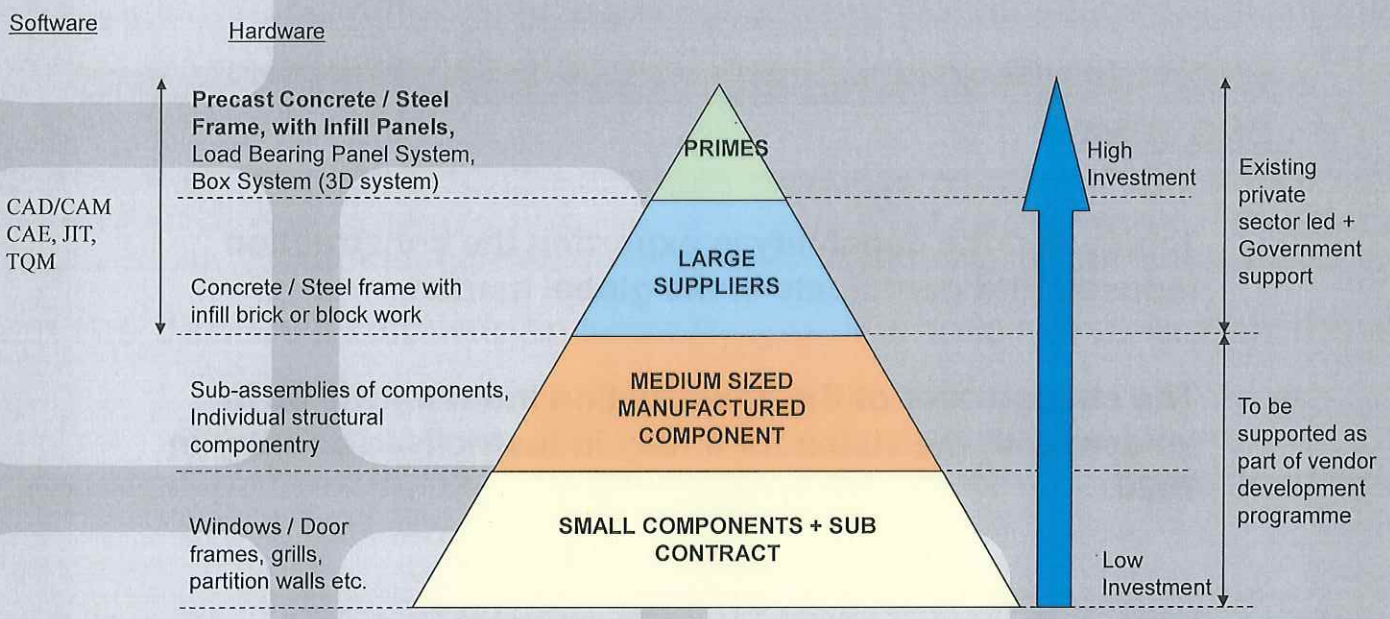

Figure 2 : INDUSTRIALISED BUILDING SYSTEM (IBS) AS CONTINUUM OF SCALE

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Modular Construction

There is a need to increase productivity

- **Industralization of the Construction process is one option**

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Productivity Improvements

Need to consider

- New Materials and construction techniques
- Increased mechanisation
- Offsite manufacturing of large components
- Improved Management techniques
- Correlation of Design & Production
- Improved Selection/Delivery of materials
- Better organization of operations on site

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UK experiences in the 60's

When system building was first applied, the competition acted as spur to the traditional side of the industry to greater efficiency.

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Improving Efficiency in Conventional Construction

The UK experience clearly indicates that much can be done to improve conventional construction methods by

- Higher Management skills
- Better Planning techniques
- New Technology i.e. partial prefab.

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Modularisation and System Building

- Needs Economics of scale to recover investment
- Continuity of work load to operate at its most efficient
- Government intervention needed to create the overall environment for this to happen
- Needs urgent consideration if housing needs to be met
- skills development Essential

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Modularisation and System Building

Issues	Present Situation	Solution/Recommendation
Modular Construction and Standardisation	Highly Labour intensive and Foreign labour dependent Poor site Conditions Co-ordination of a multitude of trades No repeatability Poor communication between designers and contractors	Move towards factory made components Encourage dry processes on site and increased mechanization Better site oganisation and improved management techniques Reduction in Labour resources

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Precast Construction – JTK Experience

- Turnkey Design
- Modular and system build construction
  - Medium Cost Apartments in Putra Jaya
  - Student and Staff Apartments in Kedah (AIMST)
- Harnessing our resources and expertise
  - Get it right first time

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The Way Forward

- Placement of Demand – Modal along the lines of SPNB, Guaranteed Housing starts
- Selection of Vendors – Chosen as Role Modals for Guaranteed success, Class ???
- Identify Incentives - Tax Incentives, Technical Backup, Guarateed Work Flow
- Open Building System with Guaranteed Designs – Designs to be developed and made available. Specify OBS in contracts to attract incentives

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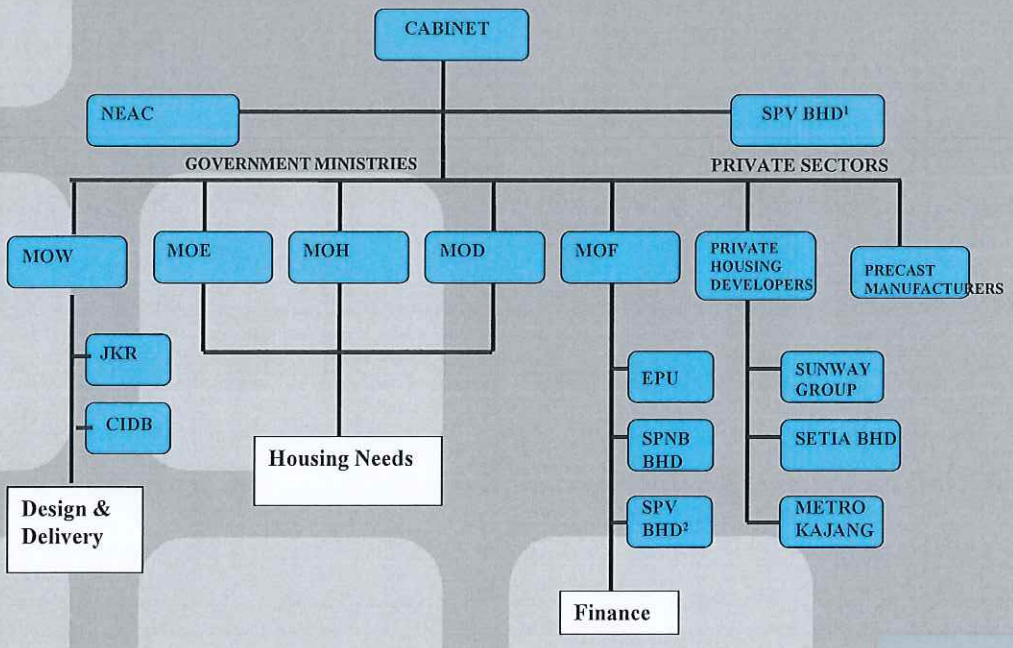

Figure 5 : Overall framework

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Identify Incentives

- Treat vendors as SME's (< 25 mil. , <150 Employees, 60% Equity Held By Malaysians)
- Facilitate Capacity Building and Growth as well as competitiveness
- Linking of SME with MNCS or Large Companies for ??
- Fiscal Incentives to be identified
- Develop Programmes that support Industrial Linkages
- Purchase of Factory Lots at Affordable prices
- Skill Upgrading (80% Grant SMIDEC, 20 % from HRDF)
- Expert Advsory Panel.

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THANK YOU

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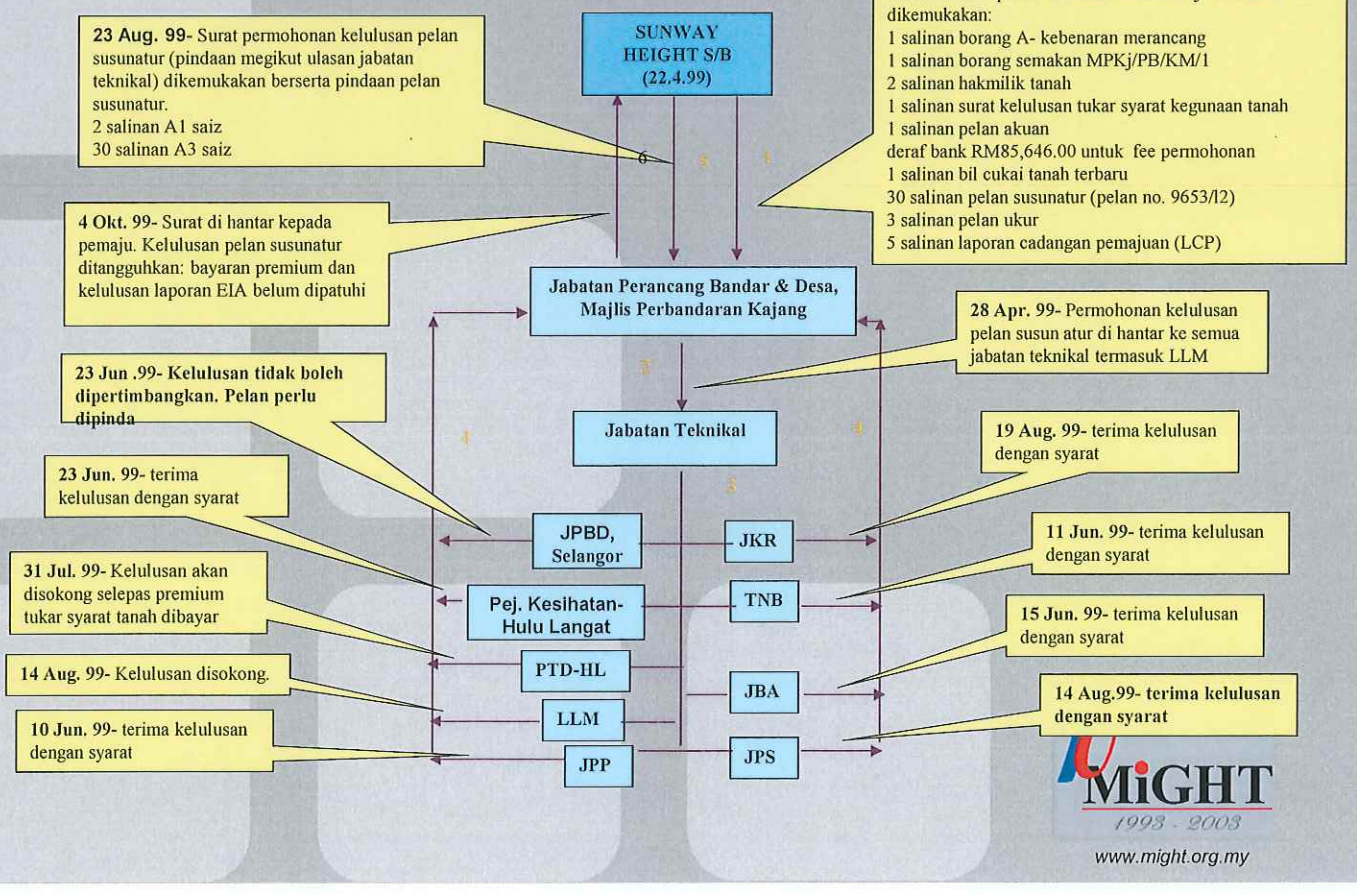
Findings of the Study (cont'd)



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CURRENT PROCESS - PROPERTY DEVELOPMENT

PRELIMINARY

- Feasibility Study
- Acquisition of Property
- Application For FIC Approval
- Appointment Of Consultants (For Layout Plan)
  - Town Planners/Architects
  - Engineers
  - Land Surveyors

PLAN PREPARATION

- Preparation Of Site Plan & Layout Plans Drainage & Sewerage Design And Section Plans

APPLICATIONS

- Application For Conversion & Subdivision Approval
  - State Planning
  - D.I.D
  - Health Dept
  - Public Works Dept
  - Waterworks
  - Telekoms
  - T.N.B.
  - SEDC
  - Land & District Office
  - Parks & Recreation Dept
  - Labour Dept
  - Forestry/Agriculture Dept
  - Civil Aviation
- LAND OFFICE
- P.T.G.
- EX-CO
- Conversion & Subdivision Approval

continue...

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- Architect
- Engineers
  - Building Plan Design
  - Submission of Building Plans: LOCAL GOVERNMENT
    - Civil
    - Architect
    - Sanitation
    - Fire
  - Plans Approved
- M & E
- Land Surveyor
  - Obtain Survey Nos
  - O.T.s
  - ISSUE OF Q.T.s
- Application of Developers Licence
  - Application For Advertising Permit

Project Planning

- Project Schedule
- Progress Charting
- Inspection
- Cost Control & Project Budgeting

Contract Administration

- Tender Documents
- Tender Selection
- Signing of Contract
- Supervision
- Clarification of Payments

Finance & Control

- End Finance
- Progress Payments

Sales Administration

- Pricing
- Advertisement
- Sales Agreement

- Certificate of Fitness
- Delivery of vacant possession

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E-enabled Approval Process