Safety in Construction in Singapore: Policies, Assessment and Further Development

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Abstract

Safety performance in any organization or sector is an important consideration owing to the potential adverse effects of poor safety practice in terms of loss of life and property, and impact on psychological and social wellbeing of workers and their families, as well society as a whole. In almost all countries, the construction industry is one of the worst performers among the sectors of the economy with regards to safety performance. This has made construction one of the least attractive sectors of the economy in most countries. For this reason, governments in most countries have formulated programmes for improving performance in safety in the construction industry.

What is Singapore's record in terms of safety in the construction industry? How effective are Singapore's policies and programmes on safety in its construction industry? What are the drivers and obstacles? What are the future policy intentions? What can be done to facilitate the efforts towards attaining the policy intentions and targets?

Keywords: C21, policies, safety improvement programmes, Singapore

1. Introduction

Performance improvement has been a major consideration in Singapore's construction industry since the 1960s. In these regards, the following areas have been given priority: (i) buildability of design; (ii) maintainability; (iii) productivity; (iv) quality; and (v) safety. Several programmes and initiatives, supported by law, and with the provision of incentives and facilitating schemes, have been introduced.

The main agent in the formulation and implementation of the performance improvement programmes has been the government of Singapore. The government has long recognized the need for the country to have a construction industry which enables it to attain its developmental aspirations. The main agency has been the Building and Construction Authority (BCA), which was formed in 1984 (as the Construction Industry Development Board (CIDB) until its name was changed when it was restructured in 1999). Among the public-sector client organizations, the public housing authority, the Housing and Development Board (HDB) has lent its support by launching its own programmes, and providing its projects for demonstration and training purposes.

What has been the situation in performance improvement in the construction in Singapore over the past decade? What have been the policies? Which programmes and initiatives have been implemented? What has been achieved?

Research aims and objectives

The paper reports on part of an ongoing two-and-half year research study being undertaken to assess the implementation of the construction industry improvement programme in Singapore which had been launched with the publication of the Report of the Construction 21 Steering Committee (Construction 21, or simply, C21) at the end of the last century. The objectives of the larger research study are:

a. To ascertain and evaluate against their original objectives, the outcomes from the implementation of the construction industry performance improvement programme in Singapore since 1999.
b. To assess the respective roles of government agencies and the private sector including professional and trade bodies, in the implementation of the advocated reforms.
c. To understand the extent to which the institutional characteristics of the construction industry in Singapore influenced the implementation of the above reforms.
d. To draw lessons from the implementation programmes for future construction industry improvements in Singapore.
e. To develop a research agenda in support of ongoing efforts to realize improvements in the construction industry in Singapore.
f. To present specific recommendations for the development of appropriate performance metrics and targets, with particular emphasis on sustainable monitoring and continuing improvements.

The larger study is a collaborative endeavour involving the University of Hong Kong, University of Reading, UK and National University of Singapore. The broad intention is to undertake a review of the implementation of the industry improvement programmes which had been launched in the three countries around the same period (in the UK, following the publication of the Egan Report entitled "Rethinking Construction" in 1999; Construction 21 also in 1999, and the Report of the Construction Industry Review Committee" of Hong Kong in 2001. This paper focuses on the aspects of the study in Singapore which relate to safety in construction. It focuses on policy considerations at the broad industry level.

2. The Study

Research method

To accomplish the aims and objectives of the research study, empirical data was collected. It comprised a set of interviews, a questionnaire-based survey, a conference and an industry forum. In the interviews, 9 interviews were held with a total of 12 senior practitioners who had played key roles in the C21 process were interviewed to obtain their views on the impact of the initiatives of C21. They were mainly former presidents or senior members of the executive committees of professional institutions in construction, or chief executive officers of key organizations. The sets of questionnaires, which had been formulated from the review of the literature, were sent to 174 clients, 524 consultants (of different areas of specialization) and 1,671 contractors of various sizes.

Table 1 Questionnaires sent and response rates

Respondent	Sent out	Wrong addresses	Sub total	Usable responses	Response rate
Clients (public and private)	174	18	156	22	14.10%
Architectural firms	337	2	335	45	13.43%
Quantity surveying firms	44	1	43	11	25.58%
Engineering firms	143	7	136	29	21.32%
Main contractors	1,671	11	1,660	150	9.04%
Total	**2,369**	**39**	**2,330**	**257**	**11.03%**

3. Construction 21 report

The Construction 21 Committee on Manpower was established in May 1998 by the Ministry of Manpower (MOM) in Singapore to address the manpower problems in the construction industry. The main issue is the reliance of the industry in Singapore on foreign workers at the operative levels; around 80 percent of construction workers in Singapore are foreign workers from designated countries in the region. The MOM's committee was subsequently merged with the Committee on Practices in the Construction Industry set up by the Ministry of National Development (MND) to form the Construction 21 Steering Committee. The members of the committee and its task force were prominent practitioners representing both the public and private sectors.

The C21 Steering Committee, its task force and the four working groups comprised more than 80 persons who were drawn from the private, public, and people sectors. They were from:

a. professional institutions: Singapore Institute of Architects (SIA) and Institution of Engineers Singapore (IES);
b. trade associations: Singapore Contractors Association Limited (SCAL) and Real Estate Developers Association of Singapore (REDAS);
c. a regulatory agency: BCA;
d. a public client agency: Housing and Development Board (HDB);
e. the unions: National Trade Union Congress (NTUC);
f. tertiary educational institutions: Nanyang Technological University (NTU), NUS and Ngee Ann Polytechnic; and
g. the public.

The members of the committee undertook study missions to Hong Kong, Japan, the UK and US to learn the best practices in the industry.

It was initially intended that the committee would investigate issues related to labour supply and productivity in the industry, but it conducted a thorough investigation and cover many aspects of the industry, from Processes (practices, techniques, and integrated approach to construction) and Players (professionalism and skills) to Products (exporting expertise).

The C21 report, published in 1999, adopted the vision for Singapore's construction industry for the 21st century: "To be a world class builder in the knowledge age", with the change in public perceptions from a Dirty, Demanding and Dangerous (3D) industry to a Professional, Productive and Progressive (3P) industry. The radical tone of the C21 report is evident from its title, "Reinventing Construction".

The committee highlighted the following key problems of the industry in Singapore:
a. low productivity level and negative productivity growth;
b. multi-layered subcontracting system;
c. segregation of industry's activities;
d. poor worksite safety; and
e. malpractices and social problems.

The committee made 39 recommendations under the following six strategic thrusts:
a. enhancing the professionalism of the industry;
b. raising the skills level;
c. improving industry practices and techniques;
d. adopting an integrated approach to construction;
e. developing an external wing; and
f. a collective championing effort for the construction industry.

The C21 report highlighted the following desired outcomes of the transformation exercise:
a. a professional, productive and progressive industry;
b. a knowledge workforce;
c. superior capabilities through synergistic partnerships;
d. integrated process for high buildability;
e. contributor to wealth through cost competitiveness; and
f. construction expertise as an export industry.

In the C21 report, the subject of this paper, safety, was covered under strategic thrust 3: improving industry practices and techniques. Before discussing the field study of the research and its results, a summary of the current situation with respect to safety performance in the construction industry in Singapore is presented.

Current situation of construction safety performance in Singapore

In considering the current situation with regard to safety performance in the construction industry in Singapore, it is pertinent to discuss developments since the launch of the C21 report. The C21 report recommended the introduction of the Construction (Design and Management) Regulations after the enactment of the Occupational and Safety Health Act (OSHA) in 2000/2001. To this end, the first significant development was the introduction of the new Occupational Safety and Health (OSH) framework on 10 March 2005. It was guided by three basic principles: requiring all stakeholders to eliminate or minimize the risks they create, instilling greater ownership of safety and health outcomes by industry, and preventing accidents through higher penalties for poor safety management (MOM, 2008). The target was to halve the occupational fatality rate within 10 years and attain standards of the current top 10 developed countries with good safety records.

The Joint MND-MOM Review Committee (JRC) on Construction Safety was convened after the two major accidents in Singapore in quick succession in April 2004. These are known as the Nicoll Highway and Fusionpolis Complex incidents in April 2004 to review the regulatory framework and ancillary systems to raise safety standards in the construction industry (JRC, 2005). The committee identified gaps in the regulatory framework and ancillary systems. It made recommendations to help strengthen the legislative provisions pertaining to temporary structures; raise the professionalism and competency of professionals, contractors, and supervisors; and make transparent the public sector procurement system to take safety into account.

The Workplace Safety and Health Act (WSHA), which came into effect on 1 March 2006, is an essential part of the new safety framework in Singapore. It replaced the Factories Act. Under the Factories Act, the main contractor was principally accountable for ensuring worksite safety. This had engendered a culture where safety was viewed as being only the concern of the main contractor. WSHA prescribes general duties for owners, occupiers, employers, designers, suppliers of machinery, equipment and hazardous substances, and individual workers. This is consistent with the principle of holding accountable those who create risks or have primary control over these risks (JRC, 2005).

The Construction (Design and Management) or CDM Regulations require designers to work closely with contractors in thinking through safety management for the entire life-cycle of a project. The UK implemented such regulations in 1995, and adherence to its principles have since helped its construction industry achieved one of the best safety records in the world (Gan, 2008).

The WSH Council, established on 1 April 2008, comprises 18 leaders from the major industry sectors (including construction, manufacturing, marine industries, petrochemicals and logistics), the government, the unions, and professionals from the legal, insurance and academic fields. The council works closely with MOM to improve WSH performance in Singapore. The MOM has been working with the Workplace Safety and Health (WSH) Council in Singapore to develop this set of guidelines based on the UK's CDM Regulations. With the new guidelines, the construction industry will be better able to fulfill one of the key principles of the WSH framework – "eliminating risks at source". It aims to create buildings that are safe to build, safe to maintain, and safe to demolish (Gan, 2008).

“Implementing WSH2015 for Construction Industry” was launched in 2007 to guide the efforts of the construction sector. Since then, there have been many key developments with regard to the formulation and implementation of policy on safety in the industry. These include the development of the Construction Safety Audit Scoring System (ConSASS), the review and enhancement of the mandatory Construction Safety Orientation Course (CSOC), the publication of the construction accident case study booklet, the release of the Guidelines on Design for Safety (DFS) in Buildings and Structures as well as the inaugural Construction Chief Executive Officer (CEO) Summit, where CEOs from top construction companies signed to pledge management commitment for zero injuries.

The construction safety guide has since been updated to include areas for enhancement and new areas of work to achieve sectoral targets by 2018.

”Implementing WSH 2018 for Construction Sector in Singapore” (WSH Council, 2010) was published in April 2010 as part of the national WSH 2018 strategy. It sets out the targeted outcomes, and the key strategies and initiatives to further enhance WSH standards in the construction industry in Singapore. The aim is to guide all stakeholders to create a safer and healthier construction industry with a progressive and pervasive WSH culture.

According to the guide, the long-term goal is to achieve zero injury in the construction industry. Figures 1 and 2 show the current statistics on construction safety in Singapore. The more immediate goals are:

a. A workplace fatality rate of less than 3.4 fatalities per 100,000 workers by 2013 and less than 1.8 fatalities per 100,000 workers by 2018; and
b. Workplace injury rate of less than 390 injuries per 100,000 workers by 2013 and less than 200 injuries per 100,000 workers by 2018.

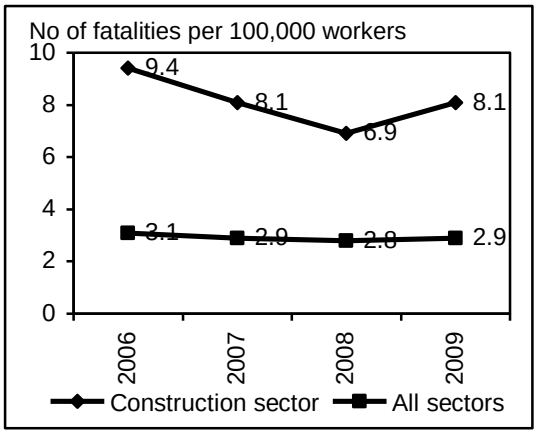

Figure 1 Accidents in the construction sector by fatality rate compared to all sectors, 2006-2009
Source: WSH Council (2010)

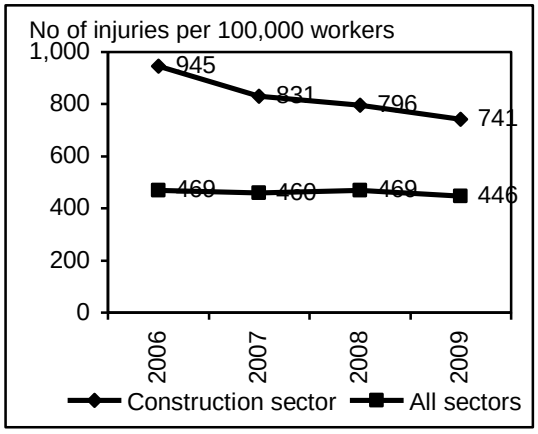

Figure 2 Accidents in the construction sector by injury rate compared to all sectors, 2006-2009
Source: WSH Council (2010)

The guide specifies action plans to improve WSH standards in the construction sector. These plans are as follows:

a. Strategy 1: Building strong capabilities to better manage WSH
    - Individual level: management, workers and supervisors, WSH professionals, designers and architects
    - Corporate level: self investigation, managing main and subcontractors
    - Industry level: enhancing Risk Management (RM), cultivating WSH culture
b. Strategy 2: Developing a performance-based regime
    - Include designers and developers in the regulatory framework
    - Improved management of workplace health
    - Self regulation
    - Setting industry standards
c. Strategy 3: Promoting the benefits of WSH and integrating WSH into business
    - Driving improvements through large organizations
    - Assessment of safety and health management systems
    - Business case

d. Strategy 4: Creating and building partnerships
    - Coordination of work
    - Industry-led taskforces.

4. Results from the field study

As mentioned above, empirical data and information for the study were collected through a set of interviews and a questionnaire-based survey. It is pertinent to state again that this paper reports only on the part of the study which concerned safety.

Interviews

Nine in-depth, face-to-face, interviews with twelve key people in the industry were conducted in September to November 2009. The interviews were intended to gain a better understanding of the implementation of the C21 report from the people who have been involved during the preparation of the report or during the implementation period.

On construction safety, the interviewees acknowledged the progress on the safety regulations. However, despite the extensive regulations on construction safety, one interviewee believed that it is the mindset of the developers, project managers, and contractors that should be improved. Emphasis on safety should also be placed on the lower levels, such as the supervisory and workers levels. Teo and Phang (2005) found that contractors understand the importance of a safety culture but do not have the right mindset or attitude towards implementing it. One interviewee felt that Singapore construction is still lag behind in terms of safety. He commented: “In terms of safety, we are just two or three only on a scale of one to ten, considering where we’ve started from – zero”.

Questionnaire survey

A questionnaire survey was conducted to assess the effectiveness of the strategic thrusts. As mentioned above, 2,369 questionnaires were sent to the stakeholders of the construction industry in March 2010. A total of 257 usable responses were received, which reflected a response rate of 11.03%.

A number of questions were asked to assess the level of effectiveness of the measures under Strategic Thrust 3 (improving industry practices and techniques) of the C21 report. The respondent was asked to rate the level of effectiveness from a scale of 1 to 5 (1 being very effective and 5 being not effective at all).

Mean ratings were calculated from the feedback received. Besides the overall mean, mean ratings were also calculated for the three different categories of respondents, which were clients, contractors, and consultants. The purpose was to ascertain whether different construction industry participants had different views about the various initiatives presented.

The average of the means for construction safety was 2.36. All three groups of respondents agreed on the measure that had been rated the lowest in terms of

effectiveness. It was the reduction of the number of unskilled foreign workers on site. The consultants and main contractors indicated the development of a pool of supervisors trained in proper site management and site procedures as the measure with the highest rating in terms of effectiveness. For the clients, the measure with the highest rating with regard to effectiveness was providing harsher penalties for poor safety management.

Factor analysis was also performed in order to extract the underlying constructs out of a set of observed variables. Under strategic thrust 3 of the C21 report, three factors were extracted. The order of factors was the same for all firms and main contractors: quality (Factor 1), buildability (Factor 2), and safety (Factor 3). It shows that main contractors believe that the quality measures under strategic thrust 3 had been most influential to improve industry practices and techniques, above buildability and safety measures. For consultants, the most important factor is buildability (Factor 1), followed by quality (Factor 2), and safety (Factor 3).

5. Discussion and recommendations

In Singapore, the safety improvement program in the construction industry has gone through a long period of intensive development, during which some of the changes have been quite radical. The country has learned from the experiences of other countries. The measures have included:

1. Increasingly more stringent legislation and regulations targeting the construction industry
2. Mandatory requirements in terms of safety personnel and implementation of management systems. These include not only the employment of safety managers, but also, that of various types of engineers for particular types of projects
3. Establishment, resourcing and strengthening of relevant public organizations such as the office of the Commissioner of Safety, the Workplace Safety and Health Council and the Workplace Safety and Health Institute
4. Launching and offering training programmes and instituting mandatory requirements on minimum levels of attainment by various categories of personnel
5. Offering of business incentives on the basis of safety performance through revisions in the procurement mechanisms and criteria to accord safety some weight in the evaluation of bids for projects
6. Fostering a culture of safety awareness and continuous improvement
7. Establishment of effective government-industry collaboration for enhancing safety performance.

The review of the literature showed that the current safety targets set in Singapore are highly ambitious when compared with the previous record. Among the sections of the economy, the construction industry will face the greatest challenge in meeting the targets.

The field study showed that, whereas construction practitioners welcomed the initiatives which had been introduced with regard to safety after the publication of the C21 report, they considered them to be the least effective when compared with those which had been put in place to address industry performance. There are setoffs and tradeoffs which must be considered at both the design and construction stages when

seeking to attain the improvement in performance along the key parameters of cost, time (productivity), environmental considerations, quality, maintainability (durability), and health and safety. In Singapore, assessment systems for several of these areas are already in place, and are being used extensively, in some cases, being mandatory requirements. These include:

1. Buildable Design Assessment System (BDAS)
2. Construction Quality Assessment System (CONQUAS)
3. Constructability Assessment Score
4. Green Mark Scheme – for assessing the environmental performance of various types of buildings and infrastructure.

The scores on all these assessment systems are widely published to enable benchmarking within the industry. There is a challenge for the research community to develop measurement and benchmarking, evaluation and monitoring frameworks which combine these different metrics. Then, computer-based decision-support systems could be developed. In the continuing research on Building Information Modelling which is now being accorded a great deal of attention in the construction industry in Singapore, it would be appropriate to devote effort to the incorporation of such a framework in the models.

As so much in Singapore's construction industry depends on government leadership as translated into legislation, regulation, policy, programmes and enforcement, it is necessary that these instruments, systems and mechanisms are the most appropriate, most effective and most efficient. For example, the field study on this research identified the measures which have been effective (training of supervisors and institution of stiffer penalties). This calls for more joint action by government and industry, and for greater consultation of industry by the government, and the putting in place of effective feedback systems for garnering inputs into the periodic fine-tuning or revision of laws, policies and initiatives. The collective championing effort between the BCA and CIJC which had been envisaged in C21 is highly relevant with respect to the initiatives on safety.

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