

## **CONSTRUCTION FROM LABOUR INTENSIVE TO SKILL-INTENSIVE SERVICE**

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### **ABSTRACT**

The Construction Industry contributed an average of 3.89% towards total GDP over the period 1985 to 1995 and comparable figures in the years 1996 to 1997. Although this is small compared to manufacturing for instance, the construction industry is unique in transcending all productive sectors of the economy. A successful construction sector is needed to provide the infrastructure support for water, mining, manufacturing, agriculture, transport and support services such as health, education and tourism. The importance of a vibrant construction sector cannot therefore be underestimated. In the last decade Malaysia was the centre of some of the largest building and infrastructure projects in the world. The latest technologies and advances into modern construction have been achieved by inviting and working with the major contractors / consultants on mega projects in all sectors. However despite these visible advances, the construction industry as a whole is largely a low skills, low productivity based sector where heavy reliance on foreign workers is a reality. With the current financial turmoil and stock market volatility, the construction and property sector in the country requires urgent attention.

This paper considers the need to move the construction industry from a labour-intensive low skills sector to one where modularisation and manufacturing principals are applied supported by a highly skilled labour force. It also considers the relevance of R&D in construction and the need for continuing professional development to meet the challenges of the future. It is imperative that these changes are considered if the construction sector is to keep pace with the developments in the country and cater for the needs of the new millennium and vision 2020. It is also a pre-requisite to becoming a major player in international construction projects, a move which is likely to be critical to the growth of the industry in Malaysia.

## **2. THE CONSTRUCTION INDUSTRY – AN OVERVIEW**

### **2.1 Current Realities**

With the present financial turmoil and stock market volatility many sectors of the economy have been affected not least the construction and property sectors. Growth in the construction sector is expected to moderate to 11% in 1997 following a growth of 14.2% in 1996.<sup>1</sup> The expected moderation is attributed to a slowdown in construction starts including high rise buildings particularly office space, retail outlets and high end condominiums. The growth rate in 1998 is expected to take a drastic downturn due to the postponement of mega projects planned as part of the Seventh Malaysia Plan.

The dramatic change of economic circumstances following the mid 1997 regional currency crises has renewed the urgency of considering the construction sector as a whole. The reality today is that the construction sector is likely to shrink considerably with the postponement of projects and a slowdown in existing work due to credit constraints. It is likely that for the first time in a decade the flow of work to the industry will be less than the available capacity. A number of consequences are likely to follow which include;

- Firms may reduce their staff or may close down all together. Staff retrenchment is already a reality.
- Fee bids by consultants will become extremely keen and may not allow the successful bidder to make any profit out of the commission.
- Tender prices submitted by contractors will be uneconomically low, with adverse effects on all participants in the construction process.
- Training and education where resources are already limited will suffer.
- The availability of money to finance research and development will be limited.
- The limited available human resources both professional and otherwise may leave the industry permanently with dire consequences for any recovery in the medium term.

Government policies remain vital to construction. If the economy is weak, the industry will suffer, and its participants will try to alleviate that suffering at the expense of others including clients. It will not be easy to create teamwork or a vision for construction if the industry is struggling to avoid losses. The industry itself has to consider even more rigorously, filling any gaps by turning to private financing or joint activities with the public sector, and in particular overseas work.

## **2.2 Significance of the Construction Industry**

Although the construction industry contributed only an average of 3.89% towards the country's GDP over the period 1985 to 1995 <sup>1</sup>, it permeates all industries. A successful construction sector provides the infrastructure support for water, mining, manufacturing, agriculture, and transport and services such as health, education and tourism. The importance of a vibrant construction sector cannot therefore be underestimated. <sup>2</sup>

The potential growth of the construction sector is also influenced by population growth and its impact on urbanisation. If current trends in population growth hold, Malaysia is expected to have a population of 22.7 million people by the year 2000 and 34 million by the year 2020 from approximately 18 million in 1990. The level of urbanisation is expected to reach 50.2 percent by the year 2000, 60 percent by the year 2010 and 74 percent by the year 2020.

The demand for urban housing and supporting infrastructure including transport, water supply, sewerage etc. is expected to increase. To meet the new growth targets, as well as support the industrialisation drive, infrastructure development is expected to expand over the next 30 years. Despite the current downturn there is considerable room for growth of the construction sector in the long term.

## **2.3 Cyclical Growth of the Construction Industry**

The Construction Industry mirrors very closely the economic well being of the country. The long term economic growth of the market orientated economies has a built in tendency to generate cycles of different periodicities. Since independence in 1957 Malaysia has suffered 3 business cyclical setbacks <sup>2</sup> which have translated into a downturn in construction. The first was in 1968 and 1969 due to political instability but was of short duration and considered a mild setback. The second was on 1976 to 1978 which was a slowdown from preceding years of growth. The third was the period 1984 to 1987 and part of 1988. This was a period of severe recession and was a considerable set back to the industry including the permanent loss of skilled personal who left the industry for good in the period. Since that time and in the last decade Malaysia experienced a rapid growth in all sectors and construction grew in double digit figures until the downturn marked by the currency turmoil of October 1997.

During accelerated growth and in the frenzy of construction activity, poor design, hasty construction methods and poor quality control can result. Only limited consideration is given to future cost of ownership particularly as the majority of existing assets are in good condition and the focus is primarily on increasing capacity. Cost of construction was of secondary importance as capital appreciation guaranteed good returns without the associated need to improve

productivity and control. Under the current economic climate and financial constraints, construction like other sectors of the economy will need to brace itself for more competition, lack of orders and clients who are likely to shop around for the best deal. Under these circumstances it is imperative to innovate and provide customers value for money through technology inputs and product delivery which is second to none.

There is also a need to consider new business opportunities both locally and internationally so that the Industry is better able to cope with economic down turns. Reinstatement, refurbishment and maintenance management of structures are likely to provide significant business opportunities and need to be considered seriously for the future<sup>2</sup>. In this regard the systematic procurement of international business is the other significant business development opportunity which needs to be pursued.

### **3.0 PROJECT VISIBILITY AND THE TRANSFER OF SKILLS**

Malaysia was the centre of some of the largest building and infrastructure projects in the last decade. We have leap frogged into the era of modern advanced technology under the leadership of major foreign contractors, architects and consultants. Projects of high visibility such as these include the Petronas Twin Towers, the Light Rail Transit System 1 and 2, the Singapore-Johor Second Crossing and the New Telekom headquarters to name a few.

The World's Tallest Building The Petronas Towers<sup>3</sup> in particular has put Malaysia in the international map. While the vision for the project came from the Prime Minister, it was realised by American Architects and Structural Engineers and built by the Japanese (Hazama) and Koreans (Samsung). Besides the involvement of a local Consulting Engineering Company (Ranhill Bersekutu Sdn Bhd) as a joint venture partner in structural design and the ready mix concrete companies supplying high strength concrete, the primary Malaysian inputs were minor and non-strategic.

In the face of it despite the accolades received for realising such a stunning project, the Malaysian Construction sector cannot as a whole claim to have developed local resources which can undertake such a project independently, let alone have a strategy to becoming a world leader in high rise construction. The primary cudus has infact gone to the foreign consultants, contractors and project managers who have not only applied engineering skills to a world first, but have in the process learnt about the construction process in a tropical environment. Of course there have been spin offs for Malaysia. Today the ready-mixed concrete industry can deliver high strength concrete if required and the benefits of this have been realised on several projects. Further the leading Malaysian consultant involved in the project is now the sole consultant in another impressive project taking shape in Kuala Lumpur the new Telekom head quarters<sup>4</sup> in Pantai, a 77-storey building of stunning architecture and complex engineering. However, more could have been achieved if high rise construction and the application of high strength concrete could have been developed as a strategic focus for Malaysian construction during the development of the Petronas Twin Towers. For instance the use of High Strength concrete in design of tall structures is a

relatively new development. No codes adequately provide for this and there is even less information of its use in the tropical environment. While a limited amount of applied R & D, related to constructability issues, was undertaken by the Author<sup>3</sup> on behalf of the contractors during the project inception the opportunity to monitor the structure and learn from the experience of the use of HSC in a tropical environment was in effect missed. Such a move could have given Malaysia the international recognition for Engineering skills unavailable elsewhere.

The STAR LRT System 1 is another good example where advanced technology such as the balanced cantilever method and match-casting of structural elements for viaduct construction has been successfully undertaken under the leadership of Taylor Woodrow a British contractor. Several of the sub-contractors involved in this project later became involved in the Renong led LRT system 2, currently under construction. Again more could have been done to focus transfer of skills to local entities with the specific aim of developing a skills base in viaduct construction which is increasingly a feature in infrastructure developments the world over.

There needs to be a more concerted effort to transfer advanced skills to the local construction sector so that Malaysian contractors and consultants can become world leaders in fields identified as potential growth areas not only in Malaysia but internationally. We cannot accept mediocrity and must take a lead. We must also accept that we cannot be world leader in all aspects of construction, there is a need therefore to identify our vision for the future. A good example of the latter is the construction of the North-South highway where through foreign involvement Malaysian contractors / consultants developed expertise in highway construction and build-operate transfer techniques. Today Malaysian led consortia are winning major road infrastructure projects in India and it is certainly comforting that much of the privatised road projects in Malaysia in the last 5 years have been undertaken by local consortia.

Such transfer of technology and development of expertise needs to be planned as part of our vision for the new millennium. The emerging global market allows the worlds best contractors and consultants to work in any country without restriction. There is simply no room for mediocrity. Underpinning such a move forward will be a highly skilled, well rewarded and confident workforce at all levels of the Industry.

#### **4.0 FROM NORMAL CONSTRUCTION TO ZERO DEFECTS<sup>5</sup>**

Construction must be one of the few industries where defective work is part of normal service. The industry has a culture of temporary completion certificates, post-handover snagging and defects liability periods in which defects are tolerated. Rework that results from defects is a significant factor in the high cost of construction and low profitability.

When defects are found it is not usually difficult to find out what has caused the problem. However the lessons are not learnt and the same mistakes are repeated time and time again. There is a need to move from normal construction to a zero defects culture. Getting the work right first time should be the aim of the construction Industry. Such a development cannot take place without the appropriate skills development at every level in the Industry.

A recent study in United Kingdom<sup>5</sup> which involved interviews of a representative group from across the whole construction industry and a survey of actual projects, set out to define elements of construction which can lead to zero defect construction. This study identified the following important features for a projects success or failure.

- **PRECONSTRUCTION TIME** - This was considered critical for detailed planning and design review. If a client wants a project completed earlier the temptation to compress this time should be resisted or the quality will suffer.
- **INTERFACE RESPONSIBILITY** - A clear responsibility needs to be defined for the design of the junctions between components of a structure and also for co-ordination of the interfaces between the component designers.
- **FEEDBACK** – This appears to be an industry weakness. Construction companies in general do not have a formal system for managing feedback. It is fundamental that reasons for success or failure are learnt, understood and reused.
- **TEAM COMMITMENT** - Sub-contractors should be involved at an early stage of the project to help improve design and buildability. Holding on site workshops before the work starts helps to build teamwork and to highlight the critical issues for success. Having an established design team has significant advantages.
- **PREFABRICATION** - Building in this way can give higher quality standards and fewer defects but requires repeatability for it to start to balance the extra costs of an assembly plant and deliveries.
- **CLIENT BRIEF** - The professional team need to ensure that the clients business needs are understood and that the client has given sufficient time and thought about future use.
- **TEAM BRIEFING** - The brief needs to be spread throughout the project team and this should include all sub-contractors and material suppliers.

These findings though based on a United Kingdom study have some relevance to the Malaysian Construction Industry. Not only is there a need to upgrade the skills and professionalism of construction personnel to meet these challenges, there is also a clear need to involve clients more intimately in the construction process. Training and exposure of clients also needs to be considered. Unrealistic demands and unreasonable deadlines make it impossible to deliver a quality product fit for its purpose. The industry cannot afford to continue accepting such requirements without the real possibility that significant problems will surface well after the projects are completed and, therefore tarnishing further the image of the Industry.

Only with experienced qualified personnel can a zero defects culture be developed. It requires a deep understanding of the processes, techniques and materials used in the project. Continual training and skills development become essential to move forward in this regard. The development of a 'skills requirement matrix' for each project should be considered. This requires an assessment right at the start of a project as to how well the project team meets the required profile .

## **5.0 THE CASE FOR MODULAR CONSTRUCTION AND STANDARDISATION**

Even prior to the present downturn there was a clear move in the industry to increase productivity to achieve greater construction volumes. This meant considering industrialisation in all aspects. This is likely to be even more critical under the present conditions where a decline in GDP growth and the departure of foreign labour are already on the cards. A greater emphasis needs to be placed on the creation of systems, processes and approaches that are advanced and capable of propelling the construction Industry to becoming highly industrialized. The term industrialisation covers all measures needed to enable the industry to work more like the manufacturing sector. This means the introduction not only of new materials and construction techniques, the use of dry processes, increased mechanisation of site processes and the manufacture of large components under factory conditions of production and quality control; but also improved management techniques, the correlation of design and production, improved control of the selection and delivery of materials, and better organisation of operations on site. It is interesting to note that in the 60's when system building was first applied earnestly in the United Kingdom <sup>6</sup>, the competition acted as a spur to the traditional side of the industry into greater efficiency. The lessons learnt in developing higher management skills and planning techniques had infiltrated into this side of the industry. This is a clear indication that much can be done to improve the present conventional construction methods relying on in situ concrete and formwork systems to achieve greater efficiencies. Considering the individual nature of the construction projects, the need to enhance and develop this traditional side of the industry could be the most effective way to improve productivity. Such possibilities as using prefabricated reinforcement cages and precast concrete formwork as part of the final structure needs to be pursued as part of the process of developing efficiency in traditional construction.

In the case of housing provision for instance the 7<sup>th</sup> Malaysia plan (1996 to 2000) has targeted the construction of 800,000 housing units. Of this 740,000 units are required to meet the growing population characterised by a declining household size and the balance of 60,000 units as replacements. Of the total target, the private sector is expected to deliver 570,000 housing units or 71%. This is a much higher target than that achieved under the 6<sup>th</sup> Malaysia plan (1991-95) when the private sector met the low-cost housing target by building 217,000 units. Industrialised housing can go some way to providing these needs on a timely and cost effective manner. At present it is normal for each structure to be designed as a one off. Whilst this leads to structures with varied appearances, tailored to the requirements of the individual clients it also has many drawbacks. More rationalization and standardization within the industry can have several positive effects:

- Easier application of manufacturing processes to fabrication; reducing site work, improving quality (hence durability), health and safety and efficiency. Reduction in the learning phase for the work force on each project
- Reduction in the learning phase for suppliers on each project improving the chances of the correct products being supplied
- Further possibilities for mechanization of construction processes reducing site staff and improving efficiency
- Rationalization of communications, particularly IT leading to better relationships within the construction team
- Reduction in Labour resources with increased efficiency

This increased rationalization / standardization does not necessarily have to result in uniformity of appearance, rather it should be used to provide customized solutions using standard components. The implementation of industrialized building systems requires a multi-disciplinary approach where focus on issues such as modular dimensions, is within the purview of the designer / consultant while the production and delivery of pre-fabricated panels is the purview of the manufacturer and requires mechanical / production engineering skills and knowledge of plant and process technology. Care however needs to be exercised in the wholesale adoption of system pre-fabricated building. There needs to be some form of appraisal of new systems, either through a central agency or appropriate technical centers, if Malaysia is to avoid the pitfalls of using poorly developed building systems which are inappropriate for the local tropical environment.

For any successful development of systems building there needs to be economies of scale. High capital investments and overheads of factory, plant and transport make it essential for system building to have continuity of work load if it is to operate at its most efficient and economic. In this context a review needs to be made of existing system building approaches in the country and the selection of the least 3-5 systems technologies available as a basis for standardization. The major difficulties during the implementation phase are likely to be establishing adequate quality control of units, the accuracy of placement of units in position in the building and the efficiency of site management. The greater speed of erection of system building and the reduced time between operations requires a higher quality of performance from site management than traditional methods. All of these require a rigorous skills development programme to be implemented.



## 6.0 INNOVATE OR PERISH - ROLE OF R & D AND TECHNOLOGY

### 6.1 R & D Approach and its relevance

From the point of view of a construction company be it designer, contractor, sub-contractor or supplier any R & D which it undertakes must result in benefit to itself. It must

- Open Up New Markets
- Increase Market Share
- Increase Profitability
- Reduce Risk
- Reduce Tender Price

The R & D must therefore give the company an edge in the market place. Materials suppliers in the industry take a lead here as the benefits of R & D are fairly clear with "customers" fairly well defined. On the other hand following through the traditional way a building is constructed (i.e.) in stages as shown in Figure 1<sup>7</sup> it is difficult for benefits to accrue from innovation.

- Designer* - Introduction of new ideas which for instance can result in cost savings is of no interest as design fees are reduced, and there is exposure to extra risk.
- Contractors tender to a design, there is no financial advantage in introducing innovations. Any cost savings will be passed onto the client, and contractor takes on extra risk while the designer will have to be indemnified.
  - Sub-contractors not involved in the tendering process and usually works for fixed lump sum. Any innovation introduces risk and he is not able to spread costs of development over several projects unless he is guaranteed repeat work.
- The Client* - Normally only interested in cost and timely hand over to realize investment. Usually not familiar with construction, relying on designer - contractor for technical solutions.

In the current framework of the construction process therefore there is apparently very little opportunity for deriving benefits from R & D. This is a limited perspective, R & D can augment the competitiveness of a contracting entity with the mobilization of technical knowledge and expertise. The advantages<sup>8</sup> could be wide ranging and includes

- a) Cost advantage

Quicker site operations  
Cheaper materials  
More economical design  
Better site performance  
Better whole life costs

b) Commercial Advantages

More competitive tenders  
Alternative design tenders  
Improved Public Perception

c) Risk Reduction

Quantifying risk  
Reduction of unforeseen circumstances  
Building Right first time  
Improved a Quality Control

These advantages may be achieved in several ways, including

- Specialist advice at Pre-tender stage or contract stage
- Development of relevant techniques, materials, processes or procedures
- Problem identification and solving during contracts
- Availability of state of the art information
- Providing relevant technical training of site staff

## **6.2 R & D Opportunities and Needs**

There is a need to develop a strategy framework of research and development<sup>7</sup> which can lead to improvement and benefits for the industry. The first premise is the exploitation of existing knowledge through application and training. The other broad themes are standardization, durability, whole life costing<sup>9</sup>, teamwork, Environmental considerations and the application of IT.

A major problem of the construction industry as a whole is a general lack of technology transfer on site work. Emphasis needs to be placed on the usage and understanding of technical knowledge which already exists and to generate new knowledge. In any strategy for R & D in the industry the dissemination of knowledge should form a central goal. This should be a two way process including feedback from sites to a central location.

A primary problem which needs to be considered in construction is the dissemination of existing knowledge. Currently existing knowledge is not

exploited by those who it could most benefit. Having the appropriate team of construction technologists to convert existing information into a usable form is the most basic R & D which needs to happen. This can have profound impact on an organization without the need for high capital expenditure. While this information can be disseminated through technical journals its impact will be limited to a select number of professionals. Other methods of informing the whole of the construction industry, of the current best practice, needs to be investigated. The use of information technology to achieve the above objective should be urgently considered including the use of CD ROM's and the Internet. The technology for this to happen is available now however the technical support needed to take this forward needs to be systematically assembled.

The integration of IT, linking client, consultant and contractor needs to be considered. This includes the promotion of standards for sharing information, developing common techniques of computer aided design and IT Project Management Skills, and the dissemination of specific solutions to problems.

Greater Integration of roles in the industry can bring lasting benefits. Particularly the involvement of contractors at the design stage to improve buildability and hence quality, health and safety, and efficiency. In addition, involvement of the concrete supplier at an early stage could ensure that the correct concrete is specified again giving improvements in quality and efficiency. Considering the industry overall, better teamwork in the form of better communication should reduce misunderstandings and lead to more efficient supply chains and less claims. This can be achieved by creating a win-win situation where the professionals benefit by enhancing their role in projects and being rewarded for technical innovation and cost savings, and the contractor for quality work and enhanced profit.

## **7.0 TRAINING and SKILLS DEVELOPMENT- UNDERPINNING THE VISION**

The need for training at all levels within the construction industry although well recognised and often discussed, remains largely unfulfilled. The lack of experience of clients and designers heavily influences the design and construction process. Designers and contractors must have a good understanding of the construction process while supervisors, clerk of works and operatives who actually handle the day to day on site issues are the critical link to the delivery of any project. Many clients have limited experience of the design and construction process. Designers' understanding of the construction process is often limited to their personal experience. Training and feed back needs to provide them with wider understanding of the process. The need for a well trained workforce is without doubt an essential ingredient to achieving a vision of a modern, well organised construction industry which will be the pride of the nation. The productivity gains that can be achieved with a skilled work force can be clearly identified and the resultant reduction in the incidence and level of construction defects. Avoiding the risk of rework and the resulting extra costs could make operative training and qualification a sound investment.

The construction industry in Malaysia has developed in leaps and bounds despite the complete lack of any recognisable skills development programme. However there is much evidence to suggest that in fact this has been achieved only by overmanning and therefore unproductive use of resources. In 1990 the industry employed 250,000 persons with about 30% of the workforce directly involved in the residential construction market. This figure had increased to >370,000 in 1993 and was estimated to be approximately 750,000 in 1997 prior to the economic crises. It is estimated that some 350,000 of these workers are foreign.<sup>10</sup> The construction industry is therefore an important sector of the economy for employment.

With the current crisis foreign workers will be repatriated once they are not employable. As a significant proportion of the unskilled and semi-skilled construction workers are foreign, there is an urgent requirement to address the human resourcing needs of the construction sector. The use of local resources, as an alternative replacement, as several thousands school leavers enter the labor market each year after completing their secondary education needs urgent attention. In order to encourage participation in construction, several key areas of the industry will need to be improved so that working conditions and benefits equivalent to other industries are realized.

Training needs to be implemented in a systematic way with progress assessed and certified with the development of an accreditation system. This should happen across the board but should involve the transfer of both basic knowledge and the latest developments, customized to the local environment and needs. Much needs to be done to tropicalise available information for application locally and develop Malaysia as a center of innovation in this regard for the tropical belt countries.

The human resource development of Malaysians needs to be stepped up to fill the vacuum particularly in the trades skill. There is an urgent need to match resources with opportunities so that the construction sector retains a capacity to continue the delivery mechanisms in construction and contribute to growth which is inevitable once the present crisis is overcome. The Construction Industry Development Board (CIDB) is best placed to spearhead such a construction matching agency.

The following actions need to be considered:

1. Clients with little or no experience of construction need good professional advice and must have the impact of their decisions carefully explained to them by the project team.
2. Designers<sup>11</sup> awareness of construction issues can be improved by
  - Review and feedback systems
  - Improved lines of communication with the contractor
  - More site experience

Continuous Professional Development effectively organised through the professional institutions.

3. Experienced staff must have time to check the work of the less experienced engineers and technicians and pass on their experience.
4. Promote and reward staff according to their specialty and contributions to projects and prioritise such individuals for continuing development through training and project exposure.
5. Develop a recognizable skills training programme and certification which can be universally be applied in the industry.

## **8.0 THE WAY FORWARD**

Construction in Malaysia is presently very much a labour intensive service. The shortage of skilled workmen in the 1990's compelled contractors more and more to hire unskilled workmen just to complete the work at hand and meet deadlines. This shortage of new skilled workers and the stand still in progress of routine construction techniques and technologies contributed enormously to slipping productivity in the Industry. It contributed to a culture where defective work is part of normal service. Where mega-projects have been undertaken the transfer of skills have been less than satisfactory.

There are several compelling reasons to move the Construction Industry from a Labour intensive low productive sector to one which is skills-intensive. For a start Malaysia has a small population base and we do not have the luxury of numbers. At this time of scarcity and competing demands on resources waste cannot be tolerated. As we go into the new millennium barriers to trade will eventually have to give way to an open flow of business. Unless we can compete on an equal footing Malaysia will begin to lose its competitive edge. A skilled workforce which is continuously upgrading and developing itself is a key to the future.

The themes for the new millennium and a vision for construction should encompass

- Providing a Quality product which meets client requirements everytime
- Application of innovation and new construction techniques at every opportunity
- Increasing productivity and reducing overall cost through systems building and improvements in conventional construction
- Identifying niche areas in construction and develop world class skills through systematic transfer of technology
- Step up R&D and enhance usage of existing best practice guidelines updated for construction in a tropical environment
- Disseminate and Educate through IT at construction sites with mobile training units
- Promoting integration of roles in the industry through design and build, shared risk and teamwork.

- Involving construction professionals in the education and training of engineers and technicians at the centres of higher learning on a part time basis
- Move towards zero defects in construction
- Promote modularisation and standardisation in the industry

Whether it is providing a quality product which meets the client needs, implementing new building techniques or moving towards a zero defects culture in construction, training and skills development are critical to success. There is no doubt that the construction industry will need to move from a labour intensive structure to one that is skills intensive and highly productive if it is to survive into the new millennium.

Government needs to consider several immediate measures to assist the industry at this time of crises

- Construction to be treated as a priority area
- Provide housing contracts as part of the identified needs to ensure continuity of work. Such systematic provision of contracts will help the industry consider innovation in construction and improve productivity through economies of scale.
- Encourage third party certification of construction projects to speed up approvals and award of certificate of completion
- Encourage the development of training and certification and provide incentives such as tax rebates and subsidisation to reduce training costs
- Work hand in hand with the professional bodies to encourage innovation and development of world class skills in key sectors of the industry
- Insist on a systematic auditable transfer of skills as part of the award of mega projects to foreign companies to develop niche skills locally
- Bring forward the award of nationally required infrastructure projects to provide the local construction sector much needed work
- Support and encourage local companies pursuing work abroad more vigorously than before.

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**Figure 1** Traditional Construction Process

