A STRATEGIC GUIDE TO IMPLEMENTING IT BUSINESS STRATEGY IN THE CONSTRUCTION INDUSTRY

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ABSTRACT

In the more recent years, strategic applications of IT in the construction industry are increasingly becoming important as more innovative organizations have witnessed improving their efficiency, effectiveness and performance through better aligning IT with their business goals. As Singapore aspires to be a Smart City where the development of infocomm-based integrated networks, capabilities and solutions for the urban environments through a systems-of-systems approach is one of the keys, the building of intelligent enterprises in the various economic sectors has to take place simultaneously to complement the social and environmental targets of achieving the 'smart' status. While there has been good progress made in other economic sectors, it is not yet clear in the construction sector. This study aims to develop a strategic guide to helping companies in the construction industry implement IT business strategy with the intent of improving the current situation. Based on the findings and recommendations of a few related studies, a framework is developed to present the established strategic alignment perspectives for the 'designer' and 'builder' categories of companies given the distinct characteristics of each. Henderson and Venkatranam's strategic alignment model (SAM) is applied which involves the dimensions of 'strategic fit' and 'functional integration' and their respective domains. Primary data is collected through a questionnaire survey and the results are verified by experts in the industry.

Keywords: strategic alignment, IT strategy, business strategy, implementation, critical success factors

1. INTRODUCTION

The construction industry is often regarded as different from other industries given its unique characteristics arising from complexity, fluctuating demand, expensive and long life expectancy of products, diversity in terms of a wide range of products and services, widely differing sizes of projects, and fragmented process and practice. In particular, the industry is seen as having relatively low levels of application of technology, as well as low levels of innovation (Harty, 2008). However, in the more recent years, many construction industries have shown to be increasingly responding to changes in markets, institutions, regulatory framework, processes, technologies, procurement arrangements and relationships between the participants in the project as a means to demonstrate their capacity to innovate and improve. Construction is expected to undergo significant innovation in technologies, processes and relationships in future as there is a growing demand, especially from regular clients, for the industry to boost its efforts in raising standards and productivity, and addressing the wider issues of social, economic and environmental sustainability. Potential areas of innovation, as suggested by Jones and Saad (2003), are the transfer of production off site and use of manufactured and standardized components, development of more collaborative relationships, more integrated processes, quality-assured products and services, and better supply chain management.

Emphasizing technologies for innovation, the role of information systems is important as it can facilitate construction businesses to improve on their processes continuously and align their outputs more closely with what their customers (i.e. clients) want for achieving competitive advantages. In the new business models, IT will become central to the implementations of strategies that are primarily concerned with achieving a focus on quality

and satisfying clients' needs, as well as improving project lifecycle processes and creating integrative organizations.

2. CREATING AN INTELLIGENT CONSTRUCTION INDUSTRY TO SUPPORT A SMART CITY

2.1 The concept of 'Smart Cities'

The concept of 'Smart Cities' arises to draw a distinction from terms like 'Digital Cities' or 'Intelligent Cities' so that it looks at the process of urbanization more holistically by involving the social and environmental aspects as well in order to balance the drive for global competitiveness with sustainable development (see Figure 1). In other words, cities in future should be well functioning organisms that are environmentally, socially and economically sustainable. A city has to be created by minimizing its ecological impact, where landscape and built form are balanced and where buildings and infrastructures are safe and resource efficient. In essence, cities and individual buildings can focus on achieving resource conservation by enhancing waste minimization and recycling and improving energy efficiency. In addition, new materials, construction methods and architectural designs can greatly improve the environmental performance of urban buildings. These aspects indeed relate to the effective design, construction and management of the built environment. With today's technology, the increased use of IT is key to enabling cities and individual buildings arrive at a more 'ideal' state of sustainability through innovation (see Figure 2). The much needed information and knowledge have to be captured, utilized and managed appropriately to allow companies to exploit them as strategic resources. Innovative tools are available and used by various stakeholders for analyzing data to arrive at better decisions, anticipating problems so as to resolve them proactively and coordinating resources for more effective operations. Overall, smarter cities have to drive sustainable economic growth and prosperity for their citizens.
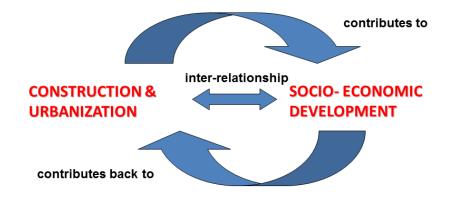

Figure 1: Construction and urbanization in the context of socio-economic development
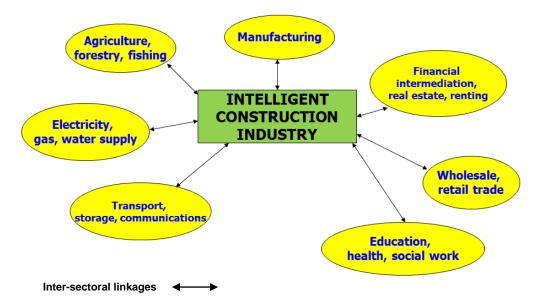
Figure 2: Creating an intelligent construction industry to support socio-economic development

2.2 The concept of 'Intelligent Enterprises'

From the perspective of organizations, applying intelligence would mean having to leverage on technologies as a means to providing better-focused and customized 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 (Sharma and Gupta, 2003): By mapping the components of a process-wide IT 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:

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

3. MOVE TOWARDS AN INTELLIGENT CONSTRUCTION INDUSTRY IN 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 – "Preparing SMEs for the 21st Century" – and the more recent Intelligent Nation 2015 (iN2015)

proposal – "To be an Intelligent Nation, A Global City, Powered by Infocomm" – have specifically mentioned the use of information and communication technologies to enhance business competitiveness through innovation in the knowledge-based economy. The new breed of small and medium-sized enterprises (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 and intelligent by 2015?

A study by Goh (2006) had 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 had 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 enterprise information system as the technologies co-mature with the processes they are acquired to support. On future developments, the study had identified core areas where companies had witnessed productivity gains of up to 15 per cent from the use of IT, such as general administration, design, project management and site management. In view of the potential for such companies to further develop their intelligent capabilities, the identified core areas could be focused on as they would have a lower barrier to change.

When IT is used strategically in design companies, it can help to generate efficiency benefits like reduced lead time for design, reduced rework and increased information exchange to effect better quality of output. For construction companies, IT can help to reduce construction time, improve productivity and reduce waste. However, all commercially driven companies must see direct gains from IT in order to want to use more of it. Otherwise, companies may end up deploying technology for the sake of technology. Therefore, this study will discuss how Singapore companies can strategically align technology with their business to achieve real benefits. A framework will be presented to cover the strategic alignment perspectives of the respective types of design and construction companies according to their distinct characteristics. It will include indicating those strategies of business and IT that are applicable to their specialization. In conclusion, the critical success factors of implementing IT business strategy will be identified.

4. STRATEGIC IT ADOPTION IN THE CONSTRUCTION INDUSTRY OF SINGAPORE

4.1 Methodology for collection and analysis of data

The questionnaire created for the IT barometer project has been used in the study to collect data from various organizations in an industry-wide survey. In February 2003, a questionnaire was mailed to 754 companies operating in the construction industry in the areas of architecture, engineering, quantity surveying, property development, construction, and product manufacturing and supplies. The questionnaire comprised a total of 39 questions. They were grouped under six distinct headings; Section A: General Information; Section B: Computers and Software; Section C: Use of IT Systems; Section D: Data and Telecommunications; Section E: The Part Played by IT in the Company; and Section F: Standardisation and CORENET. A total of 84 companies (i.e. 11.1 per cent) responded to the survey. Response from the survey was analyzed using the SPSS statistical analysis software. A post-verification of the results of the questionnaire survey was conducted with the industry's Construction Industry IT Standards Technical Committee (CITC) in 2004. Expert views and comments were solicited from members of CITC on key findings of the survey.

In the first stage, results of the survey were classified according to the 'designer' and 'builder' categories to enable a domain-specific analysis to be carried out on the companies' strategic IT practices. Henderson and

Venkatranam's strategic alignment model (SAM) was applied. They argued that a company must consider both 'strategic fit' and 'functional integration' to fully develop its competitive potential. Hence, the concept of strategic alignment has two building blocks: strategic fit and functional integration. And, within each block, there are the external and internal domains. The interactions of the domains in each of the four dominant alignment perspectives are illustrated in Figure 3 to show the model's working.
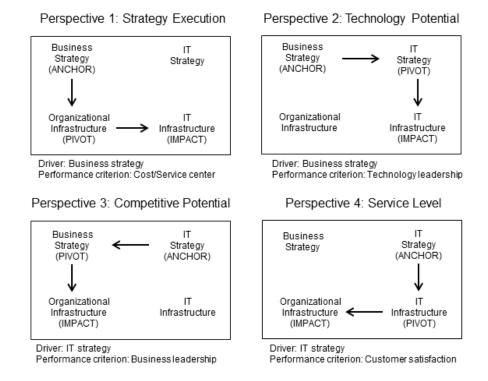

Figure 3: Four strategic alignment perspectives of SAM
(Source: Adapted from Henderson, Venkatraman and Oldach, 1996)

In order to apply SAM, the second stage focused on analyzing the data according to the four specified domains, namely, business strategy, IT strategy, organizational infrastructure and processes, and IT infrastructure and processes. The results were mapped onto the four dominant alignment perspectives, respectively, for the 'designer' and 'builder' categories (see Figures 4 & 5 for two illustrations). The objective was to attach statistical evidence to each of the four alignment perspectives to enable the "best fit" perspective to be identified for the 'designer' and 'builder' categories.
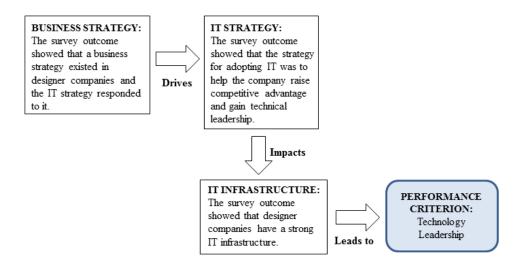
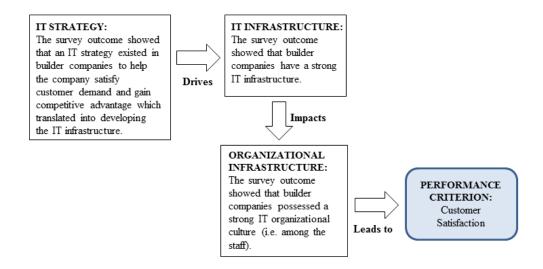Figure 4: Mapping of domains onto the 'technology potential' alignment perspective for designer companies

Figure 5: Mapping of domains onto the 'service level' alignment perspective for builder companies

4.2 Results and main findings

The results obtained from mapping the four domains onto the strategic alignment perspectives were discussed, respectively, and summarized as the main findings in Table 1.

On the first perspective, 'strategy execution', both categories of companies had demonstrated alignment in respect of having used the business strategy to drive a strong organizational culture and IT infrastructure. The performance criterion is a saving in cost, as a result of this alignment, and it can be measured by financial gains or increased efficiency of business processes. On the second perspective, 'technology potential', only companies in the 'designer' category had shown evidence of an alignment. In this case, the business strategy drives and IT strategy responds by defining the required IS infrastructure and processes. The performance criterion in this perspective is on achieving technological leadership by benchmarking along a set of critical measures so as to re-position the business in the Digital Age. While the culture of having a formalized IT strategy was not as strong, the 'designer' and 'builder' categories had shown to have conformed to the third perspective, that is, 'competitive potential'. In this perspective, the IT strategy drives business strategy by translating it into an organizational infrastructure that is geared towards IT. Here, the performance criterion is measured by attaining market

leadership in service or product or, simply, realizing a competitive advantage for the business. Finally, on the fourth perspective, 'service level', only companies in the 'builder' category had shown evidence of an alignment. But it refers to only half of those surveyed. In this arrangement, the IT strategy would drive the formation of an IS infrastructure that complements it and in the course of it creates an organizational infrastructure that is geared toward IT. The performance criterion in this perspective is measured by customer satisfaction that is based on internal and external benchmarking, and implemented through total quality management approaches.

Table 1: Summary of evaluation of strategic alignment for designer and builder companies (Source: Goh, 2007)

Alignment Perspective / Domain	Perspective 1: Strategy Execution	Perspective 2: Technology Potential	Perspective 3: Competitive Potential	Perspective 4: Service Level
Domain Anchor (i.e. the driver of change)	Business Strategy	Business Strategy	IT Strategy	IT Strategy
Domain Pivot (i.e. the area that has the problem or opportunity that is being addressed)	Organizational Infrastructure	IT Strategy	Business Strategy	IS Infrastructure
Impact Domain (i.e. the area that is being affected by the change)	IS Infrastructure	IS Infrastructure	Organizational Infrastructure	Organizational Infrastructure
Empirical Evidence of Alignment in:	'Designer' Companies and 'Builder' Companies	'Designer' Companies	'Designer' Companies and 'Builder' Companies	'Builder' Companies
Performance Criterion (or the management orientation)	Cost/Service Center	Technology Leadership	Business Leadership	Customer Satisfaction

4.3 Post validation of the results

Since the survey and expert verification had been carried out in 2003 and 2004, respectively, it was likely that the results and findings could not reflect the most current state of development. In May 2011, a questionnaire was mailed to 59 of the 84 companies that had responded to the survey in 2003. A total of 24 companies (i.e. 40.7 per cent) responded to the survey. Response from the survey was also analyzed accordingly to ascertain whether the results of the 2003 and 2011 surveys were consistent. The outcome of the comparison supported the earlier established strategic alignment perspectives of the 'designer' and 'builder' categories.

5. IMPLEMENTING IT BUSINESS STRATEGY: THE CASE OF DESIGNER AND BUILDER COMPANIES IN SINGAPORE

In order to propose how IT business strategies could be implemented in construction-related companies, a better understanding of their main characteristics had to be gained. Relevant studies on this subject were reviewed to identify and arrive at a few core traits for the 'designer' and 'builder' categories of companies. For the architectural and engineering consulting companies under the 'designer' category, a few generic types had been ascertained in a strategic management context and classified to highlight their distinctive traits and competencies (Winch and Schneider, 1993). The types included companies (or practices) that have a 'strong delivery', 'strong experience', 'strong ideas' and 'strong ambition'. For the construction and multi-disciplinary companies under the 'builder' category, a few types had been classified according to their strategies for innovation to gain appropriate competitive advantages (Lim and Ofori, 2007; Lim, Schultmann and Ofori, 2010). The companies could be described as those that have a 'strong niche', 'strong production efficiency' and 'strong quality'. On the

adoption of technology to achieve competitive performance for construction companies, the dimensions of technology strategy that were found to be critical included competitive positioning, depth of technology strategy and organizational fit (Hampson and Tatum, 1997).

For a start, by identifying the right company type that applies to them, their business domain (or strategic scope) can be explicitly defined before moving on to other stages of the process where they involve defining the goals of implementing IT business strategy, linking them to the performance criterion, focusing on the strategic intentions of the business, as well as adopting an effective plan of implementation, quantifying the costs and benefits of IT, measuring the results and tracking the right outcomes, and managing organizational culture as a result of change. As an illustration of the application of the process for the various company types in the 'designer' and 'builder' categories, some critical aspects that consisted of defining the goals of implementation, linking the goals to the performance criterion and focusing on strategic intentions of the business are presented in Figures 6 and 7. In particular, the nature of implementation of IT business strategy for the different strategic alignment perspectives was explained. While the initial stage of determining the right company type is critically important for ensuring there is better strategic IT business alignment, the point to note was that attention must also be focused on developing the other stages appropriately to follow through with the implementation so that the goal of achieving sustainable performance for the organization can be truly realized.
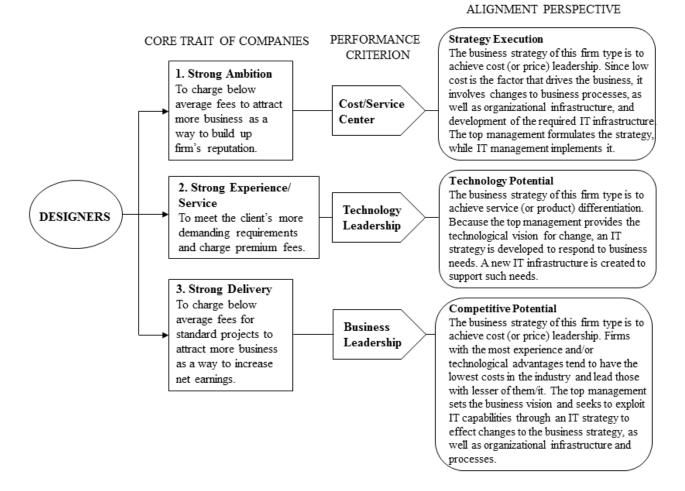

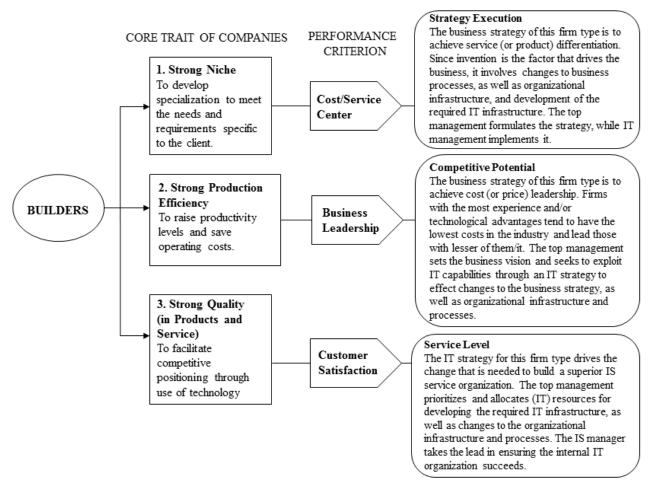Figure 6: Implementation of IT business strategy for designer companies

Figure 7: Implementation of IT business strategy for builder companies

6. CONCLUSION

The study has illustrated how companies need to achieve strategic alignment in order to sustain their competitive advantage by performing according to their IT business goals. The optimum alignment of IT and the business occurs when business strategy and IT strategy are developed together so that each can influence the other to maximize the advantage. Alignment is, in essence, applying IT in an appropriate and timely manner and in harmony with a company's business strategies, goals and needs. Needless to say, the ability to recognize the critical success factors that companies should rely on for directing them towards fulfilling their goals and missions is key. Going forward, some of the critical success factors commonly acknowledged by researchers are mentioned as follows. First and foremost, there must be leadership (from the senior management) which is both the vision to see the strategic opportunities for IT and the personal force and persistence to overcome the barriers of effective implementation. Second, there is a need to ensure IT investments are prioritized against business strategy. Third, there is also a need for well-aligned IT spending with business strategy for its entire life cycle by closely tracking IT business and technical performance. Fourth, the creation of a shared language among the business and IT users is necessary so that they can continuously evolve their corporate IT function with the goal of truly aligning information and information management with the actual or contingent strategic priorities of their organization. Therefore, translating those factors into achieving better net earnings from the use of IT would

mean that the ultimate goal of a company embarking on such implementations is to ensure that all of its IT actions will be connected to the business strategy and IT costs will be controlled so as to produce the right results over the long term. As such, the critical success factors of a company achieving reduced costs and simultaneously improving the contribution of IT to its net earnings (or overall profit) would be present (Benson, Bugnitz and Walton, 2004).

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