EXECUTIVE SUMMARY

The increase in construction activity in the past 3 years led to a resurge in foreign workers demand. Concerns were raised on the low productivity level in construction compared to other sectors which has resulted in continuing high dependence on foreign workers. As an economic sector, construction currently contributes 6 percent of the country's GDP, but takes up 7.5% of the total workforce. It also uses 25 percent of the total number of foreign workers in Singapore.

A taskforce was formed by CIDB in mid-1991 to look at the issue of construction productivity. The terms of reference of the taskforce were:

(a) To ascertain the productivity level of Singapore's construction vis-a-vis that of other economic sectors, and vis-a-vis construction productivity levels in developed countries,

(b) To identify the underlying reasons for low productivity, and

(c) To recommend directions and programmes to improve productivity in the longer term.

Objective

The taskforce determined that the objective of productivity improvement is to reduce manpower usage in site construction at reasonable cost, while maintaining design variety and high quality work. As most foreign construction workers are deployed at construction site, reduction in site labour should reduce foreign worker demand.

Productivity Levels in Singapore's Construction Industry

In terms of value added per worker, productivity growth in construction averaged 3.1 percent over the past 10 years, below the national average of 4.2 percent and 4.5 percent for manufacturing sector. The recent construction boom saw a surge in productivity growth to 12.5 percent in the first quarter of 1992. However, based on experience in developed countries such as Japan (where the productivity gap between manufacturing and construction is widening), it is unlikely that productivity in construction will catch up with that of manufacturing in the long term.

The taskforce views that the productivity indicator of value added per worker has limitations because:

- Construction boom and bust cycles more severely affect value added.
- It only measures site production which is difficult to automate and therefore will always remain low.
- Value added can be eroded by increasing material costs over long construction periods.
Using an additional indicator of square metres of built-up area per manday enables Singapore's productivity level to be compared to those in developed countries. The productivity figures show that Japan’s construction is 30 percent more productive than Singapore’s construction, while a highly industrialised country like Finland is 60 percent more productive than Singapore. The high productivity in these two countries is linked with the level of prefabrication. Japan’s construction is 15 to 20 percent prefabricated while Finland is 40 percent.

If Singapore is to achieve the Finnish levels of construction productivity, a high level of prefabrication and standardisation is necessary. This will have to be carefully considered in view of rising client and consumer aspirations for more variety in design. The Japanese level of productivity may give a better balance between productivity and design variety.

**Reasons for Low Productivity Growth**

The taskforce views that low productivity is attributed to both design and construction factors. As design is mostly done separately before construction tender is awarded, the industry, in general, does not give sufficient attention to buildable designs. This is largely because:

- Traditional but labour intensive systems are still economical.
- The industry is still not familiar with buildable designs and standardisation especially in the area of prefabrication.
- Clients want more variety as long as labour cost is not significant.

Experience from a major developer such as HDB, has shown that efforts from the developer and designer to make designs more buildable has a significant influence on the final usage of workers on site. Also, the likelihood for productivity improvement is much higher when design and construction are more integrated, such as in design-and-build projects.

At the construction (production level), low productivity is affected by:

- An eroding local, skilled workforce base because of the unattractive construction environment, insecure employment conditions, lack of recognition and more attractive wages elsewhere outside Singapore.
- A large, transient and mostly unskilled pool of foreign workers which currently constitutes about 80 percent of the workforce actually undertaking construction work.
- An underdeveloped subcontracting sector which has remained unchanged in decades. There is no system to recognise and develop these firms who actually perform construction work and are the main employers of workers.
- Inadequate site management and applications of mechanisation and automation operations although much progress has been made in these two areas.

Japan's construction is 30 percent more productive than Singapore's construction, while a highly industrialised country like Finland is 60 percent more productive than Singapore.
Potential areas of Productivity Improvement

Analysis of labour usage show that 65 to 70 percent of construction labour are engaged in structural work and the 'brick and mortar' finishing work such as external and internal brickwork, plastering and tiling. There is therefore considerable potential to raise productivity in these two areas.

The major areas of focus should be:

- More prefabrication of structural components.
- Reduction or elimination of on-site beam construction.
- Replacement of brick and plaster external walls with precast, prefinished walls.
- Greater use of internal dry wall or high quality semi-dry block construction.

Long Term Directions

The construction industry has the potential to reach the productivity levels found in developed countries. It should aim at least to achieve the current Japanese productivity levels within 10 years. Productivity improvement, however, should be pursued at reasonable cost, maintaining high quality work, and be balanced with the need to provide adequate design variety to meet consumer aspirations. The long term directions should address both design and construction. They are:

- Development and promotion of buildable designs. This should proceed on 3 fronts:
  - Public sector projects should adopt buildable designs to demonstrate the advantages and benefits of such designs for various types of buildings.
  - Buildability technology should be developed and promoted. Priority areas are prefabrication of structural systems and architectural external and internal walls, taking into account lean production considerations. The process of education should begin at tertiary level.
  - More design-and-build projects should be promoted as they tend to result in more buildable designs. The public sector’s start in this direction should be extended.
Development of core of skilled workers. It is necessary to attract and train a new generation of skilled workers and trade foremen especially in the craft trades in finishing and building services. The development will focus on 4 areas:

- Apprenticeship training, by CIDB with Singapore Contractors Association Limited (SCAL) and key subcontractors.
- Better status and employment conditions for local workers, through promotion of worker welfare by NTUC and SCAL.
- Continued assimilation of skilled foreign workers.
- Expansion of training to include assembly type and foremen skills.

Foreign worker policies to encourage higher productivity. Foreign worker policies should continue to restrict the entry of foreign workers in such a way as to favour better skilled workers or labour substitution methods.

Development and recognition of subcontractors who are the main employers of workers.

Upgrading management and technological skills of main contractors through personnel and firm upgrading programmes and wider application of mechanisation and automation.

3 Year Programme

Within this general framework, the taskforce recommends a 3 year programme as outlined below. The implementing agencies proposed are in brackets.

(a) Start a major standardisation effort to apply prefabrication and buildability technology to replace labour intensive structural and "brick and mortar" architectural work (CIDB, HDB, PWD, MINDEF, JTC, PSA).

(b) Start a concurrent programme to source, adapt and/or develop prefabrication and buildability technology suitable for Singapore’s construction needs. The tertiary institutions should be persuaded to teach buildability technology (CIDB, HDB, PWD, MINDEF, JTC, PSA,REDAS, IES, SIA, SMA, NUS, NTU).

(c) Promote the use of procurement systems which integrate design and construction. The public sector should award more projects in which a greater portion of design is done by the contractor (HDB, PWD, JTC).

(d) Launch a construction industry apprenticeship scheme to recruit and train a younger generation of skilled workers, especially for finishing and building services trades (CIDB, SCAL).

(e) Set up a recognition system for subcontractors (SCAL).
(f) Start a management upgrading programme for local firms, professional and technical personnel (CIDB, SCAL).

(g) Study the long term scope and viability of the automation or semi-automation of construction processes (CIDB, EDB, SCAL).

The underlying reasons for low productivity growth, the strategic directions to raise productivity and the immediate programmes for the next three years are summarised on the next page.

Productivity Impact

The productivity levels of Japan and Finland provide benchmarks to peg our own productivity levels. The taskforce views that the current Japanese level of construction productivity can be attained within 10 years if the recommendations are carried out successfully. This means a productivity improvement of 30 percent over the long term. This will involve a prefabrication level of 15 to 20 percent on average for building construction.

Conclusion

The above directions and programmes will set the course for a more productive construction industry with less reliance on foreign workers in the long term. With concerted and co-ordinated effort to develop and promote prefabrication and buildability technology, making conditions more attractive for locals and controlled entry of foreign workers, the industry can attain the productivity levels in developed countries in the long term.

Achieving Japan’s current productivity level will involve a prefabrication level of 15 to 20 percent.
## SUMMARY OF FACTORS AFFECTING CONSTRUCTION SITE PRODUCTIVITY AND RECOMMENDED SOLUTIONS

<table>
<thead>
<tr>
<th>Factors affecting site productivity</th>
<th>Productivity Impact</th>
<th>Long term directions</th>
<th>3-year programme</th>
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<td>Major</td>
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<tr>
<td><strong>DESIGN FACTORS</strong></td>
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<tr>
<td>Insufficient attention to buildable designs</td>
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<tr>
<td>- Labour intensive systems still economical.</td>
<td>●</td>
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<td>- Start major standardisation effort for prefabrication and buildability technology for public sector. Promote to private sector.</td>
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<tr>
<td>- Unfamiliarity with buildability technology especially prefabrication.</td>
<td>●</td>
<td>●</td>
<td>- Source, adapt and promote buildability technology from abroad. Encourage tertiary institutions to teach buildability.</td>
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<td>- Clients want more variety as labour cost not significant.</td>
<td>●</td>
<td>●</td>
<td>- Award more public sector projects on full or partial design-and-build basis.</td>
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| Procurement system separates design from construction | ● | ● | |}

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<thead>
<tr>
<th><strong>CONSTRUCTION (PRODUCTION) FACTORS</strong></th>
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<tr>
<td>Eroding local workforce</td>
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<tr>
<td>- Wage insecurity.</td>
<td>●</td>
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<td>- Launch apprenticeship scheme.</td>
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<td>- Unattractive environment.</td>
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<td>- SCAL and NTUC to promote worker welfare.</td>
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<td>- Lack of recognition.</td>
<td>●</td>
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<td>- Attract skilled workers.</td>
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<td>Large transient foreign worker supply</td>
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<td>- Cheap, unskilled workers.</td>
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<td>- Develop assembly type and foremen training.</td>
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<td>- Revolving pool.</td>
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<td>- Continue to review foreign worker policies.</td>
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<tr>
<td>Underdeveloped subcontracting industry</td>
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<tr>
<td>- Lack of development of subcontractors.</td>
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<td>- Start list to recognise subcontractors.</td>
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<tr>
<td>Inadequate application of management and mechanisation/automation</td>
<td>●</td>
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<td>- Start management upgrading programme.</td>
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