Assessment of technology factor in companies' business strategy with the use of sense and respond method

Management and Production Engineering Review
Volume 10 • Number 3 • September 2019 • pp. 81–89
DOI: 10.24425/mper.2019.129601

ASSESSMENT OF TECHNOLOGY FACTOR IN COMPANIES' BUSINESS STRATEGY WITH THE USE OF SENSE AND RESPOND METHOD

Sara Tilabi[1], Rosmaini Tasmin[2], Josu Takala[1], M.H. Muazu[3], A.H. Nor Aziati[1], A.R. Shafiee[4], Noraini Kaprawi[1], M.S. Che Rusuli[5]

[1] *University of Vaasa, School of Technology and Innovation*
[2] *University Tun Hussein Onn Malaysia, Malaysia*
[3] *Dangote Business School, Bayero University Kano (BUK), Nigeria*
[4] *PH Furniture, Muar, Malaysia*
[5] *University Malaysia Kelantan, Malaysia*

Corresponding author:
Sara Tilabi
University of Vaasa
School of Technology and Innovations
Wolffinitie 34, 65200 Vaasa, Finland
phone: (+35) 8449487216
e-mail: sara.tilabi@uva.fi

Received: 10 November 2018
Accepted: 2 August 2019

Abstract
The focus of this paper is to propose a method for prioritizing knowledge and technology factor in companies' business strategy. The data has been gathered and analyzed from Malaysian-owned company of medium size type industry, employing around 250 employees and listed in the Malaysian Bourse Stock of Exchange, since 2000. Sense and respond model is used to determine competitive priorities of the firms. Then knowledge and technology part of sense and respond questionnaire is used to calculate the variability coefficient i.e. the uncertainty caused by technology and knowledge factor. The results show that the company is not leading in term of technology (spear head technology share is around 33%). Therefore, the enhancement of technology and knowledge to SCA values is not significantly seen in this study. The usage of the core technologies is around 41% and it might seem relatively enough. In terms of basic technology, while its share is the lowest (around 25%), it has the highest source of uncertainties among technology types. In this case, the proposed model helped to have a clear and precise improvement plan towards prioritizing technology and knowledge focus.

Keywords
Technology and knowledge, sense and respond, sustainable competitive advantage.

Introduction

One vital approach in sustaining business competitive advantage is through technological innovation, hence adapting to current technological shift. Technological changes drive competition in the current business environment. A technological change is not important for its own sake. It is important if it can bring competitive advantage to industry and influence on industry structure. Technological changes shall lead to newly adapted and adopted innovation into work process, product features and service offerings to the market. Organizational innovation is synonymous to new product and process development, is as well seen as an enabler for sustainable competitive advantage [1].

Technology innovation and technology investment are paramount to building and sustaining competitive advantage. Technology has significant role in the value chain of a firm, and it can result in the ability of firm to achieve low cost and differentiation thought its value chain activity [2].

The concept of sustainable competitive advantage has been debated for the past decades. The term

"sustainable competitive advantages" was defined by Porter in 1985 as a firm basic type of competitive strategy. He classified three generic enterprise strategies: overall cost leadership, differentiation and segmentation. Later on Barney [3] has made a closer definition by uttering as: "A firm is said to have a sustainable competitive advantage when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors and when these other firms are unable to duplicate the benefits of this strategy [3]. Porter [4] argued that sustainable competitive advantage is underpinned by differentiation of distinctive knowledge of product's quality and technology used. This notion has evolved over time to mean maintaining business capabilities that create atmosphere suitable for customers to enjoy greater value [4].

Those competitive advantages that deliver value to customers, uneasy to copy by competitors, and that merit organizational performance are what make up sustainable competitive advantage [5]. Organizational performance is dependent on competitive advantage [6, 7]. Organizational competitiveness in the current economic development is often exploited for survival and stability by firms [8]. An imperative feature of competitive advantage is the manner activities fit and fortify one another [9]. Competitive advantage is thus a combination of resources, interlinked features and activities of an organization better than competitors.

As resource and product are two sides of a coin for firms, Wernerfelt [10] suggests that analyzing a firm from the resource side has more benefit rather than from the product side. He defines resources as "anything that might be thought of as a strength or weakness of a given firm". Resources can bring competitive advantages to the firm because they help companies to achieve opportunities or avoid threats, they are rare or hard to imitate and have no direct substitutes [3]. Even the resource base view theory, according to Wang [11] paid emphasis to internal resources facilitates organizational competitiveness in the environment. These internal resources could be physical assets, knowledge assets as well as human resources capital all put together makes up firms' capabilities [11]. However, some people are of the view that capabilities give rise to competitive advantage and not resources because resources are considered as source of capabilities [12] and as such do not contribute to sustainable competitive advantage [13].

What then firm capabilities stands for? To some is the ability to develop, combine, and restructure internal and external competencies [14], a capacity of deploying organizational resources into a combination of processes to address the dynamism of business environment [13]. Management capabilities can thus be argued that Teece et al. [14] "it's a combination and integration of organizational, functional and technological skills, management of research and development, product and process development, technology transfer, intellectual property, manufacturing, human resources, and organizational learning".

One of the main challenges in sustainable competitive advantage is to consider how much company's resource allocation supports its business strategy. According to Liu [15], the main idea behind the implementation of SCA is to find the critical attributes in resource allocation trough sense and respond methodology. These critical attributes provide us improvement plan to enhance company's strategy and gain sustainable competitive advantages. Broadly speaking, challenges of sustainable competitive advantage as opined by Amit and Shoemaker [13] are identifying, developing, protecting, and deploying resources and capabilities for the sustenance of market advantage.

Considering product life cycle, there are three different level of technologies in any firms: Basic, core, speared head. Considering the effect of technology on resource allocation and critical factor indices, firms are facing with one important question: In which technology they need to invest to gain higher competitive advantages. Answering to this question require to detect which technology supports firm business strategy (in terms of differentiation or cost reduction) and which brings mainly uncertainties in return. Answering this question helps companies to out-source some technology related activities and invest on some other technology innovation to achieve higher competitive advantages.

The goal of this paper is to propose a tool (guide line) for decision maker to evaluate their technology strategy regarding their desired business strategy. The rest of this paper is structured as follow: first it brings theory background about different tools and concepts such as sense and respond (S&R) method, critical factor indices, business strategy and technology and knowledge effect. The sample of questionnaire is described and then the case and results are presented. Finally, discussion and conclusion follow.

Theory background

Manufacturing strategy

Success and survival of business for long term goal depends on its ability to engage in useful production, which requires continuous resources deploy-

ment decisions for manufacturing activities. These decisions and action so chosen is regarded as strategy. Strategy can be defined as "the pattern or plan that integrates an organization's major goals, policies and action sequences into a cohesive whole" [16]. Manufacturing strategy as a concept is seen as the exploit of material goods of the manufacturing function to attain competitive advantage [17]. Similarly, manufacturing strategy is understood as a steady pattern of manufacturing decision making that is aligned with firm's corporate strategy [18]. Therefore, it is a tool for holding on to firms manufacturing capabilities as a competitive gain for the realization of organizational goals.

There are different types of strategy topology which mangers and decision makers implement in a business. One of them is miles a snow topology which classifies business strategy in four groups: prospector, analyzer, defender and reactor. This classification supports managers in front of external environment. The definition of these four strategies are [19]:

- Prospector strategy: which tries to lead it's industry with the focus of quality. Prospectors innovate in processes and take risks. Besides, they bring new opportunities to the market.
- Analyzer strategy: tries to remain in a steady state in market but at the same time provide change and innovation. Analyzer focus is to reduce cost and acceptable quality.
- Defender strategy: which focuses on a mature product or market operation. Defenders concentrate on efficiency and process improvement and prefer not to take risks; they strengthen efficiency and maintain their current customers.
- Reactor strategy: this strategy happens in absence of defined goals and objectives. In this type of strategy, there is no sense of direction and decisions are taken to respond immediate problems. Hence this type of strategy is not considered as a separate category.

The priority to the build-up of manufacturing strategies is the competitive primacies that provide linkage between the overall goal of the firm and manufacturing objectives [8]. This situation or decision is dependent on the industry and market the firm operates or intend to venture. Some of the parameters of competitive advantage as opined by Ward [20] include quality, cost, time and flexibility. Once they are present and high in organization, it means the firm has competitive advantage. Firm's competitive environment is considered as one of the major determinants of organizational innovation, which entails cost-efficiency [1]. An organizational innovation is enough scale of operation to leverage against productivity gain.

Sense and respond

Several approaches are employed in managing business sustainable competitive advantages strategies [21]. They are comprised of sense and respond, Critical factor index, and manufacturing strategy. The traditional way of planning production based on the manufacturers has been replaced by anticipation of the customers' need in real time and companies are moving from make and sell approaches to sense and respond (S&R) approaches. It is because operations in the manufacturing age were slower and predictable [22], as there is no room for anticipatory reaction from any quota. "The problem that many of us face is that most of our management techniques were created at a time when this two- way conversation didn't exist".

Sense and respond (S&R) approach is used to assist in forming a picture of what might happen in the future. Tasmin et al. [21] opined that S&R facilitates choice of action towards the foreseeable future undertakings of a firm. This method enables firms to collect data regarding expectations and experiences. S&R orchestrates dynamic, structured and unstructured information within a continuous, adaptive event-based planning process [23]. Besides, it helps firms to understand their position compared to their competitors. Moreover, it helps firms to develop a certain criterion at a given time frame. The following tables shows model of questionnaire for Sense and Respond method [24].

Table 1
Format of the questionnaire.

Performance measurement	Scale: 1 = low, 10 = high		Compared with competitors			Direction of development		
	Expectation (1–10)	Experience (1–10)	worse	same	better	worse	same	better
C1								
C2								

RAL model

The way to integrate Miles & Snow Topology [19] into Sense and Response methodology is to use RAL model. RAL is abbreviated from Responsiveness, Agility and Leanness. A firm can optimize the RAL model components by prioritizing between cost, quality, time and flexibility [25]. The model fundamentally supports firm's operational strategy [21].

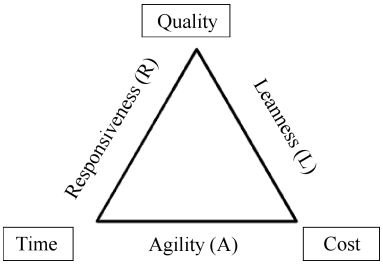

Fig. 1. RAL model.

The share of different component of RAL model are calculated as follow:

$$Q\% = \frac{Q}{Q+C+T}, \tag{1}$$

$$C\% = \frac{Q}{Q+C+T}, \tag{2}$$

$$T\% = \frac{Q}{Q+C+T}, \tag{3}$$

$$F\% = \frac{Q}{Q+C+T+F}. \tag{4}$$

Once the component of RAL model is calculated, the next step is to calculate MSI of operational competitiveness in each group.

The MSI model for prospector group:

$$\emptyset \sim 1-(1-Q\%^{1/3})(1-0.9*T\%)(1-0.9*C\%)*F\%^{1/3}. \tag{5}$$

The MSI model for analyzer group:

$$\lambda \sim 1-(1-F\%)[ABS[(0.9*Q\%-0.285) *(0.95*T\%-0.285) *(0.95*C\%-0.285)]]^{1/3}. \tag{6}$$

The MSI model for defender group:

$$\varphi \sim 1-(1-C\%^{1/3})(1-0.9*T\%)(1-0.9*Q\%)*F\%^{1/3}. \tag{7}$$

Strategy detection

The sample of different attributes used in this study are presented in the next table. In the last column, the attributes from (S&R) questionnaire are assigned to one of the multiple key categories of RAL model: Quality (Q), Cost (C), Time/Delivery (T) and Flexibility (F), depending on their most significant effect [8, 24]. These categorizations are performed to integrate Miles & Snow topology into Sense and Respond methodology.

Table 2
Sample of performance measurement which has been applied in this study.

	ATTRIBUTES	
	Knowledge & Technology Management	
1	Training and development of the company's personnel	Flexibility
2	Innovativeness and performance of research and development	Cost
3	Communication between different departments and hierarchy levels	Time
4	Adaptation to knowledge and technology	Flexibility
5	Knowledge and technology diffusion	Cost
6	Design and planning of the processes and products	Time
	Processes & Work flows	
7	Short and prompt lead-times in order-fulfilment process	Flexibility
8	Reduction of unprofitable time in processes	Cost
9	On-time deliveries to customer	Quality
10	Control and optimization of all types of inventories	Quality
11	Adaptiveness of changes in demands and in order backlog	Flexibility
	Organizational systems	
12	Leadership and management systems of the company	Cost
13	Quality control of products, processes and operations	Quality
14	Well defined responsibilities and tasks for each operation	Flexibility
15	Utilizing different types of organizing systems	Flexibility
16	Code of conduct and security of data and information	Cost
	Information systems	
17	Information systems support the business processes	Time
18	Visibility of information in information systems	Time
19	Availability of information in information systems	Time
20	Quality & reliability of information in information systems	Quality
21	Usability and functionality of information systems	Quality

Critical factor index (CFI)

Sensing beforehand then responding correctly to probable events and envisaging what will happen in the future call for a complete decision-making supporting system [27]. "The CFI method is a measure-

ment tool to indicate which attribute of a business process is critical and which is not, based on the experience and expectations of the company's employees, customers or business partners" [24]. It is a decision making tool which supports firm by providing the list of critical attribute. Later Nadler and Takala [27] developed BCFI from CFI principle. Then SCFI method was developed [28]. The calculations are presented in the following formula:

$$\text{CFI} = \frac{\text{std(experience)} * \text{std(expectation)}}{a^*}, \tag{8}$$

$$\text{BCFI} = \frac{b^* \cdot \text{Performance index}}{a^*}, \tag{9}$$

$$\text{SCFI} = \frac{c^* \cdot \text{Performance index}}{a^*}, \tag{10}$$

where

$$a^* = \text{Importance index} * \text{Gap index} * \text{Development index},$$

$$b^* = \text{SD Expectation index} \cdot \text{SD Experience index},$$

$$c^* = \sqrt{\frac{1}{n}\sum_{1}^{n}[\text{experience}(i) - 1]^2} \cdot \sqrt{\frac{1}{n}\sum_{1}^{n}[\text{expectation}(i) - 10]^2}.$$

The results of CFIs calculation can be presented in traffic bar charts. There are three different colors for different bars: green, yellow and red. In that bar chart yellow and red color represent over and under resource criteria respectively and green stand for balanced attributes. Both yellow and red attributes are critical.

After calculation CFIs and MSI components, the next step is to calculate SCA levels. By the SCA values, it can be observed how much the resource allocation supports the company's strategy. As the SCA value approaches to 1 the consistency between resource allocation and strategy becomes stronger.

MAPE (absolute percentage error):

$$\text{SCA} = 1 - \sum_{\alpha,\beta,\gamma}\left|\frac{\text{BS} - \text{BR}}{\text{BS}}\right|. \tag{11}$$

RMSE (root means squared error):

$$\text{SCA} = 1 - \left(\sum_{\alpha,\beta,\gamma}\left(\frac{\text{BS} - \text{BR}}{\text{BS}}\right)^2\right)^{1/2}. \tag{12}$$

MAD (maximum deviation):

$$\text{SCA} = 1 - \max_{\alpha,\beta,\gamma}\left|\frac{\text{BS} - \text{BR}}{\text{BS}}\right|. \tag{13}$$

Where the BS is the result of manufacture strategy index (MSI) and BR is the results of CFIs.

Knowledge and technology ranking

Knowledge and technology requirement section has been added to the sense and response (S&R) questionnaire to gather information about the companies' knowledge and technology rankings. Respondents are required to evaluate each attribute in terms of basic, core and spearhead technologies in percentages while keeping the summation of these three terms to 100%.

Basic technology is referring to the technology that is the most critical for the business. Core technologies include technologies that bring competitive advantages to competitors and enable the company to grow. And spearhead technology focuses mainly on future and is the most potential and brings successful business opportunities in future [25].

Coefficient of variance of technology and knowledge and SCA risk

The following formulas show the level of deviation between the participants' responses in terms of technology share. In fact, this is a measurement to how close are the answers of respondents. The lower the value of an attribute means the results are more reliable [25]

$$\text{Coef. Var}_{\text{Basic}} = \frac{\text{Standard Deviation}_{\text{Basic}}}{\text{Average}_{\text{Basic}}}, \tag{14}$$

$$\text{Coef. Var}_{\text{Core}} = \frac{\text{Standard Deviation}_{\text{Core}}}{\text{Average}_{\text{Core}}}, \tag{15}$$

$$\text{Coef. Var}_{\text{Spear Head}} = \frac{\text{Standard Deviation}_{\text{Spear Head}}}{\text{Average}_{\text{Spear Head}}}. \tag{16}$$

Once coefficient of variance (CV) is calculated for all the attributes in all technology level, then the fol-

lowing formula are used to calculate the risk of different level of technology

c_1 : Quality, c_2 : Time, c_3 : Cost, c_4 : Flexibility,

$$\begin{cases} \text{Total TK} \underset{c_1,c_2,c_3,c_4}{\text{risk}} \text{ (RMS)} \\ \quad = \sqrt{\sum_{c_1,c_2,c_3,c_4} \left[\left(\sum_{b_1,c_1,sh} \text{Coef. Var}_i \right)^2 \right]^2} \\ \text{Partial} \begin{cases} \text{TK} \underset{c_1,c_2,c_3,c_4}{\text{risk}} \text{ Basic (RMS)} \\ \quad = \sqrt{\sum_{c_1,c_2,c_3,c_4} \left[\sum_b \left(\frac{\text{std}_i}{\text{mean}_i} \right)^2 \right]^2} \\ \text{TK} \underset{c_1,c_2,c_3,c_4}{\text{risk}} \text{ Core (RMS)} \\ \quad = \sqrt{\sum_{c_1,c_2,c_3,c_4} \left[\sum_{\text{core}} \left(\frac{\text{std}_i}{\text{mean}_i} \right)^2 \right]^2}, \\ \text{TK} \underset{c_1,c_2,c_3,c_4}{\text{risk}} \text{ Sh (RMS)} \\ \quad = \sqrt{\sum_{c_1,c_2,c_3,c_4} \left[\sum_{sh} \left(\frac{\text{std}_i}{\text{mean}_i} \right)^2 \right]^2}. \end{cases} \end{cases} \tag{17}$$

Once the total and partial risk of different technology level is calculated, the next is to calculate SCA risk level considering technology. Next formula is used to do that:

$$\text{Total Risk (Geom)} = [(1 - \text{SCA})\text{TK risk}]^{1/2}, \tag{18}$$

$$\text{Total SCA risk level} = 1 - \text{Total Risk (Geom)}, \tag{19}$$

Case study

In this study, sense and respond (S&R) questionnaire data are collected from a Malaysian furniture industry. Four respondents answered the sense and respond questionnaire.

CFIs and business strategy results

The results of BCFI for future are presented in traffic bar chart in Fig. 2.

As the bar chart presents, most of the criteria in "Organization system" sector are under resource attribute i.e., critical and needed to be improved in terms of resource allocation. On the other hand, most of attributes in "process and work flows" area are balanced.

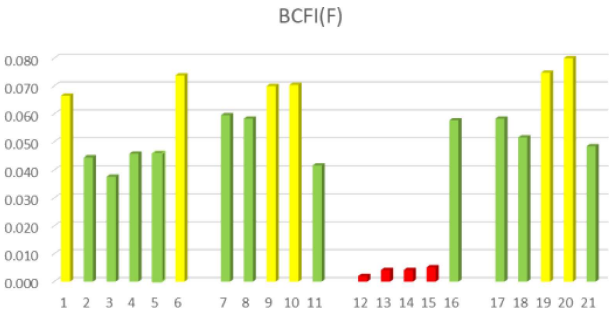

Fig. 2. Recourse allocation and critical factor based on BCFI for future.

The next is to present the values of the multiple key categories of RAL model (Q, C, T and F). These values are calculated separately based on CFIs values of the classified criteria (Table 3).

As the number in the table shows, the focus of company strategy is time.

Table 3
RAL model elements.

	Quality	Cost	Time	Flexibility
CFI(P)	0.00	0.09	**0.91**	0.16
CFI(F)	0.00	0.16	**0.84**	0.15
BCFI(P)	0.29	0.21	**0.50**	0.16
BCFI(F)	0.35	0.27	**0.38**	0.22
SCFI(P)	0.33	0.16	**0.51**	0.16
SCFI(F)	0.36	0.24	**0.39**	0.21
NSCFI(P)	0.36	0.24	**0.40**	0.23
N SCFI(F)	**0.37**	0.25	**0.37**	0.24

Based on calculated elements of RAL model, the business strategy of company is calculated, and the results shows that company business strategy is mainly analyzer. The following table and figure present company business strategy based on BCFI calculation.

Table 4
The company business strategy.

	Prospector	Analyzer	Defender	Reactor
Past	0.92	**0.95**	0.91	0.91
Future	0.91	**0.96**	0.90	0.91

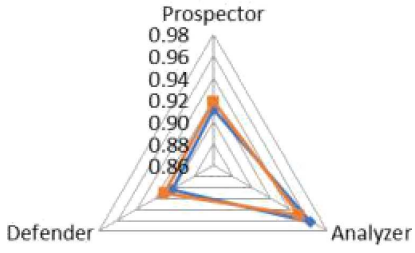

Fig. 3. The company business strategy.

Company tries to keep its operational strategy type unchanged as analyzer strategy, but in future the share of Analyzer group is slightly higher while the share of prospector group is less.

Results of K/T rankings

Core technology as Company's current competitive technology share seems to be around 41%. The share of basic technology is 25% and Spearhead technology is observed around 33% (Fig. 4).

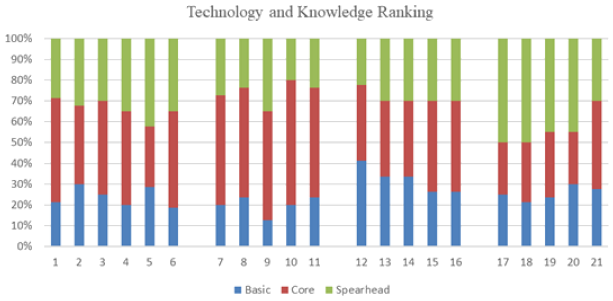

Fig. 4. Knowledge/technology rankings.

Following the formula 14–17, the coefficient of variance of different technology types and it's risk of different technology type are calculated as follows.

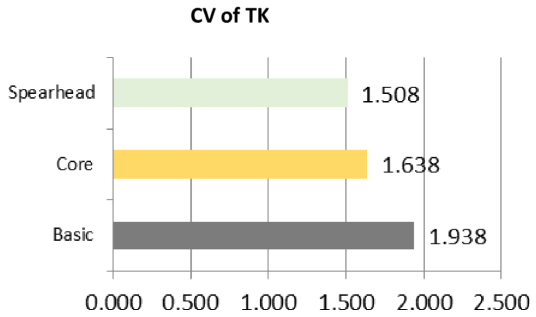

Fig. 5. The coefficient variance of different technology.

As the Fig. 5 shows, the main source of uncertainties in company is basic technology. And the risk of knowledge and technology correspond to basic technology is the highest among these three types of technology.

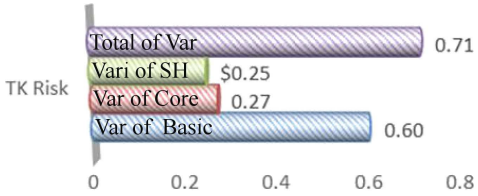

Fig. 6. The risk associated to each technology type.

Table 5
Risk of different technology level correspond different element of RAL model.

	Q	*C*	*T*	*F*
Basic	0.35	0.25	0.29	0.30
Core	0.066	0.159	0.090	0.192
Spearhead	0.131	0.098	0.131	0.133

The SCA level of business strategy of company without and with technology and knowledge effect is presented in the following.

Table 6
SCA level (without T/K effect).

SCA Level					
	MAPE	RMSE	MAD		GM
P-CFI	0.89	0.78	0.83		0.83
F-CFI	0.73	0.83	0.86		0.80
P-BCFI	0.96	0.97	0.98		0.97
F-BCFI	0.98	0.99	0.99		0.99
P-SCFI	0.92	0.95	0.96		0.95
F-SCFI	0.97	0.98	0.98		0.97
P-NSCFI	0.97	0.98	0.98		0.97
F-NSCFI	0.97	0.98	0.99		0.98

Table 7
SCA level with T/K effect.

SCA (New T/K effect)				
	Total	Basic	Core	SH
P-CFI	0.66	0.68	0.79	0.80
F-CFI	0.63	0.66	0.77	0.78
P-BCFI	0.86	0.87	0.91	0.91
F-BCFI	0.90	0.91	0.94	0.94
P-SCFI	0.80	0.82	0.88	0.88
F-SCFI	0.87	0.88	0.92	0.92
P-NSCFI	0.87	0.88	0.92	0.92
F-NSCFI	0.88	0.89	0.93	0.93

Comparing two tables above shows that considering technology and knowledge effect, the SCA risk level increases in this company (lower SCA).

Discussion and conclusion

This paper proposes a new method to evaluate the risk of different types of technology. Knowing the risk correspond to different technology type helps manager in the decision making related to technology investment. In fact, it shows which technology supports company business strategy (cost reduction or differentiation) more and which not. The model has been implemented successfully previously in two high-tech starts ups [29] and this research applies that in more conventional industry. Since technology

is one of the main drives of competition [2], the decision about that is crucial. Having known that technology could help company to increase the quality of products, reduce cost or make differentiation, the connection between technology and business strategy is clear .The paper applies resource based view (RBV) by barney [3] for assisting technology decision making process having in mind sustainable competitive advantage approaches [15].

The presented SCA model is based knowledge and technology here provides decision maker better tool towards gaining sustainable competitive advantages by making right decision regarding different technology type. The technology decision could be increasing investment or out-sourcing for example.

Moreover, the model process the possibility of:

- Observing the right type of operation strategy (cost, quality and time) which could result in company better performance.
- Investigating which company units follow company business strategy and which not.
- Take better strategic action by knowing the criteria which are unbalanced in terms of resource allocation.

The furniture manufacturing firm (this case study) is a Malaysian-owned company of medium size type industry, employing around 250 employees and listed in the Malaysian Bourse Stock of Exchange, since 2000. It produces high-grade office tables, chairs, office cabinets and cubicle partitions (marketed under AT Office system) for local and export markets to Japan, China, USA, Europe and the Middle-eastern countries. The case company has attained international quality certifications, such as from ISO 9001 UKAS Quality Management, MTTC and PEFC.

The research finding shows that this case company is not leading in term of technology (spear head technology share is around 33%). Therefore, the enhancement of technology and knowledge to SCA values is not significantly seen in this study. The usage of the core technologies is around 41% and it might seem relatively sufficient. In terms of basic technology, while its share is the lowest (around 25%), it has the highest source of uncertainties among technology types.

Although the model introduced in this paper provides an adequate practical value in case of strategic analyses and strategic decision-making process regarding technology and knowledge role in gaining competitive advantages, it still should to be tested with higher number of organizations in different type and size in order to find the best formula to validate the strategic decision (MAPE, RSME or MAP).

Although the effect of technology and knowledge on SCA observed by the proposed model here is not significant, it cannot be neglected. The main goal of this paper is to investigate the effect of different technology types on SCA level by considering the uncertainties in different technology. In case study section, the analyses are performed, and the recommendations are provided for the decision makers. Moreover, the analytical model presented in this paper could be considered as a great source to observe the weaknesses and strengths of the company's operations and accordingly to take required actions to keep up the sustainability of the company's development.

References

[1] Ganter A., Hecker A., *Deciphering antecedents of organizational innovation*, Journal of Business Research, 66, 575–584, 2013.

[2] Porter M.E., *Technology and competitive advantage*, Journal of Business Strategy, 5, 60, 1986.

[3] Barney J., *Firm resources and sustained competitive advantage*, Journal of Management, 17, 1, 99–120, 1991.

[4] Porter M.E., *Competitive strategy: Techniques for analyzing industries and competitors*, New York, Free Press, 1980.

[5] Veliyath R., Fitzgerald E., *Firm Capabilities, business strategies, customer preferences, and hypercompetitive arenas: the sustainability of competitive advantages with implications for firm competitiveness*, Competitiveness Review: An International Business Journal, 10, 1, 56–82, 2000.

[6] Ray G., Barney J.B., Muhanna W.A., *Capabilities, business processes, and competitive advantage: choosing the dependent variable in empirical tests of the resource-based view*, Strategic Management Journal, 25, 1, 23–37, 2004.

[7] Maleki F., Hosseinpour M., Rafiemanesh H., Salehi F., Lotfi Z. et al., *The review of community assessment papers to determine priority problems in selected populations of Iran*, Journal of School of Public Health & Institute of Public Health Research, 12, 3, 2014.

[8] Abdoul Malek N.A., Shahzad K., Takala J., Bojnec S., Papler D., Liu Y., *Analyzing sustainable competitive advantage: strategically managing resource allocations to achieve operational competitiveness*, Management and Production Engineering Review, 6, 4, 70–86, 2015.

[9] Ojo E., Mbohwa C., Akinlabi E., *Sustainability-competitive advantage?*, Proceedings of the 2015

International Conference on Operations Excellence and Service Engineering, Florida, pp. 592–600, 2015.

[10] Wernerfelt Birger, *A resource base view of the firm*, Strategic Management Journal, 5, 171–180, 1984.

[11] Wang H., *Theories for competitive advantage*, [in:] H. Hasan [Eds.], Being Practical with Theory: A Window into Business Research, Wollongong, Australia, pp. 33–43, 2014.

[12] Grant R., *The resource-based theory of competitive advantage: implications for strategy formulation*, California Management Review, 33, 3, 114–135, 1991.

[13] Amit R., Shoemaker P., *Strategic assets and organizational rent*, Strategic Management Journal, 14, 1, 33–46, 1993.

[14] Teece D.J., Pisano G., Shuen A., *Dynamic capabilities and strategic management*, Strategic Management Journal, 18, 7, 509–533, 1997.

[15] Liu Y., *Implementing Sustainable Competitive Advantage for Proactive Operations in Global Turbulent Business Environments*, 2010, available at: http://www.uva.fi/materiaali/pdf/isbn_978-952-476-314-1.pdf

[16] Quinn J.B., *Managing strategic change*, MIT Sloan Management Review, 1980.

[17] Skinner W., *Manufacturing – the missing link in corporate strategy*, Harvard Business Review, pp. 136–145, 1969.

[18] Hayes R.H., Pisano G.P., *Manufacturing strategy: at the intersection of two paradigm shifts*, Production and Operations Management, 5, 1, 25–41, 1996.

[19] Miles R., Snow C., *Organizational strategy, structure, and process*, McGraw-Hill, New York, NY, 1978.

[20] Ward P., *Configurations of manufacturing strategy, business strategy, environment and structure*, Journal of Management, 22, 4, 597–62, 1996.

[21] Tasmin R., Takala J., Abubakar A.A., Shylina D., Nizalek I., CheRusuli M.S., *Sustainable Competitive Advantage (SCA) analysis of furniture manufacturers in Malaysia: Normalized Scaled Critical Factor Index (NSCF) approach*, Management and Production Engineering Review, 7, 2, 73–85, 2016.

[22] Gothelf J., Seiden J., *Sense and respond*, Harvard Business Review, USA, 2017.

[23] Buckley S., Ettl M., Lin G., Wang K., *12 Sense and Respond Business Performance Management*, Supply Chain Management on Demand, Springer: Berlin Heidelberg, pp. 287–311, 2006.

[24] Ranta J., Takala J., *A holistic method for finding out critical features of industry maintenance services*, Int. J. Services and Standards, 3, 3, 312–325, 2007.

[25] Takala J., *Resilient and proactive utilization of opportunities and uncertainties in service business*, Proceedings of the University of Vaasa, Finland, University of Vaasa, 2012.

[26] Nikookar H., Sahebi D., Takala J., *Comparing sense and respon based on critical factor index methods for optimising operations strategies*, Proceedings of the 13th Management International Conference Budapest, Hungary, 22–24 November 2012.

[27] Nadler D., Takala J., *The development of the critical factor index method*, Faculty of Technology, Department of Production, University of Vaasa, 2008.

[28] Liu Y., Wu Q., Zhao S., Takala J., *Operations strategy optimization based on developed sense and respond methodology*, Proceedings of the 8th International Conference on Innovation & Management, Finland, University of Vaasa, pp. 1010–1015, 2011.

[29] Takala J., Tilabi S., *Towards developing a decision making tool for technology and knowledge priorities*, Management and Production Engineering Review, 9, 3, 33–40, 2018.