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VALIDATING KNOWLEDGE AND TECHNOLOGY EFFECTS TO OPERATIVE SUSTAINABLE COMPETITIVE ADVANTAGE

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Abstract

Purpose: This paper aims to present a fresh idea on how to model and examine the level of sustainable competitive advantage (SCA) with and without knowledge and /technology (K/T) effects in a case company's operation by taking the manufacturing strategy's development directions and the efficiency of resource allocation among its attributes into consideration.
Design/Methodology/approach: In this paper, questionnaires are filled by two different managerial groups, company's management team (G1) and company's global directors (G2). The analyses based on G1, G2 and G1-G2 (mixed results) are performed and examined as well as the effect of knowledge and /technology rankings to observe the differences on how they effect on company's operations strategy and what kind of strategy type that decision makers might follow. Besides, the effects of knowledge/technology rankings on SCA risk levels are examined on different case companies to perceive the similarities and differences with our case company. In this case study, the objectives are achieved based on several methodologies: manufacturing strategy index (MSI) [1] and sense and respond (S&R) methodology [2].
Findings: The achieved results through the model are found to be promising corresponding to the feedback from the respondents.
Research limitations/implications: The model is applied only in a big sized B2B global company that produces power electronics products. Therefore, further tests need to be applied to the model in case of multiple companies from different sizes and areas to figure out the best formula in case of validation of strategic direction (MAPE, RSME or MAD).
Practical implications: As a result of its wide applicability and its ease in arrangement the model has an enormous potential for strategic decision-making process and strategic analysis.
Originality/Value: The model can provide a more dependable possibility of sustainable improvement to the corporate operational excellence and strategy.

Keywords
Sustainable competitive advantage (SCA), knowledge and /technology rankings, manufacturing strategy, sense and respond (S&R), operational excellence, operations management, dynamic capabilities.

Introduction

The growing role of technology cannot be underestimated nowadays as it brings vast number of opportunities for business development, growth and strengthen of the competitive advantages [3]. The advanced technology is the source of profit and competitiveness to enterprises, and at the same time, it is also an important support which helps enterprises adapt market changes. Along with the unceasing renovation of technology of industry, enterprises must continually adapt to the technical requirements of the market.

Although, SCA was not formally defined at the beginning it is first aroused by Porter [4] that the firms of basic types of competitive strategies can be possessed of achieving SCA. Barney [5] has made a closer definition by uttering as a: "A firm is said to have a sustained 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 (italics in original)" (p. 102). By the SCA values, one may observe how much the resource allocation supports the company's strategy. Liu states that the main idea lies behind the implementation of SCA is to find the critical attributes in resource allocation trough sense and respond methodology (S&R) and make the improvements that provides to perform dynamic adjustments to enhance the company's strategy in turn [6]. In a fast changing business environment, companies should have a clear focus to find new and more innovative ways of working. They shall encourage firm's employees to be innovative in order to come up with new solutions. In turbulent business environments, the importance of focusing on right thinks is more important. New models and tools as well as dynamic capabilities support firms to achieve success in a long term business.

The view of an organization based on the resource allocation is started by the theoretical reference basis of competitiveness in manufacturing operations [7]. It is aimed to understand whether the right direction of development is selected to make certain that the selected strategy is followed by the corporation by employing resource allocation with dynamic capabilities' point of view. Accordingly, manufacturing strategy index (MSI) [1] and the method of detection of a company's preferable strategy type through utilization of sense and respond (S&R) methodology [2] methodologies are used for the validation.

In this paper, all analyzes are performed based on 11 interviews with vice presidents and global directors in global operation strategies in global company that produces power electronics products. In its business area, the case company is one of the biggest players focusing on profitable growth.

In this paper, the analyses based on the level of SCA is modeled and examined with and without the effects of K/T in our case company's operation by involving MSI and S&R. Here, two research questions are aroused. First one is how to evaluate K/T effects to SCA and the second one is how valid different SCA models to evaluate K/T effects to SCA are in practice. In the literature review part, great background information is provided for the reader to have a good understanding of the process and in the following part, the required equations are given for the modeling of SCA. Subsequently, analyses are performed and the results are discussed and concluded.

Literature review

Manufacturing strategy

Johnson describes strategy as 'the direction and scope of an organization over the long-term, which achieves advantage in a changing environment through its configuration of resources with the aim of fulfilling stakeholder expectations' [8]. Mintzberg states that strategy is organization's future plan, a position in specific markets, a pattern of its performance and a tactic to left behind its competitors [9].

Miles and Snow topology [10] is a dominant framework of the strategy types. They have developed a comprehensive framework which states that the strategy type can be detected depending on the fixed proportions between RAL Model elements (Quality, Cost, Time/Delivery, and Flexibility). By this framework strategy types are considered to be four different groups, prospectors, defenders, analyzers and reactors. Decision makers stick to one of these strategies at certain times depending on the market condition to avoid crisis from turbulent business environment. Prospector strategy has a definite focus on quality and it endlessly seeks for new market opportunities, defender strategy aims achieving an advantage in cost to create a stable market share and analyzer strategy is considered to be an intermediate one as it focuses on balancing between quality, cost and time.

Strategy detection

Each attribute in the list (Table 1) is numbered and analyzed in graphs with respect to the order (Fig. 1). In the last column (Table 1), the attributes from OP (Operations) 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 [3]. These categorizations are performed to integrate Miles & Snow topology into Sense and Respond methodology. According to Thomas L. Saaty: "To make a decision we need to know the problem, the need and purpose of the decision, the criteria of the decision, their sub-criteria, stakeholders and groups affected and the alternative actions to take" [11].

Table 1

The list of attributes used in Sense and Respond questionnaire.

	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-fulfillment 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

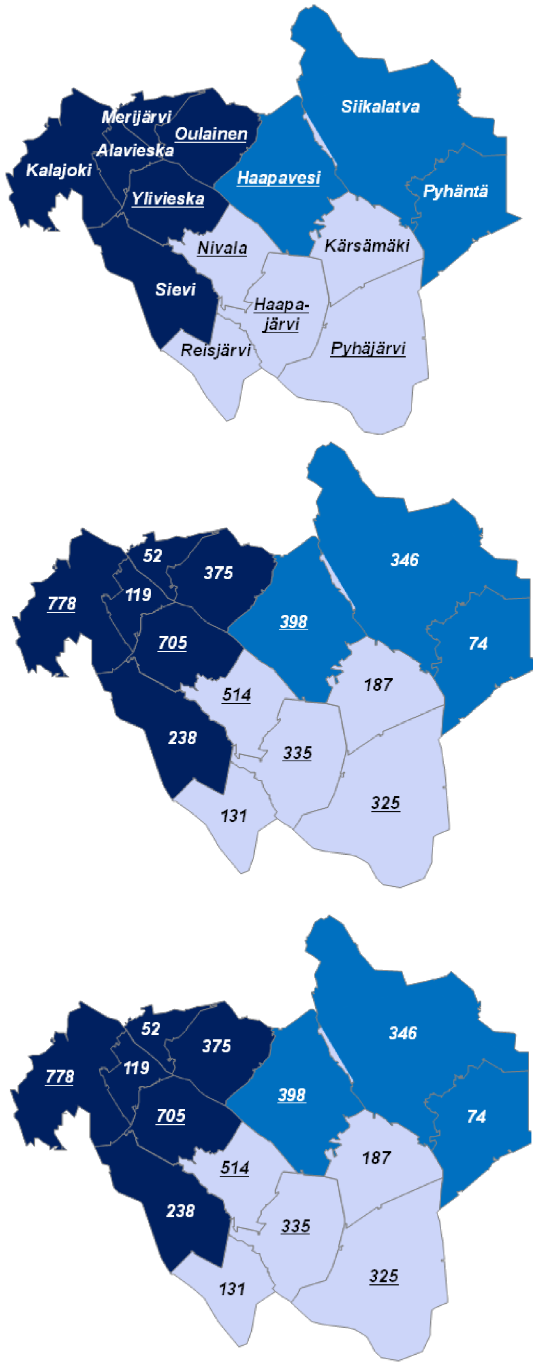

Fig. 1. Oulu South municipalities and numbers of companies.

Sense and respond

Sense and respond (S&R) is a comprehensively customizable industrial operational strategy to deal with current turbulent business environment. The main idea of 'Sense & Response' philosophy is the execution of the best practices in a turbulent business environment by detecting changes (sensing) and reacting to them properly (responding), in other words, converting threats into opportunities and drawbacks into strengths. Bradley and Nolan [12] developed dynamic business strategies with respected to the S&R thinking. In case of facing frequently changing environmental conditions, companies are able to sense, adapt and rapidly respond due to these dynamic business strategies. The S&R was utilized by Ranta and Takala [13] to develop the operative management system by introducing critical factor index (CFI). Since then, the S&R model has gone through three stages of development, which are called CFI model, BCFI model, and SCFI model [6].

Knowledge and technology rankings

Technology provides the opportunity of competitive advantage to a firm and decision makers should integrate this opportunity with their strategy [14]. Knowledge/and technology requirement section has been added to the Sense and Response 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 technologies commonly used and that can be purchased or outsourced while core technology is referring to company's current competitive technologies and spearhead technology is referring to the technologies focused on the future.

The importance of different technological levels (Basic, Core or Spearhead), in technology-based businesses, affects a lot the strategy implementation by the knowledge required, and supports the company's success in the competitive category chosen. The information is useful as it helps to understand additional ways of performance control and improvement for every listed attribute [3].

The method of judgment on critical attributes

There are three different colors defined for the resource allocation of the attributes; red, yellow and green which represent whether an attribute is under resourced, over resourced or balanced. Here the resource allocation of the attributes is considered to be ideal if it is equally distributed. The whole resource is counted to be 100% and it is divided to the total number of attributes. By this division the average resource level is defined. An attribute is counted to be balanced and takes the green color if BCFI value is between the range of 1/3 and 2/3 of average resource level. For the rest, any attribute which has a lower BCFI value than 1/3 of average resource level is counted to be under resourced and takes the red color, and any attribute which has higher BCFI value than 2/3 of average resource level is counted to be over resourced and takes the yellow color [2].

Derivation of BCFI K/T

Right after applying the method of judging under resourced and over resourced attributes, the next step is to calculate the values of BCFI K/T for each attribute, depending on the formulas provided below (Table 2). First, the color of the attribute is taken into consideration then the dominating technology for that attribute. The dominating technology is one with a value more than 43%; in case all of the technology levels are less than 43% the one with the highest value is dominating [3].

Oulu South Region (OEI)

Oulu South Area is located in Northern Ostrobothnia in the southern part of the province of Oulu. It has three sub-region area of cooperation.

Number of firms = 4597, Micro entities 95%, Small and medium sized enterprises 5%, Large companies 0.1%.

The area includes a total of 14 municipalities with a total population of just under 90 000, or about a quarter of the Northern Ostrobothnia population. In 2001, Oulu Southern Regional Ministry of the Interior approved the regional center program three sub-region network-type cooperation areas. The region's development strategy has been prepared in Oulu South 2015 agreement. The contract shall be entered in the main area of development in 2007–2015.

Table 2
Technology Rankings: General formulas.

	RED attributes	YELLOW attributes	GREEN attributes
Basic	(B)CFI / (B% / 100)	(B)CFI * (B% / 100)	(B)CFI / (B% / 100)
Core	(B)CFI * $(C\% / 100)^2$	(B)CFI / (C% / 100)	(B)CFI * $(C\% / 100)^2$
Spearhead	(B)CFI * $(SH\% / 100)^3$	(B)CFI / $(SH\% / 100)^2$	(B)CFI * $(SH\% / 100)^3$

Oulu South is one of the main agricultural areas – the area can be characterized as an industrialized in rural areas, because the region offers a significant extent, the manufacturing industry jobs. The largest industries are agriculture, metals, wood products industry, and information and communication technology (ICT). The regional unemployment rate is among the lowest in northern Finland and the age structure of the population is young. This differentiates from other Finnish Oulu Southern rural areas. Oulu South is a business-friendly area where currently about 4,600 active companies. Of these, about 95% of companies are micro-enterprises. More than a hundred of enterprises with a range of less than 20 Oulu South map numbers of companies and municipalities is shown in following picture.

The implementation of SCA

For the calculation of the operational competitiveness rankings of the case companies in different groups, prospector, analyzer and defender, the analytical models are used for manufacturing strategy (MSI) [10]. Takala [1]states that the theory of analytical models are supported by the RAL (Responsiveness, Agility and Leanness) model by taking four main criteria into consideration, cost (C), quality (Q), time/delivery (T) and flexibility (F). The development of the analytical models is held from over 100 companies in the GMSS research group. Therefore, they have good transferability and they will provide competitiveness ranking of the case companies in this paper.

The equations below (1–4) stand for the calculations of normalized weights of four main criteria in the analytical models.

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

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

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

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

The equations (5)–(7) stand for the analytical models that provide the calculations of MSI of operational competitiveness in each group.

The MSI model for prospector group:

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

The MSI model for analyzer group:

$$\lambda \sim 1-(1-F\%)\left[\begin{array}{c} [ABS[(0.95*Q\%-0.285) \\ *(0.95*T\%-0.285) \\ *(0.95*C\%-0.285)]] \end{array}\right]^{1/3}. \tag{6}$$

The MSI model for defender group:

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

Ranta and Takala [13] have introduced critical factor index (CFI) into the operative management system to shape sense and respond (S&R) theory. By this way, the critical criteria of strategic adjustment that may support the strategic decision-making phase is interpreted and evaluated. The following model, BCFI, was developed by taking the principle of CFI theory into consideration. Later, Liu et al. [2] developed the SCFI model that accurately models the S&R theory.

The following equations are used in the calculations of CFI, BCFI and SCFI models (8)–(11).

$$Importance\ index = \frac{Average\ of\ expectation}{10}, \tag{8}$$

$$Gap\ index = \frac{Average\ of\ expectation - Average\ of\ experience}{10} - 1, \tag{9}$$

$$Development\ index = |(better - worse)*0.9 - 1| \tag{10}$$

$$Performance\ index = \frac{Average\ of\ experience}{10}. \tag{11}$$

The equations of CFI, BCFI and SCFI models are listed as follows:

$$CFI = \frac{std\{experience\}*std\{expectation\}}{Impotance\ index * Gap\ index * Development\ index} - 1, \tag{12}$$

$$SD\ expectation\ index = \frac{std\{expectation\}}{10} + 1, \tag{13}$$

$$SD\ experience\ index = \frac{std\{experience\}}{10} + 1, \tag{14}$$

$$BCFI = \frac{a^*}{b^*} - 1, \tag{15}$$

where

$$a^* = SD\ expectation\ index * SD\ experience\ index * Performance\ index,$$

$$b^* = Importance\ index * Gap\ index * Development\ index,$$

$$SCFI = \frac{c*}{d*}, \tag{16}$$

where

$$c^* = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(experience(i)-1)^2}$$
$$* \sqrt{\frac{1}{n}\sum_{i=1}^{n}(expectation(i)-10)^2}$$
$$*Performance\ indes,$$

$$d^* = Importance\ index * Gap\ index$$
$$*Development\ index.$$

By the SCA values, one may observe 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):

$$SCA = 1 - \sum_{\alpha,\beta,\gamma} |\frac{BS - BR}{BS}|. \quad (17)$$

RMSE (root means squared error):

$$SCA = 1 - \sqrt{\sum_{\alpha,\beta,\gamma} \left(\frac{BS - BR}{BS}\right)^2}. \quad (18)$$

MAD (maximum deviation):

$$SCA = 1 - \max_{\alpha,\beta,\gamma} |\frac{BS - BR}{BS}|. \quad (19)$$

Case study

In this case study, MSI and S&R data are collected from a multinational Finnish company in two phases, 2 years in the past (P) and 2 years in the future (F). The collected S&R data is examined in three groups, G1, G2 and G1&G2, to analyze their distributed and normalized values in terms of quality, cost, time and flexibility as can be observed from the following tables. The values of the multiple key categories of RAL model (Q, C, T and F) are calculated separately based on CFIs values of the classified attributes (Tables 3–5).

Table 3
Results of informants G1.

	Quality	Cost	Time	Flexibility
CFI(P)	4.52	5.19	11.05	13.31
CFI(P) Normalized	0.13	0.15	0.32	0.39
CFI(F)	12.34	10.86	19.59	10.30
CFI(F) Normalized	0.23	0.20	0.37	0.19
BCFI(P)	4.82	4.75	5.88	9.66
BCFI(P) Normalized	0.19	0.19	0.23	0.38
BCFI(F)	15.22	9.08	9.19	9.95
BCFI(F) Normalized	0.35	0.21	0.21	0.23
SCFI(P)	61.37	78.01	105.72	192.53
SCFI(P) Normalized	0.14	0.18	0.24	0.44
SCFI(F)	174.24	140.76	148.54	174.76
SCFI(F) Normalized	0.27	0.22	0.23	0.27
BCFI TK(F)	15.50	5.94	13.98	17.34
BCFI TK(F) Normalized	0.29	0.11	0.27	0.33

Table 4
Results of informants G2.

	Quality	Cost	Time	Flexibility
CFI(P)	9.16	13.38	9.15	10.21
CFI(P) Normalized	0.22	0.32	0.22	0.24
CFI(F)	12.72	15.95	13.64	14.29
CFI(F) Normalized	0.22	0.28	0.24	0.25
BCFI(P)	5.20	5.73	4.05	6.97
BCFI(P) Normalized	0.24	0.26	0.18	0.32
BCFI(F)	7.17	6.25	5.98	8.87
BCFI(F) Normalized	0.25	0.22	0.21	0.31
SCFI(P)	131.84	161.99	102.55	211.67
SCFI(P) Normalized	0.22	0.27	0.17	0.35
SCFI(F)	175.99	182.29	150.21	269.47
SCFI(F) Normalized	0.23	0.23	0.19	0.35
BCFI TK(F)	9.62	5.40	9.39	16.37
BCFI TK(F) Normalized	0.24	0.13	0.23	0.40

Table 5

Results of informants G1&G2.

	Quality	Cost	Time	Flexibility
CFI(P)	8.47	11.28	11.92	13.30
CFI(P) Normalized	0.19	0.25	0.27	0.30
CFI(F)	13.97	15.48	18.37	17.40
CFI(F) Normalized	0.21	0.24	0.28	0.27
BCFI(P)	5.05	5.30	4.61	7.67
BCFI(P) Normalized	0.22	0.23	0.20	0.34
BCFI(F)	8.73	6.90	7.06	9.34
BCFI(F) Normalized	0.27	0.22	0.22	0.29
SCFI(P)	200.11	241.18	197.88	380.53
SCFI(P) Normalized	0.20	0.24	0.19	0.37
SCFI(F)	328.80	323.92	296.76	453.05
SCFI(F) Normalized	0.23	0.23	0.21	0.32
BCFI TK(F)	17.14	6.34	10.33	16.19
BCFI TK(F) Normalized	0.34	0.13	0.21	0.32

Results of K/T rankings from informants G1

Company's current competitive technologies (Core) seem to be around 35%, the technologies commonly used (Basic) differ from 25% to 50% and the technologies focused on the future (Spearhead) is observed to be roughly around 20% in average (Fig. 2). From the technology rankings point of view the company is found to be somehow competitive; however, spearhead ranking shows that company do not aim to invest on the technologies focused on the future.

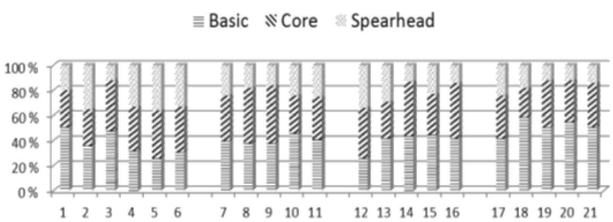

Fig. 2. Knowledge and Technology rankings.

From the technology point of view, most of the attributes are going to be critical by lack of resource allocation and the attribute number 14 is going to be over resourced (Fig. 3). Considering the K/T effects, it may be observed that while it enhances some attributes it makes it worse for others as the dominating technology ranking differs for attributes. Company may concentrate more on the right type of technologies for each attribute to keep them in balanced zone (3.17–6.35). Although, the overall situation is observed to be critical K/T effect has provide a positive impact in general.

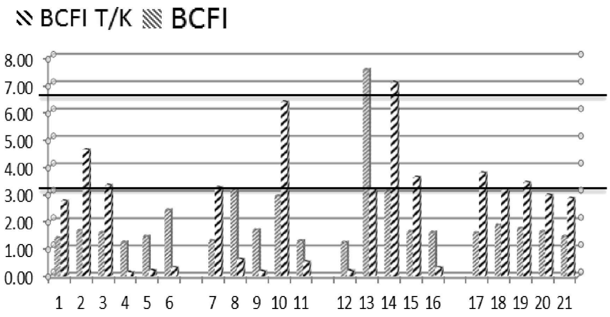

Fig. 3. BCFI (F) vs BCFI K/T (F).

Results of K/T rankings from informants G2

Technology rankings for the attributes of G2 are seen to be slightly different compared to the answers from G1 (Fig. 2, Fig. 4). Here, participants from G2 values basic technologies more than spearhead technologies while they keep the core technologies in same level with G1. Although, there are small changes between G1 and G2 in technology rankings, the change in dominating technology will effect on the enhancement of the attributes by K/T effects.

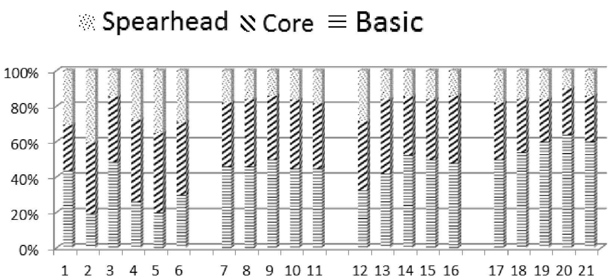

Fig. 4. BCFI (F) vs BCFI K/T (F).

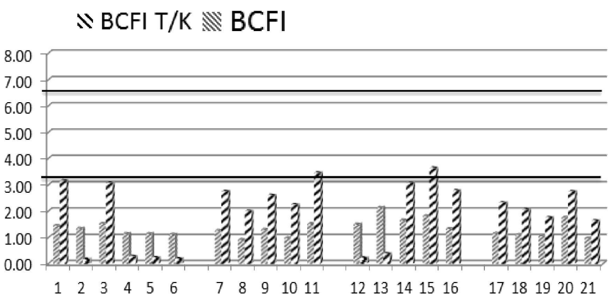

Fig. 5. BCFI (F) vs BCFI K/T (F).

Except the attributes number 1, 11 and 15, all the attributes are going to be critical by lack of resource allocation from the technology point of view (Fig. 5). The improvement done by K/T effects on BCFI in G1 is not observed well for the BCFI K/T values in G2 which means that K/T rankings consideration from G2 is not as effective as in G1 in general. Company should put more effort for under resourced attributes and decide on the right type of the dominating technology for each attribute.

Results of K/T rankings from informants G2

By analyzing the data from both groups' participants, company's core technologies seem to be around 35%. Basic technologies differ from 25% to 60% and the technologies focused on the future (Spearhead) are observed to be roughly around 20% in average (Fig. 6). It may be very clearly observed that the basic technologies are generally the dominating technology type for most of the attributes which implies that the company is not considered or going to be competitive from the technology point of view, although core technologies are around 35%.

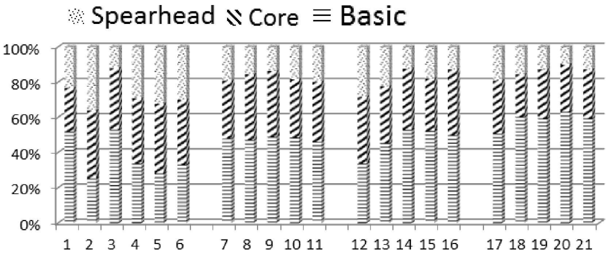

Fig. 6. Knowledge and Technology rankings.

Except the attribute number 13, almost all the attributes are going to be critical by lack of resource allocation and the attribute number 13 is going to be over resourced with a small number (Fig. 7). General situation in this figure does not seem a very bad one. Although, most of the attributes are not in the balanced zone they are quite near to be pulled to the balanced zone.

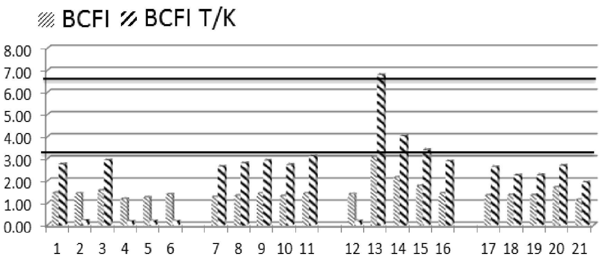

Fig. 7. BCFI (F) vs BCFI K/T (F).

Strategy type

Analyzer and defender strategy types are seen to be almost equally the most preferred strategy types for the company in the past case. Although, company aims to keep its operational strategy type unchanged analyzer strategy type is slightly less dominant for the future case but defender strategy type is the most dominant one (Table 6). It is well understood that the company is aiming to follow defender strategy type in the future case with and without K/T involvement; however, somehow it is also going to have analyzer strategy type characteristics as well in the future.

Table 6
Strategy type calculations.

	Prospector	Analyzer	Defender
G1 BCFI (P)	0.92	0.95	0.96
G1 BCFI (F)	0.78	0.87	0.89
G1 BCFI TK (F)	0.81	0.88	0.90
G2 BCFI (P)	0.95	0.97	0.97
G2 BCFI (F)	0.74	0.84	0.88
G2 BCFI TK (F)	0.77	0.86	0.89
G1-G2 BCFI (P)	0.94	0.96	0.97
G1-G2 BCFI (F)	0.74	0.84	0.88
G1-G2 BCFI TK (F)	0.76	0.86	0.89

SCA analyzes and Weak Market Test (WMT)

The calculated SCA values for the past case are seen to be relatively very high compared to the SCA values that are calculated for the future case (Table 7). In this scenario, it can be concluded that the resource allocation for attributes were partially supporting the operational strategy better; however, the resource allocation for the future scenario seems to be inadequate which means weak sustainability is unavoidable in the future operation strategies. Therefore, the decision makers are suggested to concentrate more on well distributed resource allocation between attributes.

One other point observed from Table 7 is the enhancement of K/T effects on SCA risk levels. Involving the K/T effect into the consideration shows a small improvement in SCA values for G2 and G1&G2 analyzes which simply indicates an automatic improvement in resource allocation. At this point it is highly suggested for the decision makers to adjust their technology rankings accordingly to improve the critically allocated resource for each attribute.

Validation of SCA formulas seem to work properly based on WMT. OEI case companies do not stand against the SCA risk levels; they approve the results with the practice. The same situation may be said for our case company, the practical SCA risk level is exactly same compared to MAPE and %2–3 higher risk level compared to RMSE and MAD in the past case. Although, there is a high risk level between WMT and MAPE the risk level is quite small in comparison of WMT and MAD in the future case. In this scenario, WMT data does not exactly fit to any of the SCA formulas. Therefore, there is a need to conduct more case studies to make a decision on which SCA formula would be more realistic.

Table 7
Calculated SCA results.

	α	β	γ	MAPE	RMSE	MAD	WMT
G1 BCFI(P)	1.08	0.99	1.08	0.92	0.95	0.96	
G1 BCFI(F)	1.06	1.01	1.07	0.78	0.87	0.90	
G1 BCFI TK (F)	1.04	1.03	1.07	0.74	0.84	0.88	
G2 BCFI (P)	1.07	1.01	1.07	0.95	0.97	0.97	
G2 BCFI (F)	1.07	0.99	1.08	0.74	0.84	0.88	
G2 BCFI TK (F)	1.06	1.01	1.08	0.76	0.86	0.89	
G1-G2 BCFI (P)	1.07	0.99	1.07	0.94	0.96	0.97	0.94
G1-G2 BCFI (F)	1.07	0.99	1.08	0.74	0.84	0.88	
G1-G2 BCFI TK (F)	1.05	1.01	1.08	0.76	0.86	0.89	0.91

K/T effects comparison with other OEI case companies

As the effects of K/T to SCA has also been examined for OEI case companies (OEI.1- OEI.7) a comparison between the results from these companies and our case company is performed. While the effect of K/T has a small enhancement, (1–3) %, to SCA values for our case company in case of G1&G2, it increases the risk level for the other OEI case companies except OEI.1 (Fig. 8). The derived results imply that these companies cannot take the effect of K/T into account as they use weak or wrong type of the technology for most of their attributes.

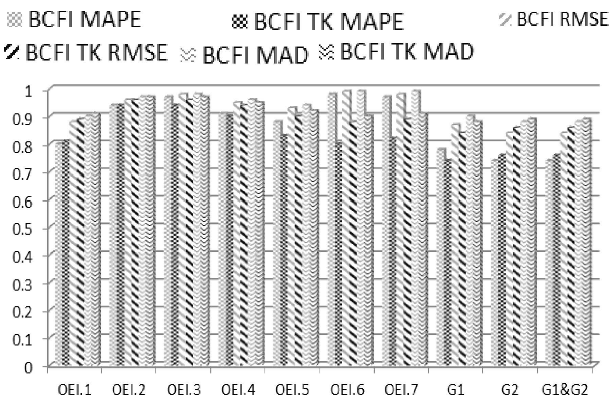

Fig. 8. BCFI (F) vs BCFI K/T (F).

Discussions

In this paper, the operations SCA evaluation may be considered as the risk probability. By achieving the SCA value, decision makers may decide on an operation strategy (among prospector, analyzer and defender operational strategy types) which causes least risk. The presented SCA method provides better sustainability, sensitivity and flexibility for the company. Moreover, it enhances its competitiveness and performance. The model provides possibility:

- To observe the right type of the operations strategies that may provide better performance for the company.
- To make the adjustments in case of the general strategy and take better strategic actions by operation with supplementary information.
- To investigate whether each unit in company follows the general strategy or not, in case of analyses for each unit separately. In case a unit is not following the general strategy, the attributes in that unit may be adjusted to converge with the company's general strategy.

Our international case company does not seem to be a competitive one in case of K/T rankings. Therefore, the enhancement of K/T to SCA values is not significantly seen in this study. The usage of the core technologies is around 35% and it might seem relatively sufficient; however, it is observed that the basic technology type is dominant for the most of the attributes. This situation shows that company is not planning to invest on the future type technologies efficiently.

Although. the model introduced in this paper provides an extensive potential and adequate practical value in case of strategic analyses and strategic decision making process it is found to be in need 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).

Managerial implications

In addition to the theoretical contributions of this paper, this study provides new ways for more robust operation strategies. Although, it has been the first validation that is based on WMT for OEI and our case companies the models proposed for the calculation of K/T effects to SCA risk levels seem to work properly in practice. By taking the results gained through the models proposed into consideration, managers may observe and avoid weak sustainability in operation strategies.

Conclusion

The main role of this paper is to validate the effect of K/T to SCA in operations by taking the firm's strategy development directions and the efficiency of resource allocation into consideration. 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.

Although, the effect of K/T to SCA is observed to be significantly small the enhancement of K/T is not negligible in case of using right type of the dominating technology. K/T effects to SCA do not increase the risk levels and WMT is very close to the calculated SCA values in case of our case company. Therefore, K/T rankings model seems to be a valid one as it enhances resource allocation; however, more case studies need to be conducted to provide a stronger validation of K/T rankings and SCA models.

This study has reached its aim and shown noteworthy results; however, it is well accepted that there are some limitations and shortcomings. First of all, the study is based on our multinational company and several OEI companies. Therefore, there should be more similar studies conducted to prove the validation of SCA models with K/T rankings. Second, the population of the participants is not that large. Collecting data from more participants might lead to steadier results. Third, the data is collected based on 3 years in the past and 3 years in the future perhaps this time duration should have been extended or data should have been collected based on different times in the past and in the future. For these reasons, the future studies will be conducted accordingly to have a stronger validation of the models introduced and to achieve better results.

References

[1] Takala J., Kamdee T., Hirvelä J., Kyllonen S., *Analytic calculation of global operative competitiveness*, Proceedings of the 16th International Conference on Management of Technology, Florida, 2012, International Association for Management of Technology, Orlando, 2007.

[2] 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.

[3] Takala J., *Resilient and Proactive Utilization of Opportunities and Uncertainties in Service Business*, Proceedings of the University of Vaasa, Finland, University of Vaasa, Vaasa, 2012.

[4] Porter M.E., *Competitive Advantage: Creating and Sustaining Superior Performance*, The Free Press, New York, NY, 1985.

[5] Barney J., *Firm Resources and Sustained Competitive Advantage*, Journal of Management, 17, 1, 99–120, 1991.

[6] Liu Y., *Implementing Sustainable Competitive Advantage for Proactive Operations in Global Turbulent Business Environments*, available at: http://www.uva.fi/materiaali/pdf/isbn_978-952-476-314-1.pdf (accessed 15 February 2013), 2010.

[7] Wernerfelt B., *A Resource-Based view of the Firm*, Strategic Management Journal, 5, 2, 171–180, 1984.

[8] Johnson G., Scholes K., Whittington R., *Exploring Corporate Strategy*, Prentice Hall, Harlow, UK, 2005.

[9] Mintzberg H., Ahlstrand B.W., Lampel J., *Strategy safari: A guided tour through the wilds of strategic management*, http://cws.cengage.co.uk/barnes/students/sample_ch/ch2.pdf (accessed 10 March 2013), 1998.

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

[11] Saaty T.L., *The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation*, McGraw-Hill International Book Co., New York, NY, 1980.

[12] Bradley S.P., Nolan R.L., *Sense & respond: capturing value in the network era*, Boston: Harvard Business School Press, 1998.

[13] Ranta J.-M., Takala J., *A Holistic Method for Finding Out Critical Features of Industry Maintenance Services*, International Journal of Services and Standards, 3, 3, 312–325, 2007.

[14] Morone J., *Strategic Use of Technology*, California Management Review, 31, 4, 91–110, 1989.