5 Towards iN2015 – Implications for the Construction Industry on Its Future Standardisation and ICT Programmes

Building an intelligent construction industry complements the aim of iN2015. The article highlights prevailing standardisation and ICT developments in the construction industry and suggests new areas in view of globalisation and rapid technological change. A review of current issues and recommendations on the thrusts of creating an active information standardisation community, promoting IT use to smaller businesses and promoting IT use to larger businesses is made. As the next phase of standardisation efforts, process modelling is proposed as a natural progression from 3D to 4D models. On the potential of Singapore construction-sector companies becoming intelligent, the systems and applications to be acquired are discussed. The article concludes that in the long run, the industry still needs to close the technology and knowledge gaps through innovation, research and training. And, it continues to emphasise that integration of people, processes and technologies is crucial for creating a holistic ICT solution for an intelligent enterprise.

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1 Introduction

The Intelligent Nation 2015 (iN2015) is a 10-year master plan that will transform Singapore by enhancing the competitiveness of key economic sectors and build a well-connected society through the use of infocomm technologies (ICTs). As described by the Infocomm Development Authority of Singapore (IDA), the broad intent of the master plan is 'to grow the infocomm sector, and chart the use of technology for work, life and leisure'. And, in order to achieve this aim, the plan will have to involve identifying new possibilities for Singapore's industries, economy and society through the innovative use of ICTs. In particular, IDA had unveiled in its roadmap the next era of technologies to include nanotechnology and biocomputing whereby 'context-aware sensors and intelligent agents will automate, analyse, synthesise and present personalised information to users in a proactive way'.

In relation to iN2015, there will be implications for the Singapore construction industry and, mainly, for the Construction Industry IT Standards Technical Committee (CITC). Its primary role is to establish an industry-wide framework for the development and promotion of information technology (IT) standards in the construction area. The formation of the Construction and Real Estate Network (CORENET) in 1993, as well as the CITC in 1998, has demonstrated a joint government and industry effort to prepare the construction sector for the IT age of the 21st century through the re-engineering of business processes in order to achieve a quantum leap in turnaround time, productivity and quality. The CORENET revolves around developing IT systems and key infrastructure to integrate the four major processes of a building project life cycle.

This article discusses the 'gap' between the construction industry's current information standardisation programme and new requirements to arrive at the goal of iN2015. Specifically, the discussion brings together current issues of concern as have been identified in a number of studies carried out since the first local construction IT standard (i.e. SS CP 80 : 1999) has been published. Correspondingly, recommendations have been made and, in this article, they are reviewed under three broad thrusts:

a) To create an active information standardisation community;
b) To promote IT use to smaller businesses; and
c) To promote IT use to larger businesses.

The 'gap' is further discussed in the context of building enterprise intelligence. In line with the broad intent of iN2015, the construction industry must acknowledge the potential value of applying intelligence to organisations by leveraging on ICTs. And, in the long run, closing the gaps of technology and knowledge is only achievable through innovation, research and training as proposed.

2 Globalisation, Technology and the Knowledge Economy

Evidently, globalisation and rapid technological change will drive the knowledge economy. In recent years, globalisation strategies have increasingly obtained an important role in strengthening the competitiveness of a country's economy. Specifically, ICTs are considered as a key factor and driving force since they are cross-sectoral technologies, affecting nearly all aspects of the economy and society.

> *In the age of knowledge and artificial intelligence -*
> We are at the dawn of an age of networked intelligence - an age that is giving birth to a new economy, a new politics, and a new society. Businesses will be transformed, governments will be renewed, and individuals will be able to reinvent themselves - all with the help of information technology.
> - Tapscott, 1996 [1]

In the global marketplace, it is highly crucial that businesses know the importance of managing knowledge in order to sustain competitive advantage. Essentially, knowledge management promotes an integrated approach to identifying, managing and sharing all of an enterprise's information needs. With the use of IT, various information systems can be set up and integrated with knowledge gathering and analysing tools for data analysis and dynamic end-user querying. And, in an increasingly collaborative business environment, such solutions would enable an enterprise to improve customer service and partner relationships, and to create marketable knowledge products from an enterprise's own internal data.

IT for socioeconomic development -

To survive in the emerging complex business environment, organisations are constantly examining their operations to devise means to respond quickly to the changing needs of customers to stay competitive. Information technology has been used to develop integrated systems that reduce cycle time, improve quality, and cut costs particularly in developed countries. In spite of this high potential of IT, its effective use is still not widespread particularly in developing countries. This may be due to low labour costs, insufficient finances and lack of knowledge and skilled work force among others. Whatever the reasons, delay in the use of IT will widen the gaps with developed countries that have embraced this technology.

- Asian Productivity Organisation, 1997 [2]

3 Standards and Standardisation in the Knowledge Age

It is envisaged that the Global Information Infrastructure (GII) will be the major enabler of the move from an industrial age to the information (or knowledge) age. As observed lately, there is an increasing trend towards national or regional information infrastructures in the US, the Pacific Rim and Europe. It is foreseeable that ultimately, almost every organisation, company, school and household will be interconnected, as the world is becoming networked. However, the pre-requisite appears to be the availability of globally agreed standards upon which this infrastructure can be based. Hence, it is often said that standards determine the technology that will implement the Information Society, and consequently the way in which industries, users, consumers and administrations will benefit from it [3].

A generic definition of a standard -

A standard is a formulation established verbally, in writing or by any other graphical method, or by means of a model, sample, or other physical means of representation, to serve during a certain period of time for defining, designing or specifying certain features of a unit or basis of measurement, a physical object, an action, a process, a method, a practice, a capacity, a function, a duty, a right, a responsibility, a behaviour, an attitude, a concept or a conception, or a combination or any of these, with the object of promoting economy and efficiency in production, disposal, regulation and/or utilisation of goods and services, by providing a common ground of understanding among producers, dealers, consumers, users, technologists and other groups concerned.

- Sivan, 2000 [4]

Projecting the trend, it is reasonable to assume that standards will play an even greater role in the knowledge age than in the industrial age as the cultures of business, technology and knowledge will demand for more standards. While standards did play a major role in the industrial age, it was regarded as mainly behind-the-scenes. Standards will have to play an even bigger role in the knowledge age, as they have to 'transmit information from those who have the knowledge to those who need and can use the knowledge' [4, p.7]. And, standards will need to satisfy the requirements of stakeholders who are getting more diverse, ranging from governments to the individual end users. Anticipating an increasingly complex process of standardisation, it can be understood that the choice of achieving consensus or speed in standards development would have to be weighed in accordance with the need for the new application or technology.

4 Information Technology and Standards for the Singapore Construction Industry – Current Developments

The CITC was specially formed to track, adopt and promote construction industry specific IT standards. It ensures that the national standards are aligned with international standards as well as other industry de facto standards. In order to do this, the CITC works closely with the International Alliance for Interoperability (Singapore Chapter) or IAI (S) to develop standards that cover the entire life cycle of a building project. To date, the published Singapore Standards include:

a) SS CP 80 : 1999 - Code of Practice for Classification of Construction Cost Information;

b) SS CP 83 : 2000; 2004 - Code of Practice for Construction Computer-Aided Design (CAD) (in 5 parts);

c) SS CP 93 : 2002 - Code of Practice for Classification of Construction Resources Information (and Amendment No. 1);

d) SS CP 97 : 2002; 2003 - Code of Practice for Construction Electronic Measurement Standard (CEMS) (in 2 parts); and

e) SS 517 - Code of Practice for Information Exchange and Documentation at Handing/ Taking-Over of Buildings upon Completion.

The standard to be published is the Code of Practice for Building Project Document Control System.

Clearly, from the list of developed standards, it can be seen that the CITC focuses on the four main thrusts of the building project's life cycle, namely, design, procure, build and maintain. The intent is to create a standardised platform or common language for all industry players to operate on or communicate more effectively and efficiently.

Since the first standard was published in 1999, there have been a number of studies conducted to gauge the industry's response to the call for information standardisation, as well as the adoption of ICTs as a means to efficiently manage and exchange project information. Some key findings are summarised here to reflect the industry's current developments.

In 2000, the response received from the industry-wide survey conducted for SS CP 80: 1999 was typical. The study [5] found that while support for standards development was good, the companies were not prepared to adopt a national standard in full. The respondents cited a lack of financial incentive, especially when immediate benefits (or returns) were not in sight. Extra costs would have to be incurred in having to re-classify historical data to meet the standard. However, the companies did acknowledge there would be longer-term benefits for them and the industry as a whole. By standardising practices, businesses could offer to clients a quicker and higher quality service through, possibly, using IT to become more efficient and customer centric. Over time, overall productivity levels of the industry could improve.

The critical issues facing the construction industry's lacklustre adoption of IT were unveiled in the study to benchmark Singapore against a few Nordic countries [6]. One of the main findings revealed that Singapore companies might have been deploying technology for the sake of technology, surfacing a problem of organisations having failed to align business needs with IT capability. Other findings included the industry's slow rate of IT diffusion as well as low interoperability between companies, and a lack of strategic IT use in the private sector coupled with ineffective planning by the public sector which could be attributed to insufficient understanding of stakeholders' needs and expectations in order to sustain interests in national programmes such as the CORENET.

At the enterprise level, the main characteristics of IT adoption by the small and medium-sized architectural, engineering and construction (AEC) companies in the construction industry were examined. In the study [7], a cross-sectional analysis of the data obtained from an industry-wide survey was conducted. The results confirmed that many of the IT-related problems faced by micro and small-sized AEC enterprises stemmed from a lack of resources, both in terms of finance and human - training for staff to learn new IT skills was limited. These enterprises also tended not to use IT for a strategic purpose which could largely explain their preference for packaged systems rather than customising one to fit their need. The smaller enterprises were also less inclined towards information standardisation as they generally did not view IT as a means to interoperate or least, share information. But, in contrast, the results showed that medium-sized enterprises were very focused on acquiring IT capability to sustain competition, as some had used it to strategise the business, share information for networking purposes, as well as transact via e-commerce.

5 Main Recommendations for Promoting Information Technology and Standards Use in the Singapore Construction Industry – A Review

Several recommendations were made in the studies [5] [6] [7]. Among them, the broadest recommendation comprised a vision to:

> "create a strategic IT-enabled construction industry that strives on interoperability and builds on integrated databases and interactive applications to achieve quantum-leap efficiency with global connectivity" [6, p.170].

The central theme of the vision was the integration of technology, process and people at the industry and global levels.

On specific recommendations made in the studies mentioned, a review of the proposals put forward entails the formulation of three broad thrusts.

Thrust 1: To Create an Active Information Standardisation Community

If standards are developed with the end in mind, the new application or technology implemented will benefit all parties involved in the standards setting process. In the same vein, Goh and Chu [5] emphasised the importance of making a conscious effort of involving as many industry players in the process as a means to achieving wider consensus or lessening any resistance to adopt. They advocated a two-staged approach that would involve reviewing established international standards and then aligning them with local practices so as to produce a

standard which as many in the industry can understand and adopt. They also mentioned there must be leaders in the industry who can drive the use of the developed standard, application or technology in order to convince others to follow suit.

> *A common language for the construction industry -*
> The construction process is unique because even the simplest of projects require the close cooperation and constant interaction between people of diverse disciplines and enterprises of all descriptions. ...
>
> Any problems arising from information retrieval and communication inevitably lead to loss of time and money. A unified information system within the Construction Industry as a whole, catering to the needs of all parties involved in the total design, construction and maintenance process, would save time and money and also facilitate better decision making and project coordination. In short, a unified construction information system, based on a common language, will support a more intelligent and efficient Construction Industry.
> - Lee et al., 1989 [8]

Embracing these recommendations, the way forward to creating an active standardisation community is to engage key stakeholders and make them understand that standards development is a means, and not an end by itself, to building a common language that will benefit all, regardless of a paper-based or computer-based system. It is advocated that a unified language must be capable of supporting communication 'between man and man, man and machine, and machine and machine' [8, p.4]. Clearly, regular promotion of national IT programmes such as the CORENET is highly recommended to continuously send the message of unity across the community.

Thrust 2: To Promote IT Use to Smaller Businesses

The construction sector is typically made up of numerous small companies and a few large ones. In Singapore, 68.6% of the total number of construction-sector enterprises employs less than ten persons, while only 0.7% employs 300 persons or more [9]. In view of its structure, promoting standardisation and IT use in the industry must target the majority of smaller businesses in order to be purposeful and effective as a national strategy. Evidence from Asian economies has shown that a growing sophisticated user base is the best resource for IT software and services companies, and having a large user base can benefit all industry sectors, primarily the manufacturing and services sectors [2].

In relation to this, studies [5] [7] have specifically recommended the setting up of targeted schemes to address resource problems faced by the smaller enterprises, as well as developing programmes to continuously educate new entrants on the benefits of adopting national standards and IT. Hence, such companies can engage standardisation faster through early participation in the specially devised schemes and programmes. As pointed out by the Asian Productivity Organisation [2], effective national strategies are needed to realise the benefits of IT and such policies can be much more effective when they are closely coordinated and receive support from the highest levels of government. At the same time, the policies should be developed in close consultation with key stakeholders and experts of the industry for greater acceptance by users when the infrastructures are put in place.

Thrust 3: To Promote IT Use to Larger Businesses

Small and large companies have different requirements for IT. In view of this, the study [7] stressed that a special set of policies be formulated for larger businesses. From the survey, it was gathered that most large companies would use IT as a collaborative platform to globalise the business. Not surprisingly, with global operation, global supply chain and intense global competition, there is a need for these organisations to set up enterprise information systems (EIS) such as enterprise resource planning (ERP), e-Business or e-Commerce systems to integrate extended enterprises in a supply chain environment with the objective of achieving efficiency, competency and competitiveness. As IT investments are much higher for these companies, they would require special incentive and assistance schemes. Besides financial assistance, businesses need to learn how to reap real benefits from their IT investments, for instance, to understand the importance of aligning business and IT strategies, and matching IT systems with organisational needs (or cultures) of the company. Training programmes could be tailored to guide participants on how to do so. Broadly as an industry, the diffusion hypothesis of the productivity paradox may suggest that it will take a longer time before the productivity benefits of IT investment can be fully realised simply because it will take time for enterprises to learn to operate a new technology, especially when the system to be built is large and complex such as a EIS. And, clearly, companies would have to be made aware of the learning curve to allow time for the diffusion of new IT systems within the organisation.

In addition, to aid the growth of potential world-class enterprises, the study recommended the formation of industry groups for networking so as to create a vibrant culture of ideas, information and knowledge sharing among the best-of-breed companies.

6 Standardising Work Processes of the Singapore Construction Industry – An Essential Building Block

In the late 1950s, the United Nations (UN) defined the building (project) process simply as "... the design, organisation and execution" of a building project that has come to be recognised as "... normal practice in any country or region ... it is characterised by the fact that all operations follow a set pattern known to all participants in the building operation" [10]. However, it is generally accepted that the nature of the design and construction process has grown in complexity since the 1950s, resulting in an increased number of participants (or actors) in the project. And, arguably, the simple definition of the UN cannot fully describe the complexities involved in today's building process.

Hence, there appears to be no 'standard project process' of construction, as it is known that variation occurs in every project process. It clearly signals the increased urgency for the industry to standardise its project process, and provide a clear indication of the roles and responsibilities of the project participants in view of the potential value that such a streamlining can add to the entire building project life cycle [11].

Standardising construction project process -

It is argued that reducing variations in the project process will improve performance and make significant cost savings. The fundamental benefit of such an improved design and construction project process should be to optimise predictability. This can only be ensured when a truly co-operative project environment exists. The project process should look to facilitate team working and effective communication between participants.

> Further, information technology can assist the attainment and maintenance of a new project process if its operation and the relationship between the parties are sufficiently prescribed and detailed.
> - Cooper et al., 2005 [11]

In the organisation of construction information, the established ISO 12006-2 framework [12] clearly distinguishes three process model categories: construction result; construction process; and construction resource. In other words, there is a distinct category for construction process. In the context of ISO's framework, a 'construction process' is defined as a process which transforms construction resources into construction results and it can be classified as a 'management process' or 'work section process'. The main construction entity life-cycle stages include: origination; design; production; use/maintenance; refurbishment/alteration/recommissioning; and decommissioning/demolition. As a construction project, the entire process can be also classified by the main project stages.

In order to keep up with international developments on construction information classification, Singapore's CITC needs to embark on the next phase of standardisation, that is, to map the process or workflow of standard activities within the major stages of a building project life cycle. In the course of standardisation, the basic value is derived from the need to re-engineer some aspects of the existing design and construction process and consider new approaches to arrive at an improved process. Effectively, the challenge of generally accepted practices and established strategies would bring about process innovation and improvement. On possible IT applications, three broad areas have been identified as emerging research initiatives in 4D planning, and they are: product modelling and visualisation; process modelling and analysis; and collaboration and communication [13]. It is not surprising to note that process modelling work is gaining serious attention as 3D CAD applications are naturally progressing to 4D by adding the temporal dimension to 3D CAD models, that is, linking a 3D graphical model to a construction schedule.

7 Towards iN2015: Building an Intelligent Construction Industry for Singapore

In recent years, the Singapore Government has developed a number of national strategic plans targeted at improving Singapore's overall competitiveness typically to be carried out over a 10-year timeframe. The SME 21 master plan and the more recent iN2015 proposal have specifically mentioned the use of ICTs to enhance business competitiveness through innovation in the knowledge-based economy. The new breed of SMEs, as envisioned in SME 21, will be world-class business entities that are professionally managed, excellent in process and customer service management, capable of creating new knowledge and technology to develop high value-added products and services, and be able to compete globally.

Going forward, how can change be accelerated in the construction industry that is traditional in practice, fragmented and diverse in nature, generally price- and cost-driven, lacking in co-ordination and communication between parties, have informal and unstructured learning process, operates on adversarial contractual relationships and lacking in customer focus? In other words, can an industry that is often regarded as inward-looking in terms of improving its technology and related processes meet the challenges posed by the Government to become world class, as well as intelligent, by 2015?

In the 1990s, computer-integrated-construction (CIC), a term derived from the computer-integrated-manufacturing concept, emerged as a method or strategy to achieve [14] [15]: (a) integration within the whole construction cycle (from design and planning to maintenance and demolition); (b) integration of construction technologies (design technology, material technology, and manufacturing and construction technology); (c) integration of information technology components (application programmes, computer-aided-x systems and computer controlled production equipment); and (d) integration of data, or information. In short, integration is the key to a viable approach.

Into the 21st century, research developments in this area have shifted towards process-wide ICT applications with major components including communication (e.g. electronic data interchange, Internet), visualisation (e.g. virtual reality, 3D CAD), integration (e.g. integrated databases), intelligence (e.g. artificial intelligence, knowledge-based systems, neural networks, case-based reasoning) and document management systems. As suggested, the long-term goal is for the industry to derive enabling ICT or application solutions from latest technologies to achieve significant improvements in a traditionally fragmented design and construction process [11].

From the perspective of organisations, applying intelligence would mean having to leverage on technologies as a means to provide better-focused and customised services. Basically, intelligent enterprises can gain in-depth analytical capabilities needed to turn raw data into actionable knowledge through adopting knowledge management and other business intelligence solutions. With intelligence capabilities, businesses can add ideas to products or turn new ideas into new products. At the consumer end, new or improved products and services would translate into greater satisfaction, essentially by giving clients more value for their money.

In principle, there are six basic building blocks for the intelligent enterprise architecture [16]: 1st Building Block - Technology Infrastructure; 2nd Building Block - Transaction Processing Infrastructure; 3rd Building Block - Data Warehousing; 4th Building Block - Decision Process Management; 5th Building Block - Analytical Applications Suite; and 6th Building Block - Information and Knowledge Delivery Service. By mapping the components of a process-wide ICT application onto the six building blocks of an intelligent enterprise architecture, the alignment of systems and applications with the respective functions (or building blocks) can be described as follows:

a) 1st Building Block - Building a technology infrastructure (there must be considerations for process and ICT alignment, and co-maturation of ICT and processes in order to acquire the best possible technologies and technical solutions);

b) 2nd Building Block - Building a transaction processing infrastructure (to adopt enterprise resource planning and customer relationship management systems for executing day-to-day functions);

c) 3rd Building Block - Developing data warehousing (to adopt integrated databases to provide a common view of data for operational, analytical and informational decision-making processes);

d) 4th and 5th Building Blocks - Enabling intelligence processing and analysis through an analytical applications suite (to establish decision support systems that build on knowledge-based systems, neural networks, case-based reasoning and/or information management systems); and

e) 6th Building Block - Providing an information and knowledge delivery service (to adopt document management systems involving storage, integration and communication technologies to allow sharing and exchanging of project information across the project teams).

A recent study [17] evaluated, through obtaining responses from the industry in a broad-based survey, the potential of Singapore's construction-sector companies becoming intelligent enterprises. A total of 84 companies responded to the survey. The findings indicated that the potential was very strong for technology infrastructure as many of these companies had invested in the standard hardware and software, and in global connectivity technology. However, the study found that the companies were generally weak in developing their capability in areas of transaction processing, data warehousing, intelligence processing, analysis, and delivery of information and knowledge. Essentially, these companies must continue to build the 2nd, 3rd, 4th, 5th and 6th blocks of the EIS as the technologies co-mature with the processes they are acquired to support.

On future developments, the same study identified core areas such as general administration, design, project management and site management where companies had witnessed productivity gains of up to 15% from the use of ICTs. In view of the potential for such companies to further develop their intelligent capabilities, the identified core areas could be focused on initially as they would have a lower barrier to change.

Research on applying artificial intelligence (AI) techniques to the management of construction projects have begun in the 1980s. The applied techniques have been expert systems, case-based reasoning, artificial neural networks, genetic algorithms and neuro fuzzy systems, as well as conventional simulation and statistical regression approaches. The commonly researched areas in project management where AI can apply are the sequencing of construction operations [18, 19], optimising the use of construction resources (in relation to time and cost) [20, 21, 22], and estimating project budget or cash flow [23, 24]. On site management, studies have used AI techniques to estimate site productivity [25, 26] and optimise the selection of site equipment [27, 28].

8 The Long Way Ahead: Closing Technology and Knowledge Gaps through Innovation and Education in the Singapore Construction Industry

The importance of the construction industry can be measured by its contribution to everyone's quality of life. In essence, the construction industry must be able to deliver buildings and structures that provide greater satisfaction, well-being and value to customers and users without compromising on the use of sustainable approaches [29]. The industry is increasingly called upon "to become more market responsive, to reduce the number of accidents on site, to minimise waste, to put an end to its appalling record of pollution incidents, to integrate the supply chain, to engage all stakeholders, to create a far more ethical and enhanced sustainability profile" [30, p.781] as a means to find a new vision where social and environmental benefits go hand in hand with lower costs and higher profits. Arising from this development, national studies in the UK have suggested that in order for the construction industry to change from its traditional fragmented processes to a more client-orientated business approach, the importance of innovation, research and training must be recognised.

The significance of innovation, research and training also applies to building an intelligent construction industry as in the long run, the potential gaps of technology and knowledge will have to be closed. On the technology front, it is proposed that the gap be gradually filled as traditional companies acquire the basic infrastructures (or building blocks) of an intelligent enterprise architecture to enable process-wide ICT applications. On the knowledge front, the gap between academia research and practice can be bridged through engaging training (or education) as a means of sustaining the supply of specialised IT manpower to the industry. Effectively, the knowledge created in a research laboratory can be transferred to the construction site. Over time, it is foreseeable that the relationship between education and the creation of intelligent enterprises will evolve into a symbiotic one when knowledge workers become a vital resource for an intelligent industry. In turn, the industry provides the platform for intelligent enterprises to operate on, which then allows them to deploy more workers who have been trained to fit into their intelligent roles naturally.

> *People, processes and technology -*
> New business processes and emerging technologies require new skills; companies must organise these skills to provide the most flexible, efficient, and effective execution. Success requires that companies acquire, train, and retain the right talent; and failure often comes from the lack of seamless integration with existing skills, processes, and technologies to create a holistic e-business solution. Separating e-business operations from people, processes, and technologies can create animosity and conflict among organisational units. Managers must develop seamless integration plans to hold e-business operations back into the core enterprise business. - Tsai, 2003 [31]

9 Conclusion

Meanwhile, the immediate challenge facing the construction industry is one of timeline (i.e., a challenge for it to become intelligent by 2015). A radical approach is necessary than one that is incremental. At the industry level, governmental schemes and programmes, targeting the needs of different types (i.e. by trade and size) of organisations within the industry, must be crafted and developed. The aim must be to promote, assist and effect change. The most crucial areas of change to be tackled by companies are how to achieve strategic and technical change, and how to overcome organisational resistance towards implementing a new technology. At the national level, the iN2015 project must attempt to involve every economic sector (or industry), be well planned and coordinated for resource allocation and deployment.

Effectively, there must be a place for the construction industry in the iN2015 master plan. Construction creates and maintains a nation's built environment - for example, it delivers housing, schools, hospitals and transport systems, contributing to the formation as well as renewal of communities. The industry's backward and forward linkages with other economic sectors are traditionally strong and resilient. Essentially, the long-term economic and social benefits which can flow from a more intelligent construction industry would be potentially enormous for a developed country.

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