SME Contractor Multi-Criteria Business Model on Adaptation of Construction Industry Revolution 4.0 in Malaysia – A Review on Business Models and Adaptation Challenges

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The construction industry worldwide is now facing the Industry Revolution 4.0. As such, the industry is undergoing significant transformation to adapt to the needs and challenges of the revolution. New technologies and digitalization in the construction industry, innovating the whole traditional project cycle and bringing more tech savvy and effective in the project delivery of its life cycle are, among others, issues that need to be addressed. Contributing towards the whole construction business model, there is a need to enhance the existing business models that are available. The objective of this paper is to review the types of business model, the definition, and the challenges faced by SMEs to adopt the business model. As a reference, more attention is given to business model canvas. Challenges faced by SME contractors to implement construction industry 4.0 technologies and enhance their productivity are the expected contributions to the body of knowledge. This paper concludes, many studies highlight on finding new elements to be added into existing business model canvas. At end of the research, it is found that manpower, machinery, material, finance and information technology are the new elements that need to be added in existing business model canvas. Furthermore, this paper will help the scholars and industry players to understand how the Industry Revolution 4.0 significantly affect the construction industry, SME and their business model.

1. Introduction

Small and Medium Enterprises (SMEs) are contributing significantly to the economic development, social uplifting and political stability of any country. SMEs are diverse in nature. SMEs can be established for any kind of business activities in urban or rural area (Amin, 2004). It can be considered as a back bone of the national economy (Edrak et al., 2014). Many entities, particularly the government, have allocated many reputations on the expansion of SMEs to realise its contribution to the progress of the economy. In order to reinforce the SMEs, a number of plans and services are provided to improve their performance and affordability. Construction is an extensive flat business, supporting all other industries suggestively, where value development almost happens in the intelligence of amenities or assets expansion. Construction workers distributes only about 30 % of their operative period to their key duty. The remaining 70 % is engaged by successive spending, moving elements, positioning up, rearranging the structure site and witnessing resources and equipment. According to the author's knowledge, no comprehensive work was dedicated to raise the competency level of SME contractors to Construction Industry 4.0 revolution. Throughout this research, challenges faced by SME contractors to implement construction industry 4.0 technologies and enhance their productivity are the expected contributions to the body of knowledge. A new recommendation of a SME contractor's business model will be proposed and

general strategies that SME's could adopt to raise their business performance and level of competency in moving towards the Construction IR 4.0.

2. Problem Statement

SME contractors' company was established a long time ago and are still practicing the conventional method of construction and are very comfortable in their old method zone. As a result, SMEs are lacking the exposure of the current trends in the construction industry. A well-established plan and procedures to deliberately adopt IR 4.0 are serious (Lim et al., 2020). SME business and productivity have to operate and monitor with advanced technologies of IR 4.0, thus, warrant the need of competent person to operate the software. As for the SME, the future will be full of challenges when the new norm is mandatory with the utilisation of Building Information Modelling (BIM) in construction project. BIM has determined the growing adaptation of the technology amongst the construction players (Rooshdi et al., 2021). In order SME contractors to stay relevant, existing business model is required for enhancement. At the end of this research, new elements will be introduced for SME contractors to absorb into the existing business model. According to Technological and Economic Development of Economy (2017), the challenges faced by SME's in adopting BIM are dictated by 5 factors. They are technology, cost, management, personnel and legal. Technology factor describes the functionality and accessibility of BIM tools, need for sophisticated data management and lack of data interoperability. Cost factor is about financing the training session, cost of specialised software and required cost for software upgrade. Under the management factor, the challenges are managers' awareness and support, cooperation from other industries and practical strategies. Personnel factor is on the habitual resistance to change and unfamiliar with the BIM. Under legal factor, the challenges are the ownership of the BIM data and its ownership, contractual environment and lack of protocols.

2.1 Background Study on the Challenges

Industry 4.0 has already been in the construction business for quite a while and the knowledge is on dissimilar levels of maturity. Technologies such as BIM, Cloud Computing, and Modularization have industrialized suggestively while other skills such as Augmented, Virtual and Mixed Reality are still being improved and by some means affect the sustainability in the industry. The application of IR 4.0 within the Construction Industry is still missing extremely despite having user-friendliness of these technologies (Alaloul et al., 2020). Table 1 below lists several other challenges being discussed by other authors.

Table 1: Topic and Author on the Construction 4.0 Challenges

No	Topic	Author
1	Customer Relation	(Guma et al., 2019)
2	Technological Challenges	(Ellahi et al., 2019)
3	Organisation / Knowledge	(Cerchione and Esposito 2017)
4	Strategy / Leadership	(Hizam-Hanafiah et al., 2020)
5	Creative Thinking	(Ellitan et al., 2020)
6	Pandemics	(Mckibbin and Fernando 2020)
7	Employees (qualification)	(Razali 2018)
8	Productivity Challenges	(Chin and Yusoff 2020)
9	Education on IR 4.0	(Tandon 2020)
10	Halal Sustainability	(Ahmad Zaid 2020)
11	Working Capital Management	(Aktas et al., 2015)
12	Management and Profitability	(Nguyen and Nguyen 2018)
13	Financial challenges	(Kukharuk and Gavrysh 2019)
14	Information challenges	(Kukharuk and Gavrysh 2019)
15	Maintenance Operations	(Mohd Noor et al., 2021)
16	Technical Competency	(Ismail and Hassan 2019)
17	Technological challenges	(Kukharuk and Gavrysh 2019)
18	Obstacles associated with automation	(Ingaldi and Ulewicz 2020)

Besides that, Coleman et al. (2016) have identified problems and challenges in business analytics and big data analytics for SMEs. SMEs are, in numerous cases, not totally alert regarding the effects of digitalisation. Subsequently, this causes misunderstanding in the difficulty and cost of digitalisation solutions, so that their possible financial assistances cannot be properly projected. The consequences of external pressure as the main driver have advantages and disadvantages, more so, for small and medium-sized enterprises. This could lead

to the late adoption of Industry 4.0, because compared to mass markets catered by large enterprises, niche markets are less competitive. According to Oesterreich and Teuteberg (2016), there are allegations of digitisation and automation in the context of Industry 4.0 towards to construction industry.

3. Type of Business Model

Business models — at the present time, in other sectors a widely used managerial practice for designing, comparing and analysing an organisation's value creation logic. There is a less discussed and researched concept in the field of construction. Current business model literature sees the concept as an essential part of successful business, as its main purpose is to separate a company from others and to give it an advantage in regard to its competitors (Teece, 2010). A business model defines the way a company operates, how it creates value for its customers and how it captures value from its operations to make a profit. In the last 15 y, much literature has developed around the concept of the business model (Lanzolla and Markides, 2021).

3.1 Business Model Canvas

A Business Model Canvas (BMC) established by Osterwalder instrument can be quite operative here in helping users recognise an organisation's business model. The BMC can help users visually represent of the elements of a business model and the potential interconnections and impacts on value creation. Table 2 below shows critical literature review analysis on the Business Model Canvas.

Table 2: Critical Literature Review Analysis on Business Model Canvas

No	Title and Author	Year Published	Keywords	Important Points
1	A Business Model Canvas for Social Enterprise (Vial, 2016)	2016	Business Model, Canvas, Social Entrepreneurship	Six components: value creation – how (1) and who for (2), competencies (3), strategic positioning (4), monetization (5), time, scope and size ambitions (6)
2	A Circular Economy Business Model Innovation Process for the Electrical and Electronic Equipment Sector (Pollard et al., 2021)	2020	Circular Economy Business Model, Innovation, Electric and Electronic Equipment, Circularity Indicators	Fivefold interconnected layers, provides electrical and electronic equipment manufacturers with a comprehensive layered process for developing and implementing a circular economy business model tailored to their business offerings.
3	Adaptation of the Business Model Canvas Template to Develop Business Models for the Circular Economy (Schöllhammer et al., 2020)	2020	Circular Economy, Business Model Canvas, Digital Ecosystem, Industrial Symbioses and Synergies.	Five patterns that extend the existing Business Model Canvas 1) Return diagnostic process; 2) Recovery system; 3) Recovery relationship 4) Recovery channels; 5) Recovery incentive system
4	Business Model Canvas as a Basis for the Competitive Advantage of Enterprise structures in the Industrial Agriculture (Dudin et al., 2015)	2015	Strategy, Competitive Advantages, Business Model Canvas, Enterprise Structures, Industrial Agriculture, Competitiveness.	Enterprise structures develop not only one business model and its canvas, but several business models, in order to increase the performance of the tools.

The literature review was conducted by referring articles indexed in Web of Science, Scopus and Science Direct journal. The conditions used were the influence of Industry 4.0 from a SME approach, demonstrate Business Model Innovations from the Industry 4.0 approach and how the acceptance of the Industry 4.0 affects the Business Models components. The time period of the literature review was defined between 2013 to the present. The keywords "Business Model" AND "Industry 4.0" OR "Industrie 4.0" OR "Business Model Canvas" OR "Innovative Business Model". The papers recollected were 264 and eliminating copies, 146 papers were taken into account. By analysing these journals (as mentioned above) in VOS viewer software, a network visualisation is developed as shown in the below Figure 1. The network contains 4 clusters (blue, red, green and yellow) with 277 links with minimum occurrence of 5. A total of 394 links are connecting with each other words. Some main keywords are competitive advantage, technology, originality value, sustainable development and sustainable business model. SME and social enterprise still lack studies and further studies can be conducted on related to this subject.
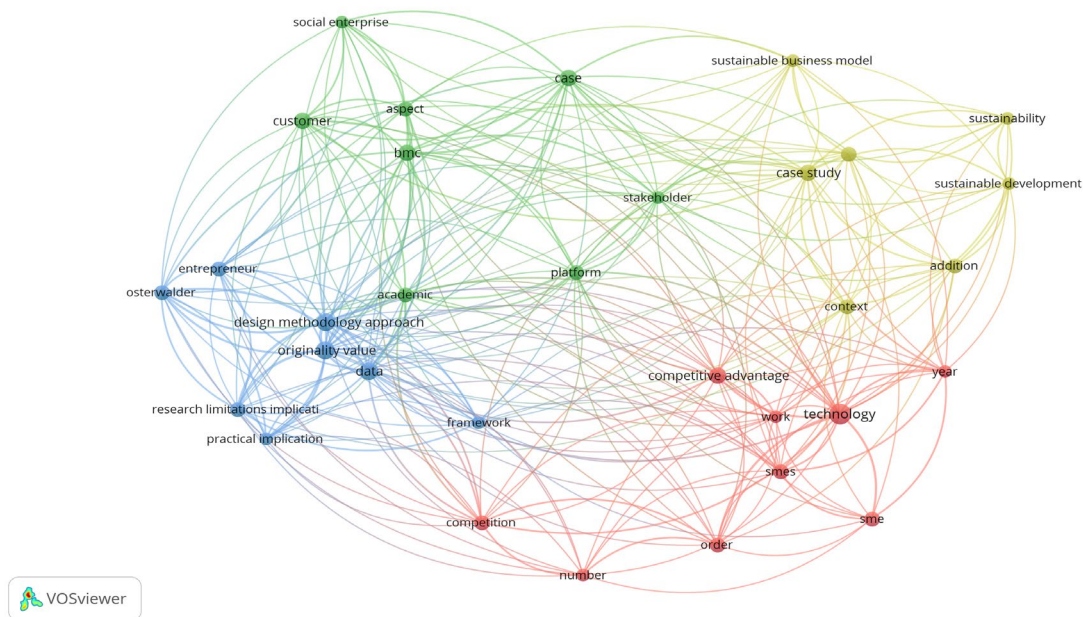

Figure 1: Illustration of Network Visualisation

3.2 Traditional Business Model

A business model describes a construction for how a firm makes and distributes value to clients and the instruments working to capture a share of that worth. It's a coordinated set of fundamentals surrounding the movements of costs and incomes (Teece, 2018). The creating, modification, application, and conversion of business models are outputs of high-order (dynamic) competences. Energetic capabilities, which are reinforced by administrative habits and executive skills, are the firm's ability to integrate, build, and reconfigure interior capabilities to report, or in some cases to bring about, variations in the business environment. The strong point of a firm's dynamic capabilities is vigorous in many ways to its ability to preserve productivity over the long term, including the capability to plan and regulate business models (Teece, 2018).

3.3 Challenges in Adopting Business Model Canvas

SMEs are engaging consultants or advisors to produce the business model canvas. A fundamental concern for any business model is required whether and how an online platform could replace such real-life interactions, for instance, because deep domain knowledge on the market conditions of SMEs is crucial. Secondly, evaluation shows that SMEs may still struggle to find the right tooling for their needs and context (de Reuver et al., 2016). Similarly, the study reveals some boundaries regarding the philosophy, namely, that when the stockholders and businesspersons have different opinions of the value proposition, it can hinder further productive conversation unless some agreement is reached, which did not always happen (Sort and Nielsen, 2018).

3.4 New Elements in Business Model Canvas

Social entrepreneurship business models deserve a specific set of components, and develop a specific business model canvas for social entrepreneurship (Vial, 2016). This author recommended a new element to be added in the business model canvas proposed by Osterwalder. From the research conducted, the new business model elements are manpower, material, machinery, finance and information technology. Element manpower describes the way SME manage the manpower challenges due to the new technologies. Element material is covers material management, material identification and vendor selection. As for element machinery, its covers equipment availability, delivery of equipment and maintenance. Element finance describes financial difficulties by SME, cash flow, and financial control. Element information technology is mainly on the SME readiness towards adopting information technology related developments. By adopting these new elements into the existing business model, SME contractors will be able to foresee the challenges and eliminate far before penetrate in to adopting the IR4.0 technologies. Schöllhammer et al. (2020) promotes a reconsidering in the economy, politics and society to be part of business model canvas which can help to generate new globular forms of association permitted by digital ecosystems. It is important to have possible and potential changes in the business model canvas such as taking into account increase and decrease of raw materials, taking into account the changes in the consumer demand, taking into account the new needs of key customers (Dudin et al., 2015). Müller (2019) studies shows that user and provider aspects need to be included in their business model. Firms need to choose if the carriages are a danger towards their recognized business models, and whether SME must consequently evade the provider role in the direction of Industry 4.0. Nevertheless, captivating a provider character to Industry 4.0 could also permit SMEs to entirely grip the capacities of Industry 4.0, which keep on out of reach of Industry 4.0 users. SMEs are recommended to study equally roles but stimulated to take the risk to change to an Industry 4.0 provider.

4. Conclusion

A new recommendation of a SME contractor's business model will be proposed and contribution of generics for the SME contractors to raise their business performance and level of competency in adopting the Construction IR 4.0. The enhanced business model will cover project delivery elements, the manpower, material, machinery, finance and information technology. This research will help SME contractor to stay relevant to Malaysia National Policy on Industry 4.0, where it underlines one of the key objectives to attract stakeholders to shift towards the industry 4.0 applications and technologies, subsequently, enhancing Malaysia's attraction as one of the preferred locations for smart manufacturing.

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