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Evaluation of Operative Sustainable Competitive Advantage of Small and Medium Sized Pharmaceutical Companies in Southern Vietnam

By Sense and Respond Methodology

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SYMBOLS AND TERMS

AHP	Analytical Hierarchy Process
BCFI	Balanced Critical Factor Index
CFI	Critical Factor Index
CV	Coefficient of Variation
MAD	Maximum Deviation
MAPE	Mean Absolute Percentage Error
MSI	Manufacturing Strategy Index
NSCFI	New Scaled Critical Factor Index
RAL	Responsiveness, Agility, and Leanness.
RMSE	Root Means Squared Error
SCA	Sustainable Competitive Advantages
SCFI	Scaled Critical Factor Index
S&R	Sense and Respond
T&K	Technology and Knowledge

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ABSTRACT:

Due to the competitive nature of the dynamic and turbulent business environment, it is crucial for businesses to establish their operations strategy in order to preserve their market position and achieve sustainable competitive advantage. The goal of this research is to evaluate the sustainable competitive advantage of small and medium-sized pharmaceutical enterprises in Southern Vietnam in terms of their current orientation, the direction of development, and sustainability. The research is based on an interview-based investigation of six case companies. The core method used in this research is Sense and Respond, which is implemented in practice with the combination of different tools and methods. The data is collected using two different sets of questionnaires: one for the Manufacturing Strategy Index (MSI) and the other for the Sense and Respond (S&R) method. When results are obtained, the second interview is implemented to validate how much the analyzed results fit the real situations of the case companies.

The findings of this paper show that the Sense and Respond method works quite well in evaluating the sustainable competitive advantage of small and medium-sized pharmaceutical companies in Southern Vietnam. The results indicate that all case companies act as an analyzer when implementing operations strategies. Besides, the research shows that spearhead technology brings the most uncertainty for all six companies.

Data collection was based on the answers of only two respondents from each company; therefore, it is difficult to say whether the trustworthiness of the results is good or not. Besides, the case companies wish to remain anonymous, thus, it is also hard to provide a more detailed conclusion and analysis of the results.

KEYWORDS: sustainable competitive advantage (SCA), small and medium-sized pharmaceutical company, sense and respond (S&R) method, operations strategy, Southern Vietnam

1 INTRODUCTION

This section introduces the context of the research being conducted by summarizing current knowledge and background information about the topic, indicating the objective of the study in the form of research questions, briefly defining key terms, revealing the limitations, and describing the remaining structure of the thesis.

1.1 Background of the research

Nowadays, the economy is not only increasingly characterized by intense globalization but also significantly affected by market turbulence; therefore, to position itself against the competition, a company is obligated to have a sustainable competitive advantage. More specifically, the main purpose of implementing sustainable competitive advantage is to find out how many resources are deployed and how performance objectives are set to enhance the company's strategy in the long term (Takala et al., 2013). Companies, particularly small and medium-sized enterprises, are facing more challenges than ever before, not only to enhance competition in the marketplace but also to meet the needs of a speedily changing business environment (Timilsina et al., 2016). In Vietnam, as an illustration, small and medium-sized pharmaceutical companies have been growing considerably in recent years, accompanied by a change in demand for medical supplies caused by the Covid-19 pandemic. Hence, these companies are being forced to have a clear operations strategy both to compete in the vast marketplace and to look for the right ways to fit the requirements of a rapidly shifting business environment. Although it is true, there has not been any research yet analyzing the competitive advantage of these companies on the whole to provide brief overviews of their operations strategies.

1.2 Research questions and objectives

This study aims to evaluate the sustainable competitive advantage of small and medium-sized pharmaceutical companies in Southern Vietnam regarding the current orientation, the direction of development, and sustainability. Although the research addresses pharmaceutical companies, the focus is on those retailing drugs, medical equipment, cosmetics, and hygiene products. The purpose of the study is to carry out a detailed analysis of the case companies' competitive priorities of cost, quality, delivery, and flexibility. Moreover, the division and risk level of basic, core, and spearhead technology and knowledge used is also examined. Lastly, recommendations for change and improvement for sustainable future development will be proposed. The thesis may also be beneficial to the case companies because it assists decision-makers in better understanding the business situation and reacting more appropriately and precisely in the turbulent business world.

The proposed research questions are set as:
- What are the case companies' competitive advantages, and what is their direction of development?
- How sustainable is the case companies' operations strategy?

1.3 Key definitions

As mentioned, the companies studied are from Southern Vietnam. This area is one of the three geographical regions of Vietnam and is considered the most dynamic market and also the largest drug consumer in the country. Besides, these are small and medium-sized pharmaceutical companies, that is, companies that manufacture and trade drugs, medical equipment, cosmetics, and hygiene products, with a scale of 50 to 100 employees. The operations strategy mentioned in this study means, as Slack & Lewis (2017) states, the strategy that refers to a set of operational decisions that a firm makes to achieve a long-term competitive advantage. About sustainable competitive advantage

(SCA), Barney (2001) suggests that SCA is a resource-based strategy, which is a very powerful business strategy today. The sense and respond method used in this thesis is created by Haeckel (1992), which suggests that the decision-makers should "sense earlier and respond effectively to what is actually happening, rather than what was predicted to happen".

1.4 Limitations

There are currently up to nearly 300 small and medium-sized pharmaceutical companies in Southern Vietnam, but this case study targets the population of only six companies. That is because the thesis is done in parallel with the main work of the author, plus certain difficulties caused by geographical distance, all causing limitations in time and resources. Besides, approximately 20-100 employees are working for the case companies; however, the data collection is based on the answers of only two respondents from each company, which somewhat affect the degree of reliability. Furthermore, the case companies wish to remain anonymous, making it difficult to provide a more detailed conclusion and analysis of the results.

1.5 Structure of the thesis

The thesis begins with the introduction of the research background and objectives. Next, an overview of the theoretical frameworks, methods, and tools relating to the studied topic is presented, while the applied research methodology in this study is discussed in the following part. The next section is the analysis of the gathered primary data. And finally, a discussion of the results, limitations, and conclusions are presented.

2 LITERATURE REVIEW

This chapter is established to, as Wallace & Wray (2016) states, make the connections between the research objectives and the published literature to assess what findings or theories have particular significance for the research. Accordingly, this chapter explains the theories relating to operations strategy and offers some insight into the subject matter of the study.

2.1 Sense and Respond (S&R)

Nowadays, businesses are struggling with the issues caused by rapid and unpredictable economic change. For example, Haeckel (1992) emphasizes that businesses are obligated to think about how to shift the focus from products to processes and competencies; how to empower people close to the firing line; and how to draw attention to customers' needs. Handling these issues requires managers to produce fundamental changes, especially in operations strategy. By extension, to deal with the adaptive challenge, a leader needs to sense opportunities and threats earlier and respond adequately to what is truly happening, not what was anticipated. As a result, in the industrial operations strategy, a more adaptive "sense and respond" strategy is developed to replace the less competitive "make and sell" strategy (Haeckel, 1992).

The sense and respond method was originally established by Haeckel (1992) and later advanced by Bradley and Nolan (1998), and shortly thereafter Markides (2000) used it as the main research method for analyzing dynamic business strategies. The S&R method aims at offering a means to meet the challenges caused by a break or change in a continuous process (Haeckel, 1998).

For this purpose, following the principle of the S&R method, Takala and Ranta (2007) created an operational management system called the Critical Factor Index (CFI). According to Takala and Ranta (2007), the CFI is a tool for interpreting and evaluating the essential attributes of strategic adjustment to determine which processes are indispensable and which are not to support managers in making the right strategic decisions in a constantly changing market. Based on the CFI model, Nadler, D. & Takala, J. (2010) then established the Balanced Critical Factor Index (BCFI) model which figures out the standard deviation of the critical factors that affect the processes of an organization. To overcome the shortcomings of CFI and BCFI models, Liu & Takala (2012) developed Scaled Critical Factor Index (SCFI) model which produces more reliable results even when the respondent sample is too small and restricted. Shortly afterward, based on feedback obtained from the case studies where SCFI was used, (Takala et al., 2013) introduced the New Scaled Critical Factor Index (NSCFI) model that outperforms the SCFI model in terms of accuracy and stability. In short, the fundamental purpose of these methods (CFI, BCFI, SCFI, and NSCFI) is to quantify the level of resource allocation according to predefined attributes.

In the research on operations strategy, the S&R method is typically used to collect data from employees regarding their experiences, expectations, and comparisons of a company to its competitors. This is done using a questionnaire that Ranta & Takala (2007) introduced in their article about the evaluation of operations strategy. The questionnaire consists of four critical sections: Processes and Workflows, Knowledge and Technology Management, Information Systems, and Organizational Systems. To analyze these four main factors, a list of 21 critical attributes is included and each of which connects to the attributes of Quality, Cost, Flexibility, and Time (see Table 1). On a scale from 1 to 10 (low to high), each attribute is rated based on the respondent's expectations and experiences, the degree of development (past and future), and the comparison to competitors (worse, same, or better). Ranta & Takala (2007) emphasizes that the questionnaire data are then examined and calculated using the AHP method.

The models are specifically listed as the following equations. In which, equations (1) - (8) are utilized to analyze the raw data collected from the questionnaire, and equations (9) – (12) are used to further analyze the data by using the BCFI, SCFI, and NSCFI methods (Ranta & Takala, 2007).

Important Index: is based on the relative relevance of the criterion to others and reflects the company's actual expectations

$$\text{Importance Index} = \text{Avg}\{\text{expectation}\}: 10 \quad (1)$$

Gap Index: presents the discrepancies between experiences and expectations for each criterion.

$$\text{Gap Index} = |\ \text{Avg}\{\text{experience}\} - \text{Avg}\{\text{expectation}\}: 10 - 1| \quad (2)$$

Performance Index: is based on the real experiences of the informant and proves the value of the criterion.

$$\text{Performance Index} = \text{Avg}\{\text{experience}\}: 10 \quad (3)$$

Development Index: indicates the true direction in which the company is moving depending on the positive or negative change in the criterion's performance.

$$\text{Development Index} = |\ (\text{better\%} - \text{worse\%}) * 0.9 - 1| \quad (4)$$

Standard Deviation of Experience: represents whether the informants' responses were similar or contradictory based on their experiences with the criterion's attributes.

$$\text{SD Experience Index} = \text{Std}\{\text{experience}\}: 10 + 1 \quad (5)$$

Standard Deviation of Expectation: represents whether the informants' responses were similar or contradictory based on their expectations with the criterion's attributes.

$$\text{SD Expectation Index} = \text{Std\{expectation\}}: 10 + 1 \tag{6}$$

Gap Index': is a developed Gap Index used with NSCFI.

$$G\text{ap Index}\ ' = 2\ \text{Avg\{expectation\}-Avg\{experience\}}: 10 \tag{7}$$

Development Index': is based on the development index for the NSCFI.

$$\text{Development Index}\ ' = 2\ (\text{worse\%-better\%}) \tag{8}$$

Critical Factor Index: is a tool that identifies the critical and non-critical characteristics of an organization's processes based on the experiences and expectations of informants.

$$\text{CFI} = \text{Std\{experience\}} * \text{Std\{expectation\}}: \text{Importance Index} * \text{Gap Index} * \text{Development Index} \tag{9}$$

Balanced Critical Factor Index (BCFI): reflects critical characteristics in the same way that CFI does, but the performance index is added to the indicator's weight.

$$\text{BCFI} = \text{SD Expectation Index} * \text{SD Experience Index} * \text{Performance Index}: \text{Importance Index} * \text{Gap Index} * \text{Development Index} \tag{10}$$

Scaled Critical Factor Index (SCFI): is used to determine which responses are the most important. This is necessary when the property's standard deviation has reached zero or is extremely near to zero. The NCFI index is used to assign a number used to calculate the SCFI to a property.

SCFI = √ 1 n ∗∑n [experience(i) -1]^2i= 1 ∗ √ 1n ∗∑n [expectation(i)-10]^2 i=1 ∗ Performance index: Gap index ∗ Development index ∗ Importance index (11)

New Scaled Critical Factor Index (NSCFI): is a developed version of the SCFI model.

NSCFI = √1 n ∗∑n [experience(i)]^2i= 1∗ √ 1n ∗∑n [expectation(i)-11]^2 i=1 ∗ Performance index: Gap index'∗ Development index' ∗ Importance index (12)

Table 1. List of 21 attributes used in the S&R questionnaire (Takala et al., 2013)

	ATTRIBUTES	
	Knowledge and 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
	PROCESS AND 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 (projects, teams, processes...)	← 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

2.2 Analytic Hierarchy Process (AHP)

Analytical Hierarchy Process (AHP) is a mathematical method created by Saaty (1980) and, since then, has been widely used by organizations for analyzing strategic issues in businesses and for dealing with multi-attribute decisions. To put it bluntly, AHP is a decision-making tool to assist decision-makers in setting priorities and selecting the optimal choice among quantitative and qualitative measures. In other words, it is a thorough, logical, and structural framework that breaks down the issues into a hierarchy to make it easier for decision-makers to understand complex issues (Takala et al., 2007). By including all relevant decision criteria and comparing them to each other, decision-makers can figure out the trade-offs between different goals.

The AHP method requires the data and formula to determine the outcome. For instance, the formula may be the following matrix (see Figure 1). The AHP begins with the establishment of evaluation criteria and sub-criteria that have a substantial impact on the decision-making process. Then, the decision maker conducts a pairwise comparison of different criteria and sub-criteria on a scale ranging from 1 to 9 to set priorities and choose the optimal alternative. Saaty, R. W. (1980) claims in his research about the AHP method that “pairwise comparisons are fundamental in the use of the AHP”.

To validate the reliability of AHP, it is crucial to determine the consistency ratio (CR) because, as Saaty, R. W. (1980) points out, the factors may be engaged in several comparisons and there is no standard scale, thus, inconsistencies may happen. Accordingly, the optimal CR value should be less than 0.10. The CR is calculated using the following formula.

$$\mathrm{CR} = \frac{\text{Consistency index (CI)}}{\text{Random consistency index (RI)}} \tag{13}$$

Main criteria	Pairwise comparisons																Main criteria
Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Quality
Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Time/Delivery
Cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Flexibility
Quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Time/Delivery
Quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Flexibility
Time/Delivery	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Flexibility

Figure 1. An example of pair-wise comparison of competitive priorities

2.3 Manufacturing Strategy Index (MSI)

The Manufacturing Strategy Index (MSI) is a model for determining an organization's operational level of competitiveness. The MSI method calculates analytically weighted priority rankings for multiple factors, including quality (Q), cost (C), time (T), and flexibility (F). Miles and Snow (1979) created the MSI model in 1979 to assist in determining the strategy type for the organization. The MSI is a measurement tool that assesses the relationship between the company's leadership and the company's resource development. Prospector, defender, analyzer, and reactor are the various strategy topologies that Miles and Snow (1979) presented in their work.

Prospector strategy companies focus on product innovation and actively seek new product-market opportunities. They are forward-thinking and prioritize R&D, pioneering, and risk-taking. The prospector strategy is more likely to be successful in markets or industries where technology and product characteristics are constantly evolving. The prospector's strategic orientation is toward quality.

Defender strategy companies prioritize increasing the effectiveness of existing operations, goods, and services. Cost management is the primary characteristic of the

defender strategy. Where there is minimal room for innovation in a market or industry, the defender strategy is more suited. Therefore, rather than attempting to build a new market, the defender organization strives to maintain its current market share. The defender's strategic orientation is toward cost.

Analyzer strategy companies have features of both Prospector and Defender in their approach to business. They monitor the market and follow market innovations and new developments. In a static market, for instance, they pursue cost efficiency, while in a dynamic market they imitate their most successful competitors (Takala et al., 2013). They are able to adapt to a new market or industry development and maintain their position in the market or industry. The analyzer's strategic orientation is toward quality, cost, and time.

Reactor strategy companies are not aggressive in the market because they lack a clear strategy, objectives, and goals. They strive to adapt consistently to the ever-changing business environment by focusing on everything at once and shifting between a prospector and defense strategic position. In addition, they do not upgrade their operations unless the market or industry environment compels them to do so. They exhibit no strategic orientation.

MSI employs the Responsive, Agility, and Leanness (RAL) model created by Takala (2002) to determine the type of business strategy that an organization has selected. Responsive refers to the "speed by which the system satisfies unanticipated requirements", agility refers to the "speed by which the system adapts to the optimal cost structure", and leanness refers to "minimizes waste in all resources and activities" (Takala, 2002). The RAL model consists of four components: quality, cost, time, and flexibility. Figure 2 shows an example of the RAL model/MSI triangle. As illustrated in Figure 2, the prospector is positioned at the top corner of the triangle with a focus on quality, the analyzer is located at the right corner with a focus on Cost, and the defender is located at the left corner with a focus on Time (Heimonen & Takala, 2019).

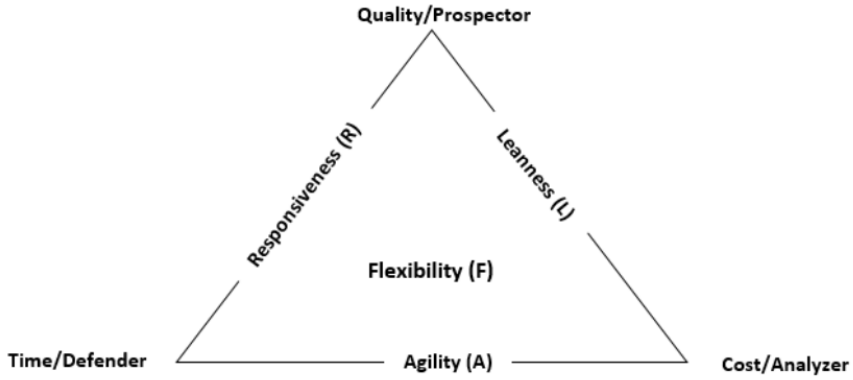


Figure 2. RAL model/MSI triangle (source: Takala, 2002 and Heimonen & Takala, 2019)

The following equations, (14) to (17), are used to calculate the percentage share (normalized value) of each component of the RAL model, namely cost, quality, and time (Takala et al., 2013).

$$\text{Cost (C\%)} = \frac{\text{C}}{\text{Q+C+T}} \tag{14}$$

$$\text{Quality (Q\%)} = \frac{\text{Q}}{\text{Q+C+T}} \tag{15}$$

$$\text{Time (T\%)} = \frac{\text{T}}{\text{Q+C+T}} \tag{16}$$

$$\text{Flexibility (F\%)} = \frac{\text{F}}{\text{Q+C+T+F}} \tag{17}$$

The next equations, (18) to (20), are used to calculate MSI values that aid in identifying the company's strategy type and level of competitiveness. Prospector prioritizes quality, defender prioritizes cost, and analyzer strikes a balance between cost, quality, and time (Takala et al., 2013).

MSI model of Prospector

$$\mathrm{MSI_P} = 1 - [(1 - (\mathrm{Q\%})_{1/3}) * (1 - 0.9 * \mathrm{T\%}) * (1 - 0.9 * \mathrm{C\%}) * (\mathrm{F\%})_{1/3}] \quad (18)$$

MSI model of Defender

$$\mathrm{MSI_D} = 1 - [(1 - (\mathrm{C\%})_{1/3}) * (1 - 0.9 * \mathrm{T\%}) * (1 - 0.9 * \mathrm{Q\%}) * (\mathrm{F\%})_{1/3}] \quad (19)$$

MSI model of Analyzer

$$\mathrm{MSI_A} = 1 - [(1 - F\%) * [ABS[(0.95 * Q\% - 0.285) * (0.95 * T\% - 0.285) * (0.95 * C\% - 0.285)]]_{1/3}] \quad (20)$$

2.4 Sustainable Competitive Advantage (SCA)

The sustainable competitive advantage (SCA) technique analyzes if the resource allocation of a business supports its operations strategy. A company can achieve a durable competitive edge over other companies if it can provide customers with value that cannot be replicated by other companies. The SCA method can provide the instruments for developing an operations strategy to deal with turbulent business conditions by merging manufacturing and technology strategies with the change management profiles of decision makers (Liu Y., 2013). By applying the MSI questionnaire and S&R analysis, the SCA can be utilized to analyze the typologies of prospector, defender, and analyzer.

SCA risk level calculated values range from 0 to 1 (Vuoti et al. 2014). SCA values near or greater than 0.97 are regarded as high, while values between 0.93 and 0.97 are regarded as medium, and values below 0.93 are regarded as low, according to the authors. Similarly, Liu & Liang (2015) propose 0.9 as a threshold value for the SCA risk level. The higher

the SCA risk level, the greater the consistency between resource allocation and operations strategy (Tilabi et al. 2019; Liu & Liang, 2015; Takala et al. 2013), implying that the operations strategy is more sustainable. As a result, it is reasonable to assert that the closer the SCA risk level approaches 0, the less consistency there is between resource allocation and operations strategy, implying that the operations strategy is on the verge of collapsing. SCA risk levels are calculated using three approaches: Mean Absolute Percentage Error (MAPE), Root Means Squared Error (RMSE) and Mean Absolute Deviation (MAD). The mathematical equations, (21) to (23), for calculating the SCA risk level are shown below (Takala et al., 2013 and Tilabi et al., 2019).

Mean Absolute Percentage Error (MAPE)

$$\mathrm{SCA} = 1 - \sum\alpha, \beta, \gamma \left|\frac{\mathrm{BS}-\mathrm{BR}}{\mathrm{BS}}\right| \tag{21}$$

Root Means Squared Error (RMSE)

$$\mathrm{SCA} = 1 - \left(\sum_{\alpha,\,\beta,\,\gamma} \left(\frac{\mathrm{BS}-\mathrm{BR}}{\mathrm{BS}}\right)^2\right)^{\frac{1}{2}} \tag{22}$$

Mean Absolute Deviation (MAD)

$$\mathrm{SCA} = 1 - \max_{\alpha,\,\beta,\,\gamma} \left|\frac{\mathrm{BS}-\mathrm{BR}}{\mathrm{BS}}\right| \tag{23}$$

2.5 Technology & Knowledge Ranking and Risk Levels (T&K)

The importance of technology and knowledge cannot be underestimated these days, as they provide a huge number of chances for business development, growth, and competitive advantage (Takala et al., 2013). In other words, Tilabi et al. (2019) points out that

technological developments will lead to new labor processes, product features, and service offerings.

Basically, technology is the specialized knowledge required to make a marketable product. The three categories of technological knowledge are descriptive, prescriptive, and tacit. Both descriptive and prescriptive knowledge are explicit knowledge. Prescriptive knowledge specifies what must be done to achieve the desired result, whereas descriptive knowledge explains things as they are in reality. Tacit knowledge is implicit in action. (Vincenti, 1993)

In fact, the design and production procedures of a technology product frequently necessitate the use of tacit knowledge, which prevents competitors from imitating the product's design and production processes (Herschbach, 1995). Hence, organizations must have good knowledge to prevent a risky operation. The best knowledge is simple to disseminate within the company but tough for rivals to duplicate. Thus, any benefit that could elevate the company's position in the market is deemed significant, such as reducing costs or inventing a solution that distinguishes it from competitors. Different sorts of technology are identified based on the stage of a technology's life cycle.

Regarding the product life cycle, companies have three levels of technology: basic, core, and spearhead. Figure 3 depicts the link between these three categories of technology and the product life cycle. Basic refers to the technology that is most essential to the operation of a business, while core gives a competitive advantage and aids in corporate expansion, and the spearhead focuses more on the future (Takala et al., 2013).

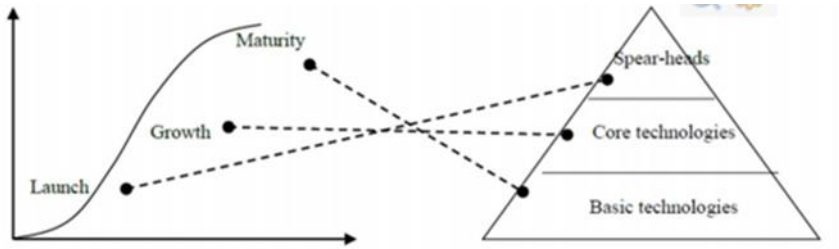


Figure 3. Different technology through product life cycle (source: Tilabi et al., 2019)

The S&R questionnaire contains a section in which the company's technology ranking is evaluated (see Table 2). Respondents must determine whether the attributes are basic, core, or spearhead technologies, and the sum of all three must equal 100 percent (Liu Y., 2012). The calculation reveals the dominant technology and the risk level (see Figure 4).

Table 2. Technology Rankings: General formulas (source: Takala et al., 2013)

	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

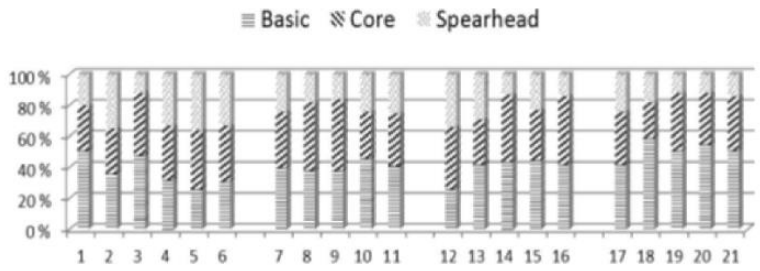


Figure 4. Knowledge and Technology Rankings (source: Takala et al., 2013)

Technology and knowledge factor boosts the company's strategy but also brings uncertainty. Therefore, implementing S&R in practice concludes with the calculation of

technology and knowledge risks (T&K$_{RISK}$). T&K$_{RISK}$ is calculated partially and totally utilizing the root mean square (RMS) method. Partial risks refer to T&K$_{RISK}$ concerning the basic, core, and spearhead separately, whereas total risks refer to the risk as a whole, taking into account the cumulative effect of the basic, core, and spearhead T&K (Tilabi et al., 2019).

The partial and total risks are calculated using the following equations, (24) to (27):

T&K$_{RISK\ BASIC}$

$$= \sqrt{(((\text{Sum of } CV^2)Q)^2 + ((\text{Sum of } CV^2)C)^2 + ((\text{Sum of } CV^2)T)^2 + ((\text{Sum of } CV^2)F)^2)} \quad (24)$$

T&K$_{RISK\ CORE}$

$$= \sqrt{(((\text{Sum of } CV^2)Q)^2 + ((\text{Sum of } CV^2)C)^2 + ((\text{Sum of } CV^2)T)^2 + ((\text{Sum of } CV^2)F)^2)} \quad (25)$$

T&K$_{RISK\ SPEARHEAD}$

$$= \sqrt{(((\text{Sum of } CV^2)Q)^2 + ((\text{Sum of } CV^2)C)^2 + ((\text{Sum of } CV^2)T)^2 + ((\text{Sum of } CV^2)F)^2)} \quad (26)$$

Where,

Q = All quality attributes

C = All cost attributes

T = All time attributes

F = All flexibility attributes

CV= Coefficient of Variance = $Standard\ deviation/Mean$

Standard deviation (σ) = $\sqrt{((\sum(X - Mean)^2)/N)}$

T&K$_{RISK\ TOTAL}$ = $\sqrt{((\text{T\&K}_{RISK\ BASIC})^2 + (\text{T\&K}_{RISK\ CORE})^2 + (\text{T\&K}_{RISK\ SPEARHEAD})^2)}$ (27)

3 RESEARCH METHODOLOGIES

This section describes the methodologies and methods utilized in this thesis and outlines a procedure that helps keep the study on track, making it more efficient, manageable, and productive.

3.1 Case study

This evaluative research is conducted based on a quantitative methodology. In order to answer the research questions, seven case studies are investigated. These are small and medium-sized pharmaceutical companies located in Southern Vietnam with a scale of 20 to 100 employees. Accordingly, two sets of questionnaires are used to obtain the data: one for the Manufacturing Strategy Index (MSI) approach and the other for the Sense and Respond (S&R) method. This research primarily employs the Sense and Respond method, which is implemented also using a variety of tools and models, including Analytic Hierarchy Process (AHP), Critical Factor Indexes (CFI), Manufacturing Strategy Index (MSI), Sustainable Competitive Advantage (SCA), and Technology & Knowledge Ranking and Risk Levels.

Video-call interviews were chosen to collect the data since most of the respondents needed a further explanation for some of the factors in the questionnaires. The respondents are top and middle managers of six companies, with the following numbers:

- Company A: two respondents
- Company B: two respondents
- Company C: two respondents
- Company D: two respondents
- Company E: two respondents
- Company F: two respondents

3.2 Research process

The first step in the data collection process was contacting the targeted small and medium-sized pharmaceutical companies via emails and phone calls, in which the concept of this case study was described briefly. As these companies were interested in learning more, the other emails detailing the case study were sent to the contact people, to which the questionnaires and instructions were attached. Because English is not used at these case companies, the translation of the questionnaires into Vietnamese is also enclosed in the emails to make it simpler for all respondents to understand the questions. After the case companies had reviewed the questionnaires and confirmed their interest, the dates for video-call interviews were set.

In the process of analysis, the data obtained from the MSI questionnaire were calculated using the AHP Priority Calculator developed by Klaus D. (2018) to determine the value of the consistency ratio. Because there were some respondents gave their answers resulting in an inconsistency ratio, data were recollected and recalculated until the desired value of consistency ratio was all reached. All data from the two questionnaires were then manually transferred to the “predefined Excel sheet for S&R method” provided by Timilsina (TUTA3080: Operations Strategy, 2020). This Excel sheet was predefined with all the necessary formulas presented in chapter 2.

After transmitting the data, results could be obtained instantly for analysis. Conclusions were then reached by carefully interpreting the results using the theoretical framework provided. Then, a second interview round was conducted to validate how closely the analyzed results correspond to the actual situations of the case companies. Moreover, the comparison was made to provide some discussion and conclusions.

4 EMPIRICAL RESEARCH

According to statistics from the Ministry of Health (2018), Vietnam's drug market has a relatively fast growth rate, averaging 17% per year in the 5-year period from 2014 to 2018. Although the industry accounts for a relatively small proportion compared to the size of the economy, with its fast growth rate and a large degree of economic integration, the pharmaceutical industry has the potential to be a dynamic economic industry and will make a very positive contribution to the overall growth of the country (Ministry of Health of Vietnam, 2018). In Vietnam, the Southern market is considered to be the largest market for drug consumption in the country. In particular, Ho Chi Minh City has a consumption volume of up to 55% of the drug products used in the country (Vietcombank Securities, 2018). For that reason, the small and medium-sized pharmaceutical companies selected as research subjects in this report are the companies whose offices or main businesses are in Ho Chi Minh City. More specifically, these case companies have been generally operating for 4-8 years, and their main businesses are retailing drugs, medical equipment, cosmetics, and hygiene products. Besides, some of the case companies provide packing services, and drug storage and testing services.

One more thing that is worth noticing is that, in Vietnam, small and medium-sized pharmaceutical companies have grown significantly in recent years, accompanied by a shift in medical supply demand caused by the Covid-19 pandemic. As a result, these companies are being required to create a clear operations strategy in order to compete in the massive marketplace and to determine the most effective ways to meet the requirements of a rapidly changing business environment.

In order not to lose their competitive advantage over the competitors, the case companies wished to remain anonymous in this research. Therefore, this report only generally describes what kind of context they are operating in, and then discusses what challenges they are facing.

4.1 Company A

This is a medium-sized company with about 60 employees and was established in 2018. Besides retailing drugs, medical equipment, cosmetics, and hygiene products in specialized stores, company A also provides pharmaceutical packaging materials to manufacturing companies.

Based on the outcomes of the MSI questionnaire, which evaluates the relative importance of cost, quality, time, and flexibility, it can be seen that quality was the most essential factor for company A in terms of experience in the past. The weight for quality is 55.7%, while the weight for time is 29.3%, making it the second most essential factor. Cost is given an average weight of 7.8%, while flexibility is given the lowest weight of 7.1%, which is considered the least important, but not very low compared to cost.

Regarding future expectations, it is obvious that quality remains the most important criterion, which increases slightly and reaches a value of 58%. In the same way, the weight of cost steps up in the future, but more significantly. With an average percentage of 15%, company A may expect to reduce costs to make it a more important factor in the future. On the other hand, time moves down to the third most important factor. This means that the order of importance for future expectations is not the same as the order for experience in the past, as shown in Table 3. However, in both cases, the consistency ratio is less than 10%, which means that the results are valid and the comparisons are correct.

Table 3. AHP results from the MSI questionnaire – Company A

	Results using average numbers				
	Quality %	Cost %	Time %	Flexibility %	CR %
Experience in the past	55.7	7.8	29.3	7.1	3.2
Future expectations	58	15.1	21.5	5.4	3.7

Figure 5 depicts the results of the CFI calculations. It can be seen that the expectations that company A set for the attributes mostly exceed the experience in the past. Specifically, the ratings of experience range from 4.5 to 8.0, while the ratings of expectations range from 7.0 to 8.5. The greatest gaps between future expectations and experience in the past can be found in attributes 3, 7, 8, and 19. The detailed names of the attributes used in this chapter are shown in Table 1 in Chapter 2. The difference has a value of 3 regarding these four attributes. The rating of attribute 16 is quite high and there are no differences between future expectations and experience in the past, which indicates that the data and information privacy policy of company A is considered to be effective. For the rest ones, the smallest gaps are in attributes 11, 14, 15, and 18. In relation to these attributes, the gap has a value of 0.5, and three of them belong to the criterion of flexibility.

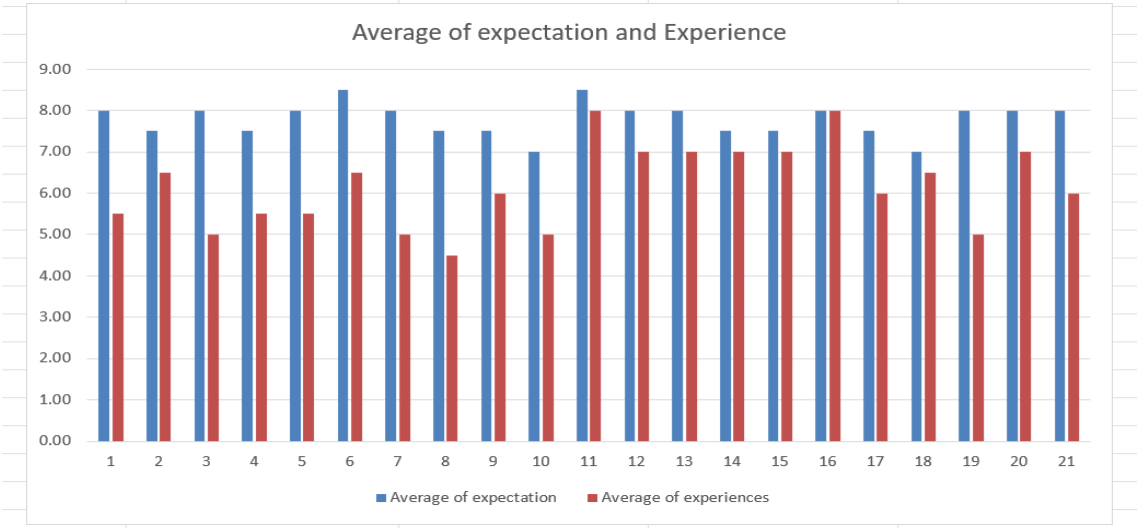


Figure 5. Average of Expectation vs Experience – Company A

Figure 6 shows the historical allocation of resources. It can be seen that the lower limit is set at 0.032, and the upper limit is set at 0.063. Attributes that fall between the upper and lower limits represent balanced resources, while those above the upper and lower

limits represent critical resources, as they are either over-resourced or under-resourced. According to the BCFI model, there are eleven under-resourced attributes, eight balanced attributes, and two over-resourced attributes. The attributes that are under-resourced are 3, 5, 6, 7, 8, 10, 11, 15, 16, 19, and 21. The attributes that are over-resourced are 1 and 2. The outcomes of the SCFI model are quite similar to those of the BCFI model. In particular, ten attributes are under-resourced; they are attributes 3, 5, 6, 7, 8, 10, 11, 16, 19, and 21, and three attributes are over-resourced; they are attributes 1, 2, and 18. The NSCFI model, however, provides more optimistic results. Specifically, there are only six attributes that are under the lower limit; they are attributes 3, 6, 7, 8, 10, 19, and 21, and three attributes that are above the upper limit; they are attributes 2, 14, and 18. Although there are differences between the outcomes of these models, they all indicate that company A has suffered from problems with knowledge and technology management, and processes and workflows the most. To improve the mentioned attributes (for instance, attributes 6, 7, and 8), company A could cut processing time by allocating more human resources. On the other hand, company A focused too much on the performance of research and development, which may be currently considered overprioritized.

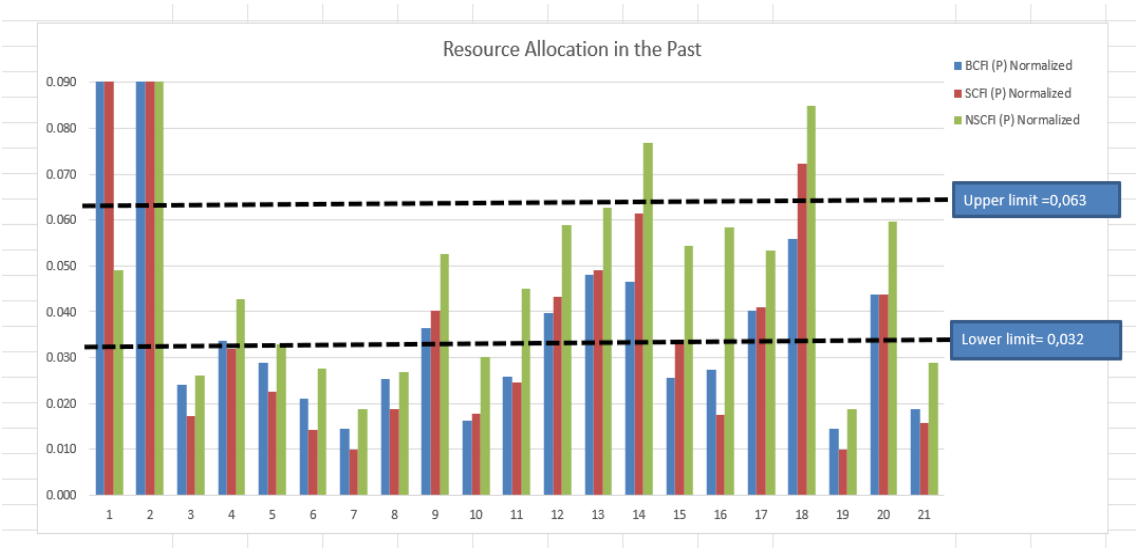


Figure 6. Resource allocation in the Past – Company A

Following that, the same attributes are compared in the future, which can be seen in Figure 7 and Table 4. According to the BCFI model, it is obvious that future resource allocations get much worse. Namely, there were eight balanced attributes in the past, but most of them turn out to be over-resourced in the future. Besides, attributes 5, 6, 8, 10, 11, 15, and 16 are still under the lower limit in the future. Along the same lines, the balanced attributes get much less in the future based on the SCFI model. As an illustration, only attributes 3, 7, 18, and 19 lies between the lower limit and the upper limit. On the contrary, the NSCFI model shows that the number of balanced attributes in the future is the same as in the past, however, the attributes themselves are not exactly the same. The upshot of all this is that the respondents of company A seem not to be very optimistic about their company's resource usage in the near future, especially, the aspects of knowledge and technology management, and the process and workflows.

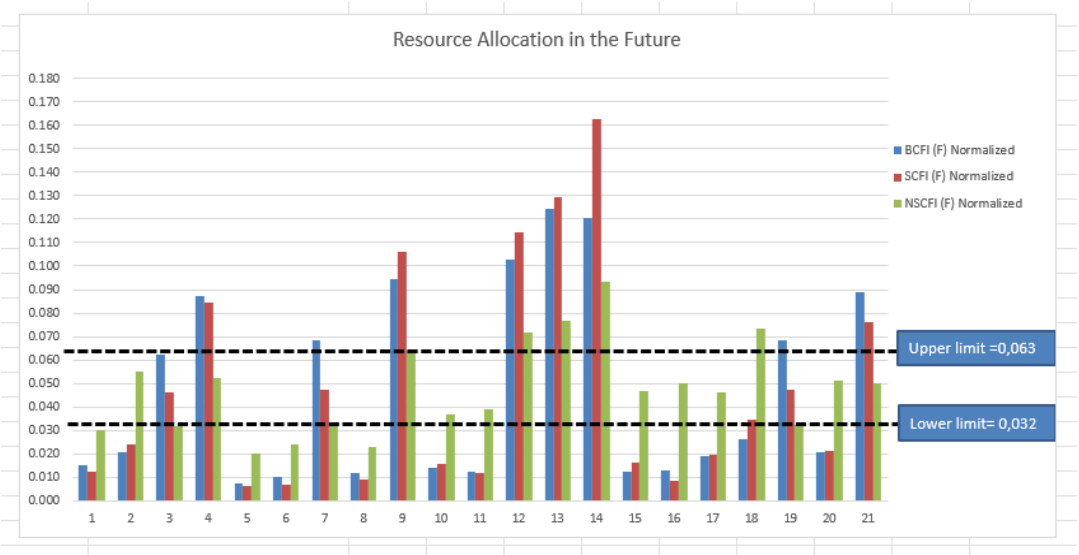


Figure 7. Resource allocation in the Future – Company A

Table 4. The number of resource allocations in the Past and in the Future – Company A

	Under	Balance	Over
P-BCFI	11	8	2
F-BCFI	12	1	8
P-SCFI	10	8	3
F-SCFI	11	4	6
P-NSCFI	7	11	3
F-NSCFI	5	11	5

For further detail, Table 5 draws a comparison of the trend of resource allocations using BCFI, SCFI, and NSCFI models. According to the BCFI model, fifteen attributes show negative development in the future, five attributes change their position in reverse, and only one attribute shows positive development. According to the SCFI model, thirteen attributes show negative development in the future, four attributes change their position in reverse, and four attributes show positive development. Likewise, according to NSCFI, ten attributes show negative development in the future, six attributes remain unchanged, and five attributes show positive development. As can be seen, the results of the BCFI model are somewhat concerning. In other words, it can be said that the situation of company A is neither good nor healthy, however, it still relies on whether or not company A's human resources are optimistic about their future. The Covid-19 pandemic has been showing that unexpected and unusual events that interrupt the continuity of operations are not "black swans" (Avishai, 2020); thus, future outcomes may vary a lot in reality. The SCFI model, however, indicates a better trend in some attributes, while the NSCFI model presents the best positive results. Specifically, based on the NSCFI model, half of the attributes follow an upward trend.

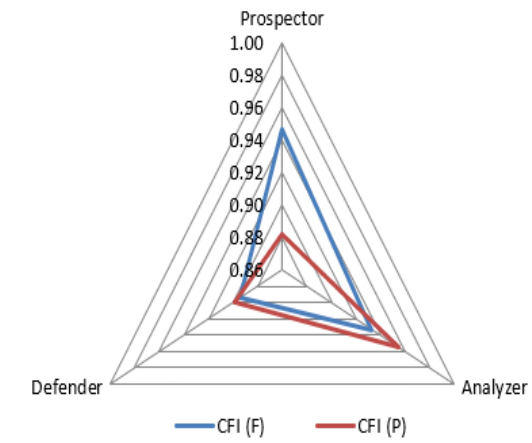
Table 5. Comparisons of Past and Future BCFI, SCFI, and NSCFI – Company A

Attribute	BCFI(P)	BCFI(F)	Trend	SCFI(P)	SCFI(F)	Trend	NSCFI (P)	NSCFI (F)	Trend
1	Over	Under	180 degree reversed	Over	Under	180 degree reversed	Balance	Under	Worse
2	Over	Under	180 degree reversed	Over	Under	180 degree reversed	Over	Balance	Better
3	Under	Balance	Better	Under	Balance	Better	Under	Under	Worse
4	Balance	Over	Worse	Under	Over	180 degree reversed	Balance	Balance	Same
5	Under	Under	Worse	Under	Under	Worse	Balance	Under	Worse
6	Under	Under	Worse	Under	Under	Worse	Under	Under	Worse
7	Under	Over	180 degree reversed	Under	Balance	Better	Under	Balance	Better
8	Under	Under	Worse	Under	Under	Worse	Under	Under	Worse
9	Balance	Over	Worse	Balance	Over	Worse	Balance	Over	Worse
19	Under	Under	Worse	Under	Under	Worse	Under	Balance	Better
11	Under	Under	Worse	Under	Under	Worse	Balance	Balance	Same
12	Balance	Over	Worse	Balance	Over	Worse	Balance	Over	Worse
13	Balance	Over	Worse	Balance	Over	Worse	Balance	Over	Worse
14	Balance	Over	Worse	Balance	Over	Worse	Over	Over	Worse
15	Under	Under	Worse	Balance	Under	Worse	Balance	Balance	Same
16	Under	Under	Worse	Under	Under	Worse	Balance	Balance	Same
17	Balance	Under	Worse	Balance	Under	Worse	Balance	Balance	Same
18	Balance	Under	Worse	Over	Balance	Better	Over	Over	Worse
19	Under	Over	180 degree reversed	Under	Balance	Better	Under	Balance	Better
20	Balance	Under	Worse	Balance	Under	Worse	Balance	Balance	Same
21	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Under	Balance	Better

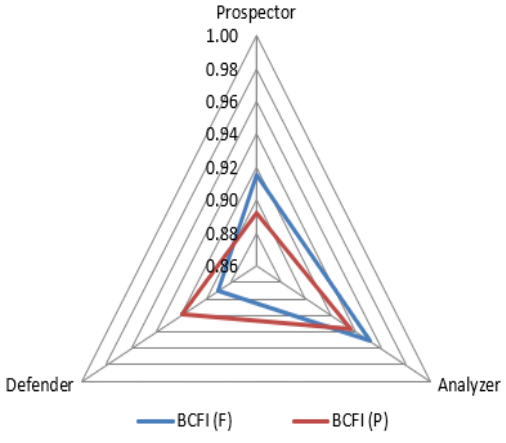
It is clear that the BCFI, SCFI, and NSCFI models each indicate distinct trends; therefore, these models should be thoroughly adopted and followed in accordance with the one that best fits the real situation of company A. Based on feedback from company A regarding the trend of resource allocations using the BCFI, SCFI, and NSCFI models, the management group believed that the NSCFI model more accurately reflects their company's actual situation, in comparison to the BCFI and SCFI models. To improve the ineffective attributes that may currently exist in company A, a strategic plan should be carefully developed, because, as Timilsina (2018) emphasizes in his research, successful strategic planning and implementation have been acknowledged as significant factors in the growth and survival of a business.

Figure 8 depicts the comparison and evolution of MSI competitiveness for the CFI, BCFI, SCFI, and NSCFI methods. According to the MSI triangle (RAL model), the red triangle reflects previous experience, and the blue triangle represents future expectations. MSI values for prospector, analyzer, and defender determine the shape of the triangles. The

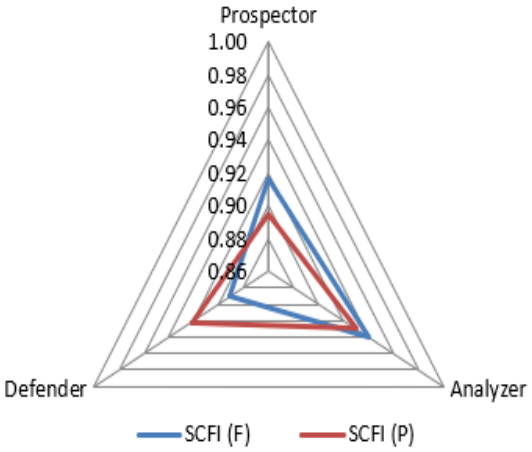
closer the MSI values are to 1, the better it defines the company's strategy type (Takala et al., 2013).



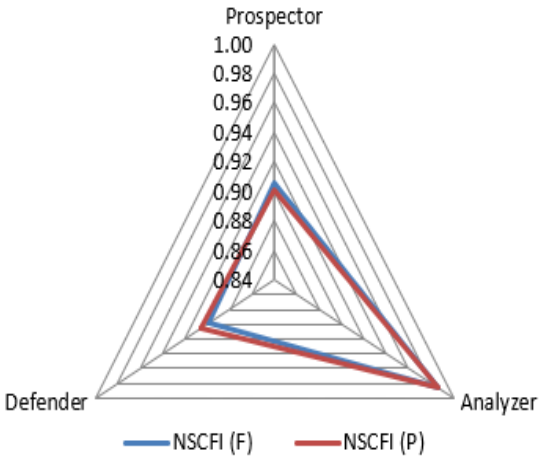
CFI	Prospector	Analyzer	Defender	Reactor
Past	0.88	0.95	0.9	0.89
Future	0.95	0.93	0.89	0.92



BCFI	Prospector	Analyzer	Defender	Reactor
Past	0.89	0.94	0.92	0.91
Future	0.92	0.95	0.89	0.90



SCFI	Prospector	Analyzer	Defender	Reactor
Past	0.90	0.93	0.92	0.91
Future	0.92	0.94	0.89	0.90



NSCFI	Prospector	Analyzer	Defender	Reactor
Past	0.90	0.99	0.91	0.90
Future	0.91	0.99	0.90	0.90

Figure 8. MSI competitiveness using CFI (top left), BCFI (top right), SCFI (bottom left) and NSCFI (bottom right) – Company A

As can be seen from Figure 8, the MSI values for analyzer are high both in the past (values ranging from 0.93 to 0.99) and in the future (values ranging from 0.94 to 0.99). This indicates that the company's business strategy in the past was analyzer and that the company's strategy in the future is also expected to be analyzer, but slightly more dominant. On the contrary, the CFI results show that prospector is the strategy of company A in the future. In the literature, it has been argued that CFI is not as advanced as other methods (BCFI, SCFI, and NSCFI); consequently, it is more plausible to follow results from other methods than CFI (Timilsina, TUTA3080: Operations Strategy, 2020). Besides, company A confirmed that analyzer best describes its operations strategy, as quality, cost and time are what company A has been continuously focusing on.

The next step is to calculate SCA risk levels in order to determine whether or not a company's resource allocation supports its operations strategy (Takala et al. 2013). It can be noticed from Table 6 that nearly all values for the RMSE and MAD methods are greater than 0.9, while most of the values for the MAPE method are under 0.9. This indicates that the operations plan of the company has been sustainable and will continue to be sustainable in the future, but not entirely because there may be a slight inconsistency between resources. However, company A said that the RMSE and MAD methods make more sense in evaluating SCA risks.

Table 6 also demonstrates that the majority of SCA values obtained using historical scenarios are greater than those calculated using future scenarios. This shows that the operations strategy received adequate support from resource allocations in the past, but will have less support in the future. Company A, however, believed that the support in the future will follow a positive direction. Therefore, it is proposed that decision-makers examine development trends more closely to identify the reasons for inadequate support for the operations strategy.

Table 6. SCA result – Company A

	Normalized criteria weight				MSI values			Measures of SCA risk level		
	Q	C	T	F	Prospector	Analyzer	Defender	MAPE	RMSE	MAD
P-CFI	0.19	0.32	0.50	0.33	0.88	0.95	0.90	0.89	0.92	0.94
F-CFI	0.64	0.06	0.31	0.17	0.95	0.93	0.89	0.89	0.93	0.95
P-BCFI	0.24	0.53	0.23	0.32	0.89	0.94	0.92	0.91	0.94	0.95
F-BCFI	0.50	0.23	0.27	0.32	0.92	0.95	0.89	0.85	0.91	0.93
P-SCFI	0.24	0.54	0.22	0.30	0.90	0.93	0.92	0.92	0.95	0.96
F-SCFI	0.52	0.24	0.23	0.33	0.92	0.94	0.89	0.86	0.92	0.93
P-NSCFI	0.33	0.38	0.30	0.29	0.90	0.99	0.91	0.87	0.92	0.93
F-NSCFI	0.39	0.31	0.29	0.29	0.91	0.99	0.90	0.80	0.88	0.91

Figure 9 illustrates company A's orientation toward the various categories of basic, core, and spearhead technology and knowledge. It can be seen that company A utilizes an average of 31.74% of basic T&K, 38.90% of core T&K, and 29.36% of spearhead T&K. Thus, it can be inferred that company A gives spearhead T&K the lowest importance while giving core T&K the highest priority. All core T&K attributes demonstrate increased competitiveness, with the exception of attributes 10, 11, and 14. The competitiveness of these attributes, therefore, should be considered to be enhanced.

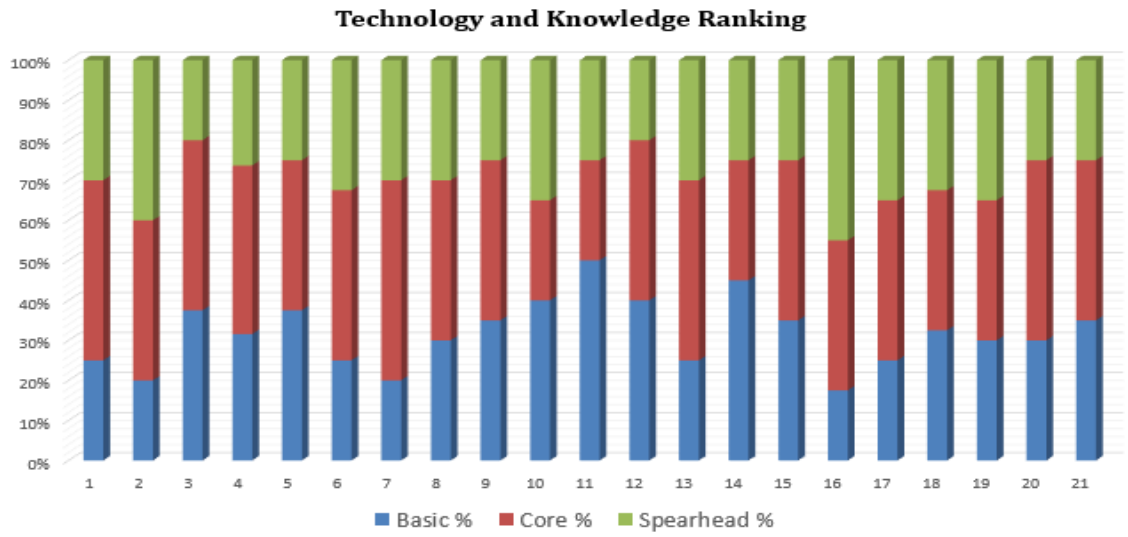


Figure 9. Ranking of Basic, Core, Spearhead Technology and Knowledge – Company A

Figure 10 represents the values of T&K's coefficient of variance. As mentioned in Chapter 2, the bigger the coefficient of variance, the greater the variation among respondents' responses. Accordingly, the closer the opinions of respondents are, the smaller the coefficient of variation. It is shown clearly in Figure 10 that the coefficients of variation for basic, core, and spearhead T&K are discovered to be 0.33, 0.42, and 0.76, respectively. This means that in the case of spearhead T&K, respondents' opinions vary greatly, resulting in the major source of uncertainty in instituting T&K in the company.

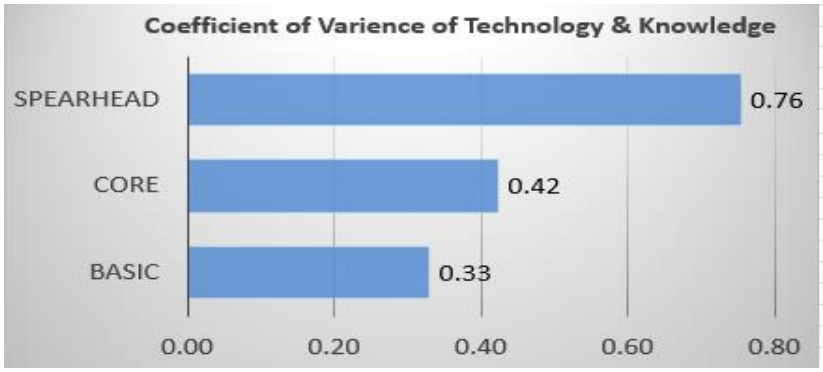


Figure 10. Coefficient of variance of T&K – Company A

Figure 11 depicts the total and individual T&K risk levels for basic, core, and spearhead T&K. These risk levels are calculated by taking the coefficient of variation of 21 attributes into account. The level of T&K risks reflects the respondent's uncertainty about the company's share of basic, core, and spearhead T&K. T&K risks are calculated to be 1.743, 2.43, and 6.83 for basic, core, and spearhead, respectively. This indicates that the higher risks of T&K correspond to spearhead T&K, whereas basic T&K carries the lowest risks. These findings are consistent with the findings shown in MSI triangles (see Figure 8), namely that company A's operations strategy in the past was analyzer and that the strategy is expected to be the same in the future. Actually, it is appropriate for an analyzer to have a larger risk in spearhead T&K, given that an analyzer studies the market and follow innovations and new developments, but does not take the risk of being innovative. In a

static market, for example, they seek cost efficiency, whereas in a dynamic market they mimic their most successful competitors (Takala et al., 2013). As a result, it stands to reason that company A's main risk is the spearhead T&K. Company A also mentioned that these results about T&K risks highly make sense of its situation.

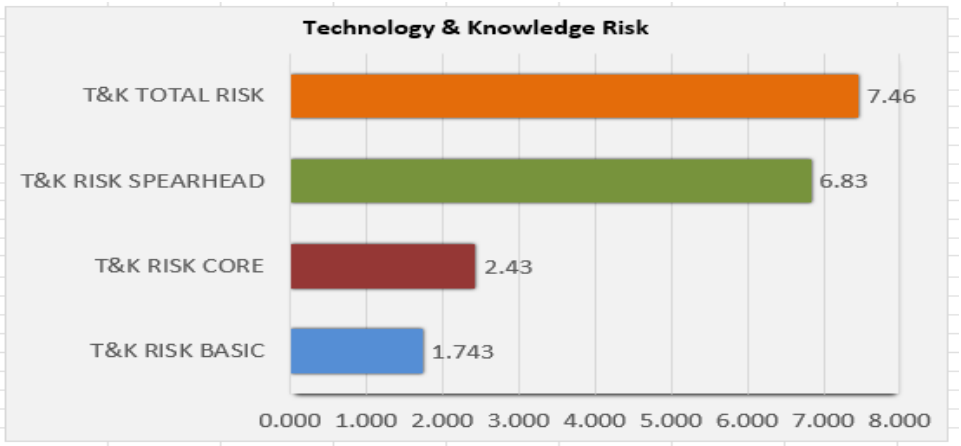


Figure 11. Technology & Knowledge risk – Company A

4.2 Company B

This is a small-sized company with around 30 employees that was founded in 2018 as company A. Company B's main line of business is cosmetics and hygiene products, as well as wholesale distribution of other household goods.

The results of the MSI questionnaire make it very evident that quality was the single most significant factor of company B's previous experiences. When compared to the weight that is assigned to time, which is only 20.7% of the total, the weight that is assigned to quality is 56.6%, making it the most essential factor. Cost is given an average weight of 16.8%, while flexibility is given a weight of 5.9% and is ranked as the criterion with the lowest importance.

In terms of expectations for the future, it is clear that quality remains the most essential criterion, but gets an average value of 59.1%. This is completely consistent with the pharmaceutical industry, where quality is always a top priority for the health of consumers. In the same way, there is a slight increase in cost in the future, pushing it to the second position with a value of 19.4%. This means that company B may anticipate reducing costs in the future to make a more significant impact. Time, on the other hand, falls to the third most major element in the upcoming years with an average weight of 16%. As demonstrated in Table 7, the order of importance for future expectations differs from the order of importance for previous experience. However, according to the theoretical frame in Chapter 2, the acquired results are reliable and the comparisons are accurate because the consistency ratio is less than 10% in both calculations.

Table 7. AHP results from the MSI questionnaire – Company B

	Results using average numbers				
	Quality %	Cost %	Time %	Flexibility %	CR %
Experience in the past	56.6	16.8	20.7	5.9	3.1
Future expectations	59.1	19.4	16	5.4	3.6

The CFI calculations for company B are depicted in Figure 12. It is obvious that the expectations set by company B for all 21 attributes primarily exceed previous experience. Specifically, experience ratings range from 5.5 to 8.0, while expectations ratings range from 7.5 to 9.5. Attribute 17 has the largest gap between future expectations and past experience, and the difference has a value of 2.5. Besides, the smallest gaps are found in attributes 10 and 14, and the difference has a value of 0.5. These results indicate that the differences that exist between future expectations and past experiences of the assigned attributes are not very significant, in other words, company B may think that these attributes are currently effective to some extent; therefore, a slight increase in the future may sufficient enough for its operations.

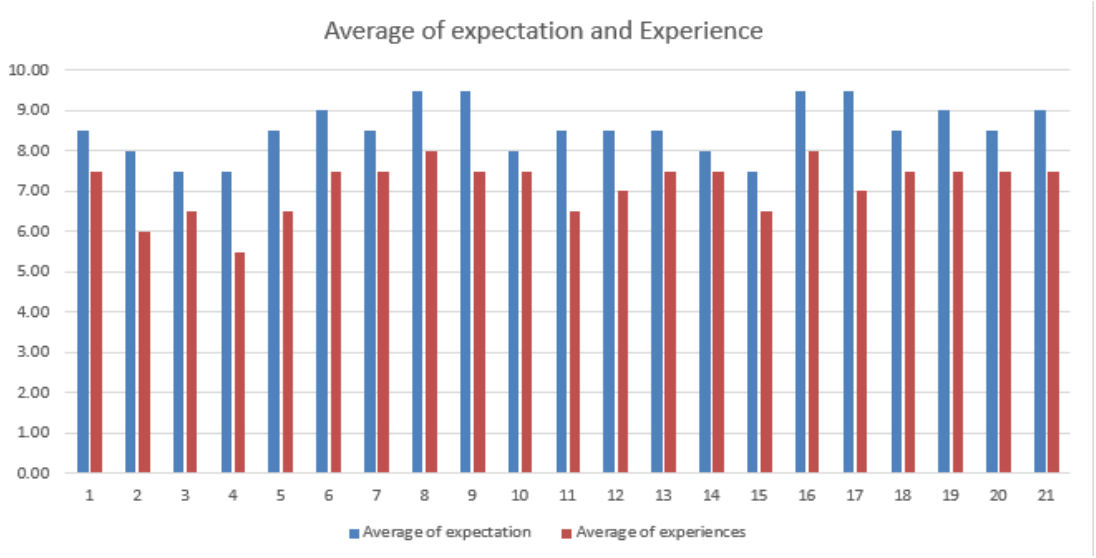


Figure 12. Average of Expectation vs Experience – Company B

To determine the effectiveness of resources more precisely, resource allocations in the past and in the future need to be evaluated. Figure 13 illustrates the historical allocation of resources. Based on the BCFI model, there are fifteen under-resourced attributes, three balanced attributes, and three over-resourced attributes. The under-resourced attributes are 1, 2, 3, 4, 5, 8, 9, 10, 11, 16, 17, 18, 19, 20, and 21. The over-resourced attributes are 6, 12, and 13. The results of the SCFI model show a similar pattern to those of the BCFI model, but the SCFI gives more balanced values. Namely, attributes 4 and 10 achieve balance in the SCFI, while the rest of the under-resourced and over-resourced attributes are the same as those of the BCFI model. The NSCFI model, on the other hand, produces more optimistic results. There are only five attributes that are below the lower limit, six attributes that are above the upper limit, and up to ten attributes that are considered to be in balance. Although the outcomes of these models differ slightly from one another, they all indicate that company B may have the most problems with its information systems, which cause inefficiencies in resources. To improve the inefficiencies, company B could, for example, make the information more available for use to facilitate its business processes. Company B, however, much focused on the quality control of products, processes, and operations, which is currently considered overprioritized.

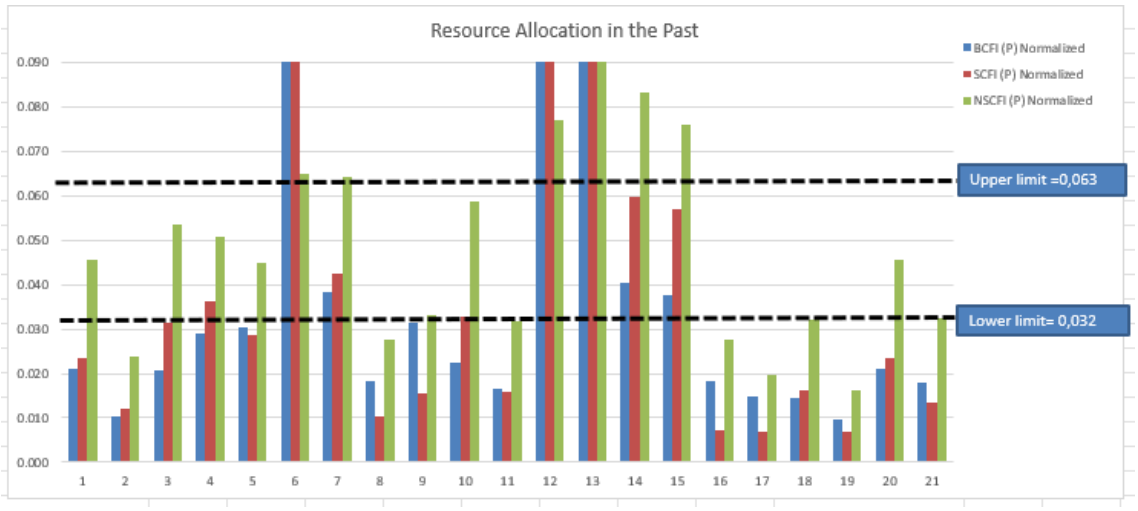


Figure 13. Resource allocation in the Past – Company B

The same attributes are then compared in the future, as shown in Figure 14 and Table 8. The BCFI model clearly shows that future resource allocations will be slightly better. In particular, there were three balanced attributes in the past, but the balanced attributes will reach the number of six in the future. However, some of the attributes that used to be in balance in the past will turn out to be under-resourced in the future; they are attributes 14 and 15. According to the SCFI model, it is obvious that there are no differences between the number of balanced attributes in the past and in the future, however, the attributes themselves differ from each other totally. Namely, the balanced attributes in the past are 4, 7, 10, 14, and 15, but in the future, the balanced attributes are 5, 6, 11, 19, and 21. Besides, there are fewer under-resourced and more over-resourced attributes compared to the number in the past. The NSCFI model, on the other hand, shows that the number of balanced attributes increase significantly in the future. It indicates that respondents from company B may appear to be quite optimistic about their company's resource utilization in the upcoming years, particularly in terms of knowledge and technology management, as well as information systems.

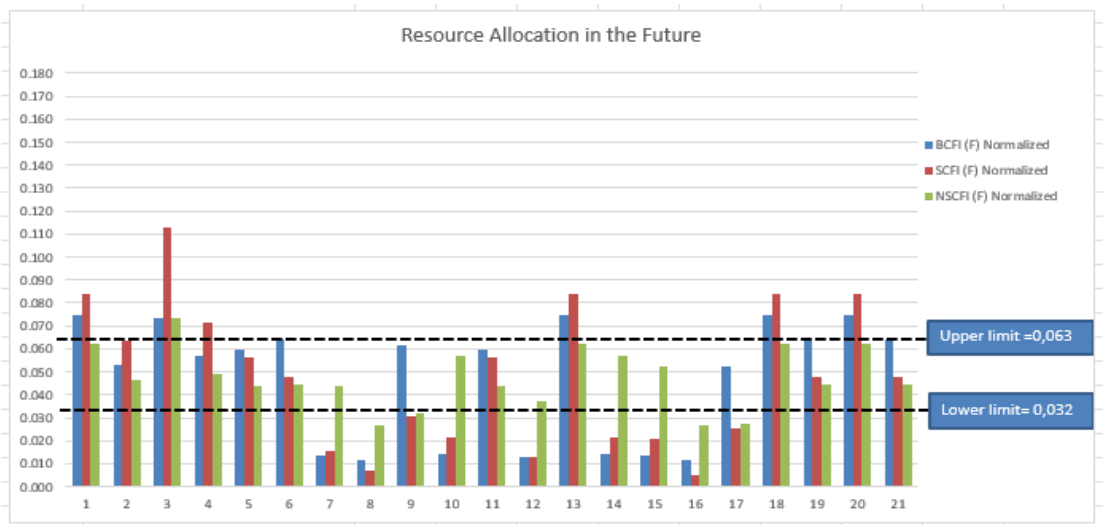


Figure 14. Resource allocation in the Future – Company B

Table 8. The number of resource allocations in the Past and in the Future – Company B

	Under	Balance	Over
P-BCFI	15	3	3
F-BCFI	7	6	8
P-SCFI	13	5	3
F-SCFI	9	5	7
P-NSCFI	5	10	6
F-NSCFI	3	17	1

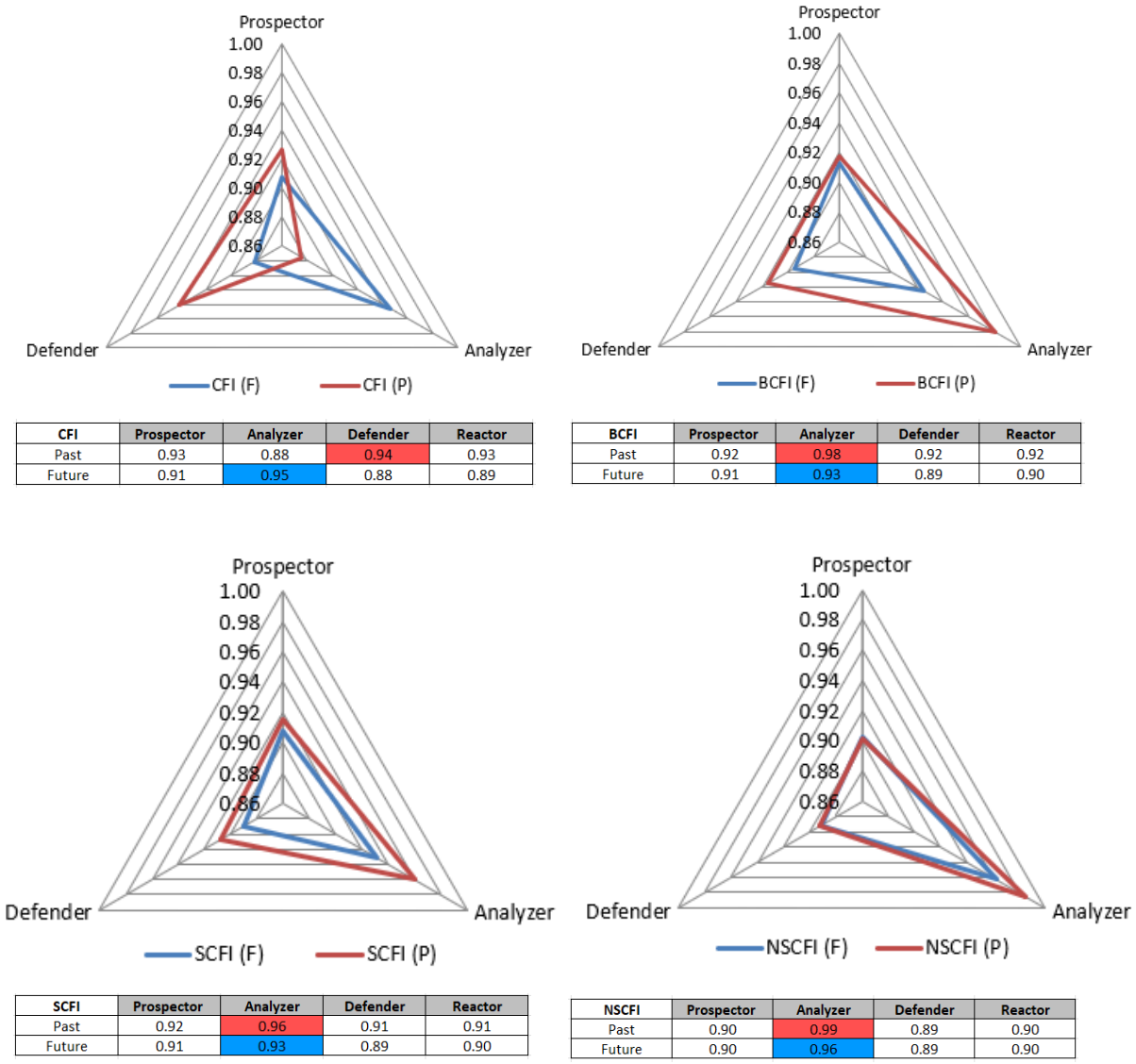
Table 9 compares the trends in resource allocations using the BCFI, SCFI, and NSCFI models. In accordance with the BCFI model, eight attributes will experience negative development in the future, seven attributes will experience reverse development, and six attributes will experience positive development. Based on the SCFI model, ten attributes will have negative future development, six attributes will have reverse development, and five attributes will have positive future development. Nevertheless, the NSCFI model predicts that only four attributes will change negatively in the future, eight attributes will remain unchanged, and nine attributes will change positively. The upshot of all this is that the BCFI model gives the most negative results, indicating that company B is not

in a good situation. Although it is true, the real situation much depends on the optimism of the respondents about their company's future. The SCFI model, on the other hand, shows a better trend in some attributes, whereas the NSCFI model shows the best positive results.

Table 9. Comparisons of Past and Future BCFI, SCFI, and NSCFI – Company B

Attribute	BCFI(P)	BCFI(F)	Trend	SCFI(P)	SCFI(F)	Trend	NSCFI (P)	NSCFI (F)	Trend
1	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Balance	Same
2	Under	Balance	Better	Under	Over	180 degree reversed	Under	Balance	Better
3	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Over	Worse
4	Under	Balance	Better	Balance	Over	Worse	Balance	Balance	Same
5	Under	Balance	Better	Under	Balance	Better	Balance	Balance	Same
6	Over	Over	Worse	Over	Balance	Better	Over	Balance	Better
7	Balance	Under	Worse	Balance	Under	Worse	Over	Balance	Better
8	Under	Under	Worse	Under	Under	Worse	Under	Under	Worse
9	Under	Balance	Better	Under	Under	Worse	Balance	Balance	Same
19	Under	Under	Worse	Balance	Under	Worse	Balance	Balance	Same
11	Under	Balance	Better	Under	Balance	Better	Under	Balance	Better
12	Over	Under	180 degree reversed	Over	Under	180 degree reversed	Over	Balance	Better
13	Over	Over	Worse	Over	Over	Worse	Over	Balance	Better
14	Balance	Under	Worse	Balance	Under	Worse	Over	Balance	Better
15	Balance	Under	Worse	Balance	Under	Worse	Over	Balance	Better
16	Under	Under	Worse	Under	Under	Worse	Under	Under	Worse
17	Under	Balance	Better	Under	Under	Worse	Under	Under	Worse
18	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Balance	Same
19	Under	Over	180 degree reversed	Under	Balance	Better	Under	Balance	Better
20	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Balance	Same
21	Under	Over	180 degree reversed	Under	Balance	Better	Balance	Balance	Same

Clearly, the BCFI, SCFI, and NSCFI models reflect diverse trends. Nevertheless, based on feedback from company B regarding the trend of resource allocations using the BCFI, SCFI, and NSCFI models, the respondents believed that the NSCFI model reflects their actual situation more precisely than the BCFI and SCFI models. To put it another way, company B may believe that their resource allocations are sufficient now and will remain the same or even better situation in the future. In spite of that, company B should carefully develop a strategic plan to improve any ineffective attributes that may currently exist, based on the answers given by its management group.



CFI	Prospector	Analyzer	Defender	Reactor
Past	0.93	0.88	0.94	0.93
Future	0.91	0.95	0.88	0.89

BCFI	Prospector	Analyzer	Defender	Reactor
Past	0.92	0.98	0.92	0.92
Future	0.91	0.93	0.89	0.90

SCFI	Prospector	Analyzer	Defender	Reactor
Past	0.92	0.96	0.91	0.91
Future	0.91	0.93	0.89	0.90

NSCFI	Prospector	Analyzer	Defender	Reactor
Past	0.90	0.99	0.89	0.90
Future	0.90	0.96	0.89	0.90

Figure 15. MSI competitiveness using CFI (top left), BCFI (top right), SCFI (bottom left) and NSCFI (bottom right) – Company B

Figure 15 illustrates the MSI competitiveness using the CFI, BCFI, SCFI, and NSCFI models. According to the BCFI, SCFI, and NSCFI methods, MSI values for the analyzer are high in both the past (values ranging from 0.96 to 0.99) and in the future (values ranging from 0.93 to 0.96). This indicates that the company's business strategy in the past was analyzer and that the company's future strategy is also anticipated to be analyzer, but with a slight decrease. In contrast, the CFI results represent that the company's business

strategy in the past was defender. When asked about these results, the respondents emphasized that the CFI model does not reflect accurately the operations strategy of company B. As they said, a pharmaceutical company often prioritizes quality over other criteria, while the defender's strategic orientation is toward cost. They then confirm that analyzer best reflects their current operations strategy. Furthermore, it has been argued in the literature that CFI is not as advanced as other methods (BCFI, SCFI, and NSCFI). Consequently, it is more reasonable to follow results from other models than the CFI.

The following step is to determine whether or not company B's resource allocations support its operations strategy by calculating SCA risk levels. Table 10 clearly shows that almost all of the values for the RMSE and MAD methods are higher than 0.9, whereas the majority of the values for MAPE methods are lower than 0.9. This appears to indicate that company B's operations strategy has been and will continue to be sustainable, but not completely since there may be a small but noticeable lack of consistency between resources. However, company B claimed that the RMSE and MAD methods are more appropriate for determining SCA risks and those results also match company B's situation.

In addition, Table 10 represents that the SCA values in the future between the models are not in the same direction of development. However, the gaps between the SCA values in the past and in the future are not significant. This demonstrates that resource allocations provided adequate support for the operations strategy in the past, and may provide such support in the future. On the other hand, it is also suggested that decision-makers evaluate development trends in great depth in order to determine the causes of insufficient support for the operations strategy.

Table 10. SCA result – Company B

	Normalized criteria weight				MSI values			Measures of SCA risk level		
	Q	C	T	F	Prospector	Analyzer	Defender	MAPE	RMSE	MAD
P-CFI	0.36	0.59	0.05	0.18	0.93	0.88	0.94	0.96	0.97	0.98
F-CFI	0.45	0.20	0.34	0.35	0.91	0.95	0.88	0.83	0.89	0.92
P-BCFI	0.37	0.34	0.29	0.18	0.92	0.98	0.92	0.83	0.90	0.92
F-BCFI	0.38	0.19	0.43	0.23	0.91	0.93	0.89	0.86	0.92	0.93
P-SCFI	0.42	0.33	0.25	0.23	0.92	0.96	0.91	0.85	0.91	0.93
F-SCFI	0.37	0.20	0.44	0.27	0.91	0.93	0.89	0.85	0.91	0.93
P-NSCFI	0.40	0.31	0.29	0.35	0.90	0.99	0.89	0.81	0.88	0.91
F-NSCFI	0.37	0.26	0.36	0.31	0.90	0.96	0.89	0.81	0.88	0.91

Figure 16 depicts the orientation of company B toward the different categories of basic, core, and spearhead technology and knowledge. It can be noticed that company B uses an average of 49.52% basic T&K, 29.05% core T&K, and 21.43% spearhead T&K. The results demonstrate that company B gives basic T&K the highest importance and spearhead T&K the lowest rate. However, the basic T&K applied to attributes 12, 13, 14, 15, and 16 seem to lack competitiveness as they represent only a small proportion of T&K categories. Naturally, basic technological upgrading may enhance competitiveness of these attributes to some extent.

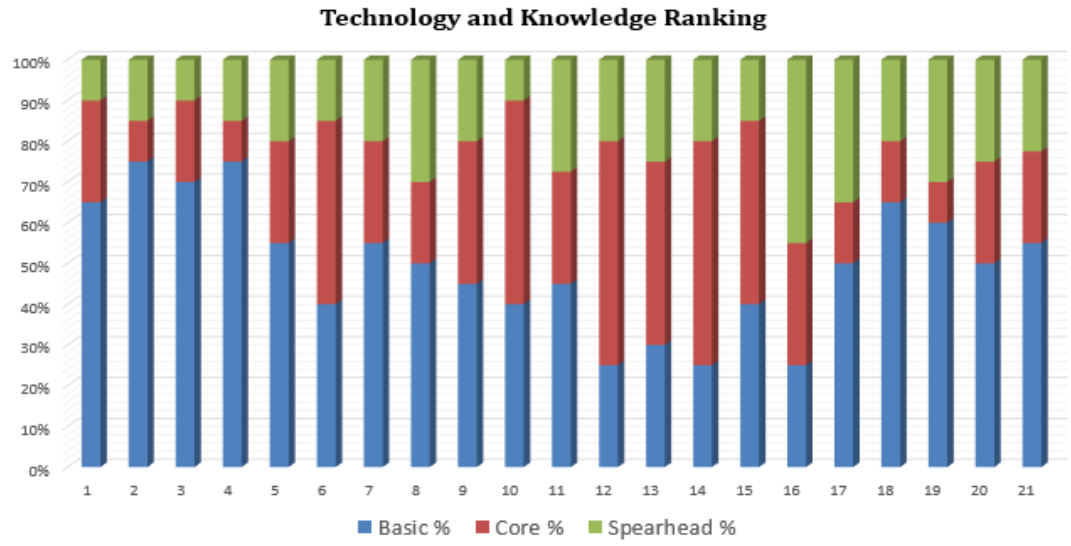


Figure 16. Ranking of Basic, Core, Spearhead Technology and Knowledge – Company B

Figure 17 then illustrates the variance coefficient values for T&K. As mentioned in the theoretical framework, the answers from the respondents vary more when the coefficient of variation is high; contrarily, the lower the coefficient of variation is, the more similar the opinions of the respondents are. The coefficients of variation for basic, core, and spearhead T&K in company B are determined to be 0.1, 0.19, and 0.3 respectively, as shown in Figure 17. This indicates that in the situation of spearhead T&K, respondents' opinions are distinctively different, resulting in the greatest source of uncertainty in implementing T&K within the company.

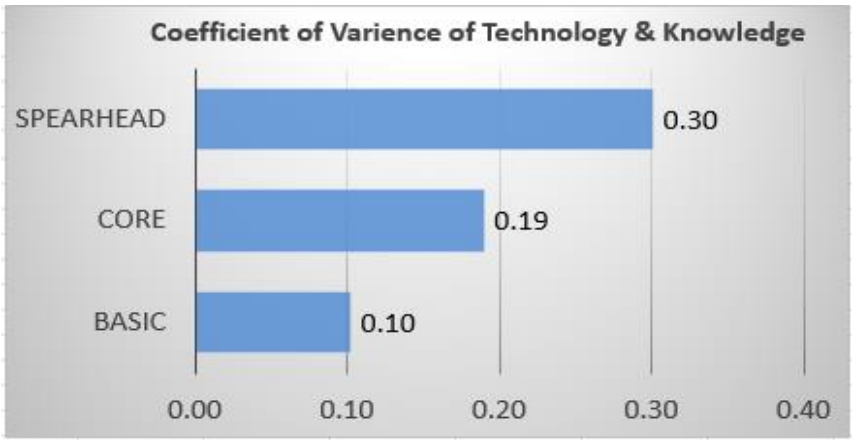


Figure 17. Coefficient of variance of T&K – Company B

Next, the total and individual T&K risk levels for basic, core, and spearhead T&K are displayed in Figure 18. The respondents' level of T&K risks reflects their uncertainty about the company's share of basic, core, and spearhead T&K. As can be seen from Figure 18, T&K risks for basic, core, and spearhead are calculated to be 0.243, 1.01, 1.52, respectively. This means that the highest risks of T&K correspond to spearhead T&K, while basic T&K has the lowest risks. These findings are similar to the results shown in MSI triangles (see Figure 15), which state that company A's operations strategy in the past was analyzer and that the strategy is expected to remain the same in the future. Given that an

analyzer researches the market and follows innovations and new developments, but does not take the risk of being original, it is reasonable for an analyzer to have a bigger risk in spearhead T&K. As mentioned before, in a market that is not dynamic, the analyzer will look for ways to reduce costs, whereas, in a market that is dynamic, they will try to imitate their most successful competitors (Takala et al., 2013). As a direct consequence of this, it is reasonable that the spearhead T&K presents the primary risk for company B. When asked about these results, company B said that the results seem to fit what the company has been experiencing so far.

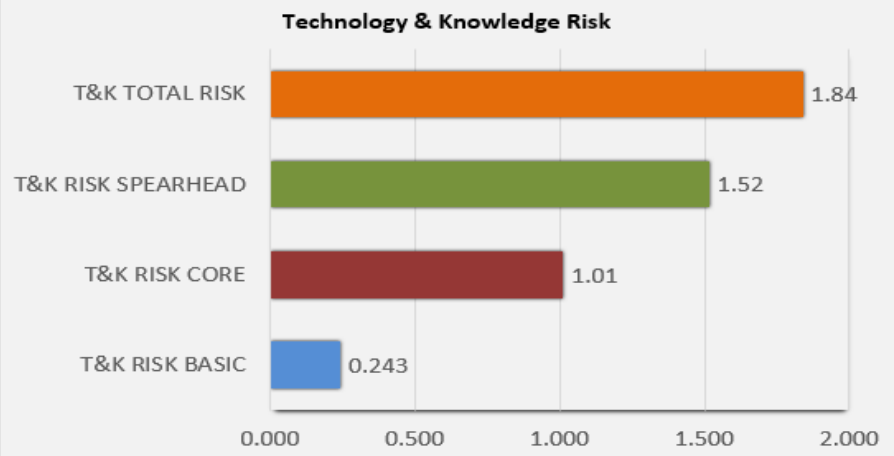


Figure 18. Technology & Knowledge risk – Company B

4.3 Company C

This is a medium-sized company with about 80 employees and was established in 2016. In addition to retailing drugs, medical equipment, cosmetics, and hygiene products in specialized stores, company C provides packing services, and drug storage and testing services.

According to the results of the MSI questionnaire (see Table 11), which evaluates the relative importance of cost, quality, time, and flexibility, it is obvious quality was the most important factor for company C in terms of previous experience. Quality has a weight of 58.1%, while cost has a weight of 24.3%, making it the second most important factor. Time receives an average weight of 12.9%, while flexibility receives the lowest weight of 4.7%. This shows that there is a significant gap between quality and flexibility.

In regard to future expectations, it can be seen that quality still remains the most important criterion, which, however, decreases slightly and stands at 55.5%. By contrast, the weight of cost increases in the future, but not significantly. With an average of 26,7%, company C may expect to reduce costs little to continue keeping its position in the order of importance of these four criteria. Along the same lines with quality, the proportion of time drops from 12,9% to 12% in the future. Actually, this decrease in time only makes a very small gap between past experience and future expectations. Despite the variation in the ratios of the factors, the order of importance for future expectations remains the same as for past experience. The consistency ratios in the past and in the future are under 10%, which indicates that the results are valid and the comparisons are particularly appropriate.

Table 11. AHP results from the MSI questionnaire – Company C

	Results using average numbers				
	Quality %	Cost %	Time %	Flexibility %	CR %
Experience in the past	58.1	24.3	12.9	4.7	5.6
Future expectations	55.5	26.7	12	5.7	5.8

Figure 19 represents the CFI calculations for company C. It is completely obvious that company C's future expectations for all 21 attributes are bigger than past experience. The experience ratings range from 5.5 to 7.0, while the expectations ratings range from 7.5 to 9.0. Attribute 11 has the largest difference between future expectations and past

experience, with a value of 3.5. This means that company C may look forward to highly enhancing its ability to adapt to changes in demand and backlog. On the other hand, the smallest gap is found in attribute 9, with a difference of 0.5. This shows that company C may be satisfied with their current delivery time to customers. In short, these ratings represent the optimism of the respondents when evaluating their usage of resources in the past and in the future because it can be seen that no attributes are below average on a scale of 10.

Figure 19. Average of Expectation vs Experience – Company C

In order to establish the effectiveness of resources with better accuracy, past and future resource allocations should be reviewed. As can be seen, Figure 20 displays the allocation of resources in the past. In accordance with the BCFI model, fifteen attributes are under-resourced, six attributes are over-resourced, and no attributes achieve balance. The under-resourced attributes are 1, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, and 20. The over-resourced attributes are 2, 3, 4, 5, 17, and 21. The SCFI model provides better results as three are three attributes found to be in balance; they are attributes 9, 18, and 21. The rest under-resourced and over-resourced attributes are nearly the same as those

indicated in the BCFI model. By contrast, the NSCFI model provides much better results. Namely, there are up to twelve balanced attributes, only five under-resourced attributes, and four under-resourced attributes. The under-resourced attributes in the NSCFI model are attributes 1, 8, 11, 12, and 19. The over-resourced attributes are 2, 5, 9, and 18. Whereas the outputs of these models vary from one another, they all show that company C's past resource allocations are somewhat inefficient. For instance, company C seems to place a considerable amount of emphasis on knowledge and technology diffusion, while underestimating the availability of information in information systems.

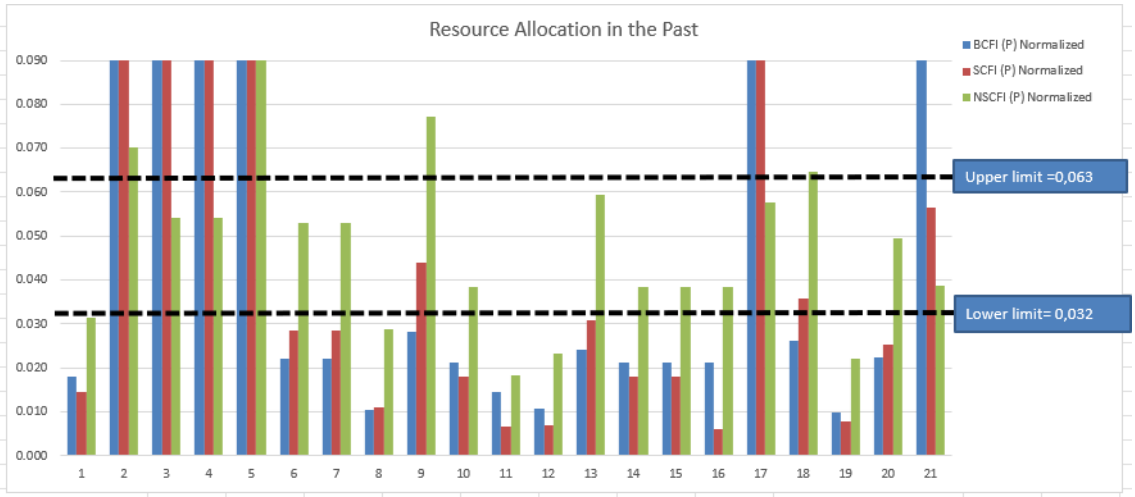


Figure 20. Resource allocation in the Past – Company C

Table 12 and Figure 21 show how the same attributes are compared in the future. The BCFI model demonstrates clearly that future resource allocations will be not improved as there are no balanced attributes found based on this model. Besides, attributes 1, 8, 9, 10, 11, 14, 16, 18, and 19 are still under-resourced as in the past, whereas attributes 6, 7, 12, 13, and 20 change from under-resourced to over-resourced. In the same way, the SCFI model does not represent a significant change in the number of balanced attributes in the future, even though there is a slight decrease compared to the past. Specifically, according to SCFI, there are eleven under-resourced attributes, two balanced

attributes, and eight over-resourced attributes. Although NSCFI provides much better results compared to the CFI and SCFI models, there is a minor decline in the number of balanced attributes in the future compared to those in the past. Based on these findings, it can be noticed that the respondents from company C seem to overestimate some of the company's resources which leads to a shift from under-resourced to over-resourced. Accordingly, there are no positive changes in the number of balanced attributes found in the future in all applied models.

Table 12. The number of resource allocations in the Past and in the Future – Company C

	Under	Balance	Over
P-BCFI	15	0	6
F-BCFI	11	0	10
P-SCFI	13	3	5
F-SCFI	11	2	8
P-NSCFI	5	12	4
F-NSCFI	4	11	6

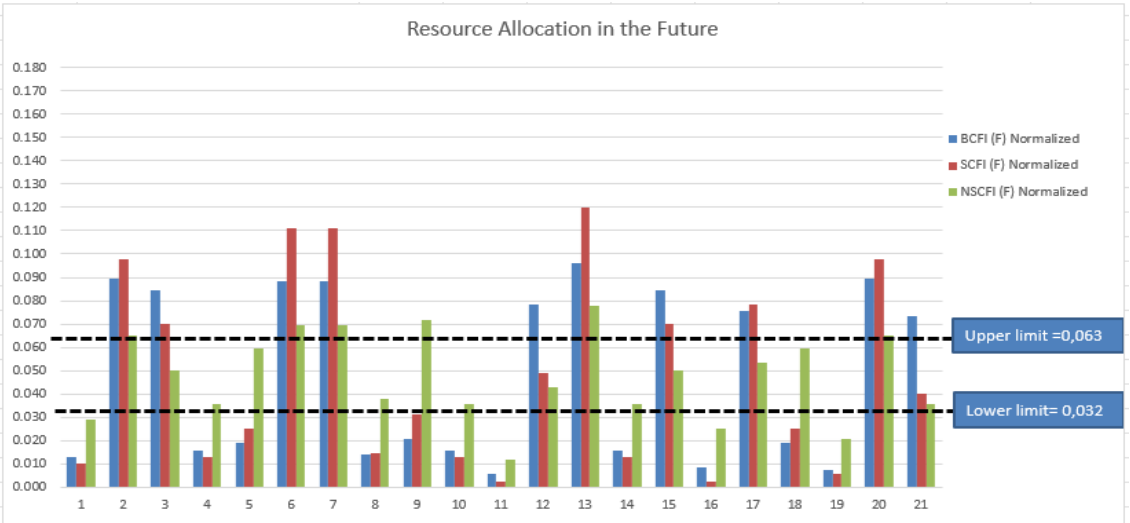


Figure 21. Resource allocation in the Future – Company C

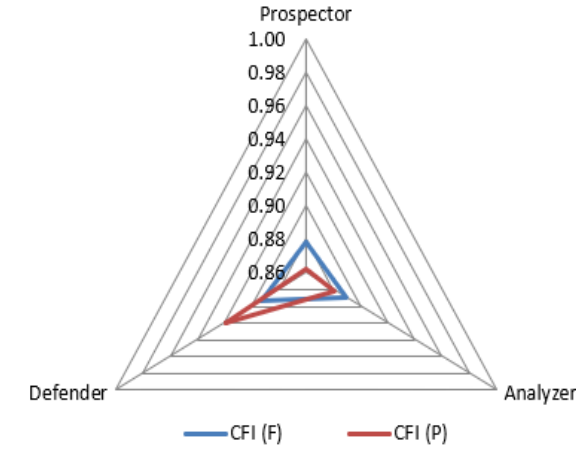
Table 13 compares the trends in resource allocations using the BCFI, SCFI, and NSCFI models. According to the BCFI model, eight attributes will perform negative development in the future, thirteen attributes will perform reverse development. This result represents an unhealthy situation for the company as there are no attributes following positive future development. The SCFI model produces slightly better results, where twelve attributes will experience negative future development, seven attributes will experience reverse development, and two attributes will follow positive future development. On the contrary, the NSCFI model predicts that in the future, only ten attributes will change negatively, seven attributes will remain unchanged, four will change positively, and especially no attributes are found to perform reverse development. It is not difficult to see that the BCFI model produces the most negative results, indicating that company C is in a really bad situation. Although this is right, the real situation is heavily influenced by respondents' optimism about the future of their company. The SCFI model, on the other hand, exhibits a better trend in some attributes, while the NSCFI model exhibits the most positive results.

The BCFI, SCFI, and NSCFI models clearly reflect various trends. Nevertheless, the respondents believe that the NSCFI model more accurately reflects their company’s actual situation than the BCFI and SCFI models. In addition, they add that the trends, in their opinion, are much better than what is shown in the NSFI model. To put it succinctly, company C may think that its current resource allocations are adequate and will remain the same or even improve in the future. Regardless, based on the answers provided, company C should also thoughtfully develop a strategic plan to strengthen any inefficient attributes that may take place.

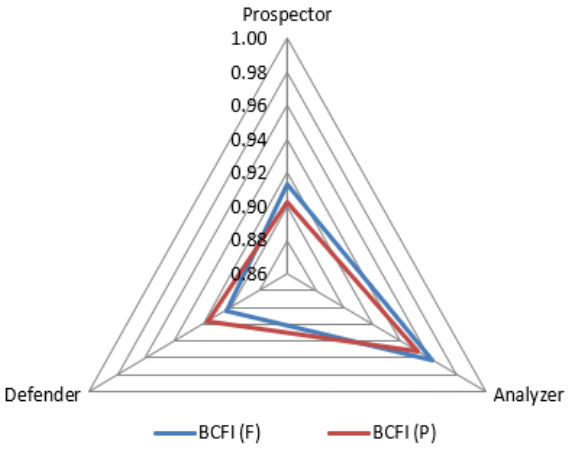
Table 13. Comparisons of Past and Future BCFI, SCFI, and NSCFI – Company C

Attribute	BCFI(P)	BCFI(F)	Trend	SCFI(P)	SCFI(F)	Trend	NSCFI (P)	NSCFI (F)	Trend
1	Under	Under	Worse	Under	Under	Worse	Under	Under	Worse
2	Over	Over	Worse	Over	Over	Worse	Over	Over	Worse
3	Over	Over	Worse	Over	Over	Worse	Balance	Balance	Same
4	Over	Under	180 degree reversed	Over	Under	180 degree reversed	Balance	Balance	Same
5	Over	Under	180 degree reversed	Over	Under	180 degree reversed	Over	Balance	Better
6	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Over	Worse
7	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Over	Worse
8	Under	Under	Worse	Under	Under	Worse	Under	Balance	Better
9	Under	Under	Worse	Balance	Under	Worse	Over	Over	Worse
19	Under	Under	Worse	Under	Under	Worse	Balance	Balance	Same
11	Under	Under	Worse	Under	Under	Worse	Under	Under	Worse
12	Under	Over	180 degree reversed	Under	Balance	Better	Under	Balance	Better
13	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Over	Worse
14	Under	Under	Worse	Under	Under	Worse	Balance	Balance	Same
15	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Balance	Same
16	Under	Under	Worse	Under	Under	Worse	Balance	Under	Worse
17	Over	Over	Worse	Over	Over	Worse	Balance	Balance	Same
18	Under	Under	Worse	Balance	Under	Worse	Over	Balance	Better
19	Under	Under	Worse	Under	Under	Worse	Under	Under	Worse
20	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Over	Worse
21	Over	Over	Worse	Balance	Balance	Same	Balance	Balance	Same

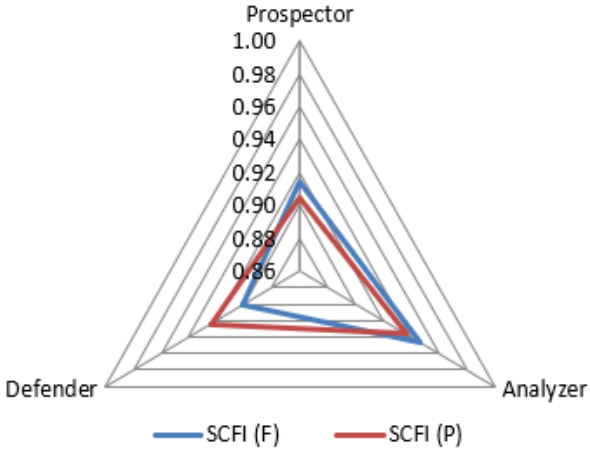
Figure 22 displays MSI competitiveness according to the CFI, BCFI, SCFI, and NSCFI models. According to the BCFI, SCFI, and NSCFI methods, the MSI values for the analyzer are high both in the past (values ranging from 0.94 to 0.98) and in the future (values ranging from 0.95 to 0.99). This shows that company C's past strategy was analyzer and that the predicted future strategy will similarly be analyzer, but slightly more dominant. By contrast, the CFI model indicates that company C was a defender in the past, and does not have a clear strategy for the future. When questioned about these results, the respondents from company C stress that the CFI model provides a big gap compared to their company's real situation and that other models best reflect their company's current operations strategy. In other words, the respondents believe that quality, cost, and time are what company C is oriented toward. In terms of the differences in results between the applied models, it has been stated in the literature that the CFI model is not as sophisticated as other models. Therefore, it makes more sense to follow the results of the BCFI, SCFI, and NSCFI models other than the CFI model when evaluating competitiveness.



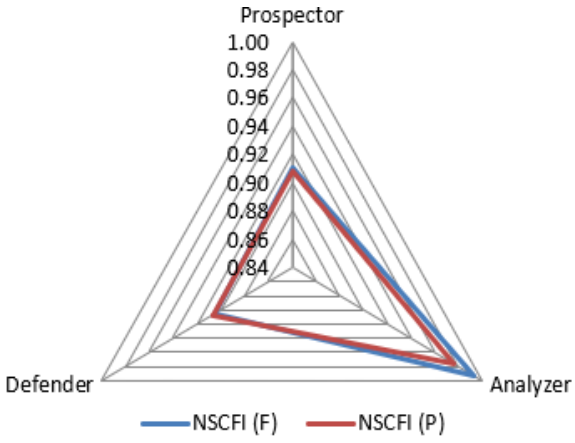
CFI	Prospector	Analyzer	Defender	Reactor
Past	0.86	0.88	0.92	0.89
Future	0.88	0.89	0.89	0.89



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



SCFI	Prospector	Analyzer	Defender	Reactor
Past	0.90	0.94	0.92	0.91
Future	0.91	0.95	0.90	0.91



NSCFI	Prospector	Analyzer	Defender	Reactor
Past	0.91	0.98	0.91	0.91
Future	0.91	0.99	0.90	0.91

Figure 22. MSI competitiveness using CFI (top left), BCFI (top right), SCFI (bottom left) and NSCFI (bottom right) – Company C

The next step is to calculate SCA risk levels to see if company C's resource allocations support its operations strategy. Table 14 clearly shows that all of the results based on RMSE and MAD methods are greater than 0.9, whereas over half of the MAPE method values are less than 0.9. This appears to indicate that company C's operations strategy has been and will continue to be sustainable, but not entirely because there may be a

minor but visible lack of consistency among resources. However, company C asserted that the RMSE and MAD methods are more suitable for identifying SCA risks and that those results also correspond to the circumstances of company C.

Furthermore, Table 14 shows that all SCA values obtained using future outcomes are higher than those obtained using historical outcomes. This demonstrates that company C's operations strategy has previously received sufficient support from resource allocations, and will receive more support in the future. However, development trends should be examined more carefully in order to identify whether or not insufficient support exists when implementing operations strategy.

Table 14. SCA result – Company C

	Normalized criteria weight				MSI values			Measures of SCA risk level		
	Q	C	T	F	Prospector	Analyzer	Defender	MAPE	RMSE	MAD
P-CFI	0.06	0.50	0.43	0.33	0.86	0.88	0.92	0.90	0.93	0.95
F-CFI	0.11	0.19	0.71	0.44	0.88	0.89	0.89	0.95	0.97	0.97
P-BCFI	0.25	0.39	0.35	0.21	0.90	0.95	0.92	0.86	0.91	0.93
F-BCFI	0.38	0.27	0.35	0.22	0.91	0.96	0.90	0.89	0.94	0.95
P-SCFI	0.21	0.44	0.35	0.18	0.90	0.94	0.92	0.89	0.93	0.95
F-SCFI	0.39	0.24	0.37	0.22	0.91	0.95	0.90	0.91	0.95	0.96
P-NSCFI	0.34	0.33	0.33	0.23	0.91	0.98	0.91	0.83	0.90	0.92
F-NSCFI	0.37	0.30	0.33	0.23	0.91	0.99	0.90	0.86	0.91	0.93

Figure 23 represents the orientation of company C toward the various categories of basic, core, and spearhead technology and knowledge. It can be seen that company C uses 39.05% of basic T&K, 42.62% of core T&K, and 18.33% of spearhead T&K on average. This demonstrates that company C prioritizes spearhead T&K the least and core T&K the most. Even so, since they represent such a small percentage of T&K categories, the core T&K applied to attributes 9, 10, 11, 15, and 16 appear to be uncompetitive. Obviously, core technological advancements may improve the competitiveness of these attributes to a certain extent.

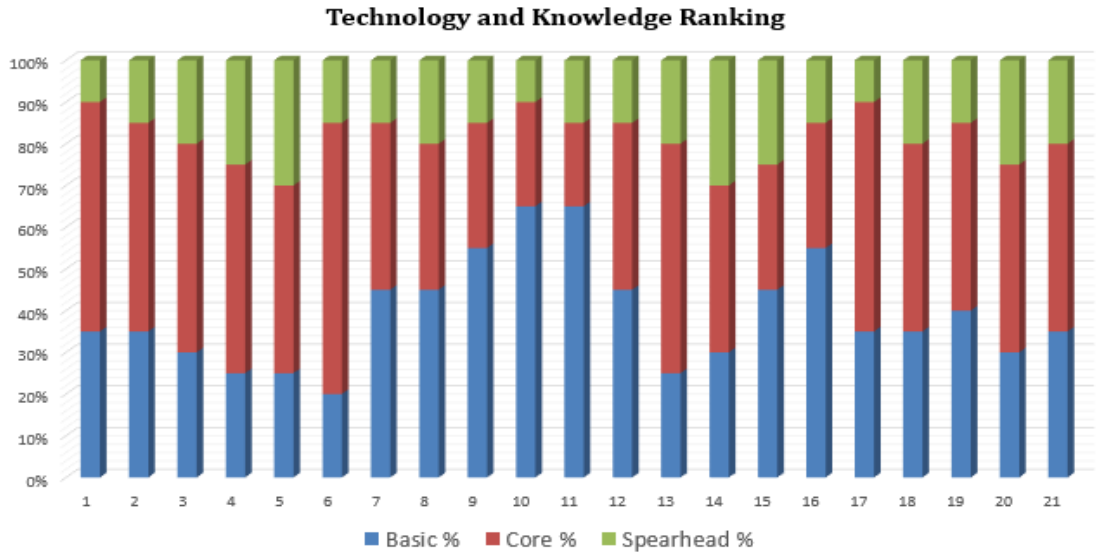


Figure 23. Ranking of Basic, Core, Spearhead Technology and Knowledge – Company C

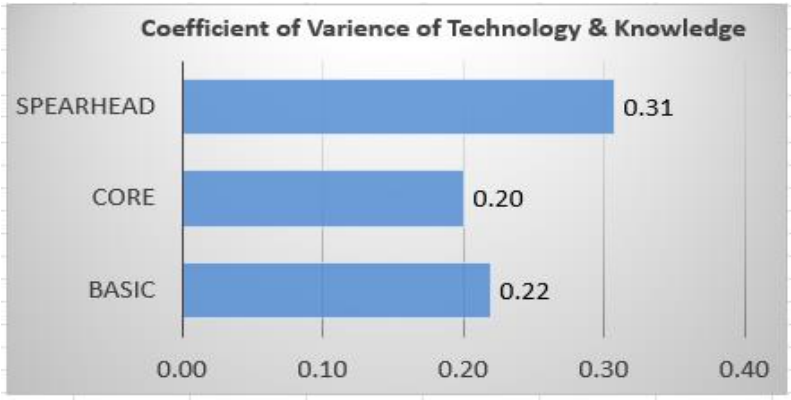


Figure 24. Coefficient of variance of T&K – Company C

Figure 24 shows the variance coefficient values for T&K. As stated in the theoretical basis when the coefficient of variation is high, the responses of the respondents vary more; conversely, when the coefficient of variation is low, the opinions of the respondents are more similar. As shown in Figure 24, the coefficients of variation for basic, core, and spearhead T&K in company C are 0.22, 0.20, and 0.31, respectively. This indicates that in

the case of spearheading T&K, respondents' perspectives differ significantly, likely to result in the greatest source of uncertainty in implementing T&K within the company. Figure 25 shows the total and individual T&K risk levels for basic, core, and spearhead T&K. The level of T&K risks expressed by respondents reflect their uncertainty about the company's share of basic, core, and spearhead T&K. As shown in Figure 18, T&K risks for basic, core, and spearhead are calculated to be 0.93, 0.32, and 1.05, respectively. This means that the highest risks of T&K correspond to spearhead T&K, while the lowest risks correspond to core T&K. These findings are consistent with the results shown in MSI triangles (see Figure 22), which show that company C's operations strategy was analyzer in the past and is expected to remain so in the future. Considering that an analyzer researches the market and pursues innovations and evolutions yet does not take the risk of being innovative, it is reasonable for an analyzer to take a greater risk in spearhead T&K. However, Figure 25 also depicts that the risk rate of basic T&K is nearly the same as the risk rate of spearhead T&K. This means that basic T&K may cause considerable concern for company B; therefore, it is better not to underestimate the risk it may pose. In terms of the results, company C agreed that spearhead T&K seems to cause the most risk to its operation.

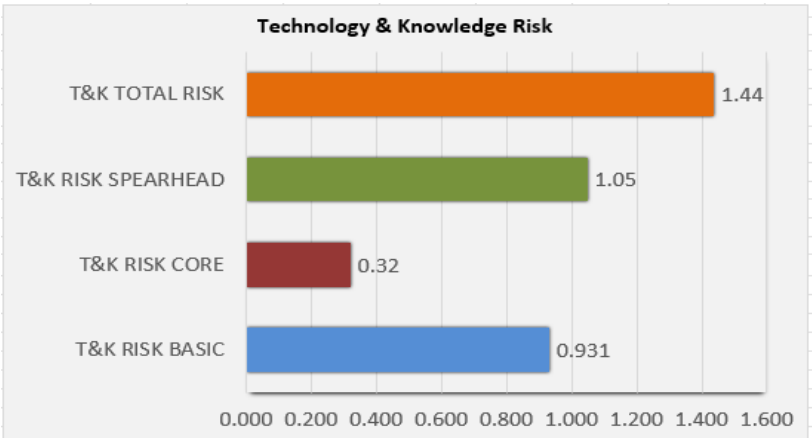


Figure 25. Technology & Knowledge risk – Company C

4.4 Company D

This is a small-sized pharmaceutical company with a current staff size of about 20 people. The company was established in 2018 and specializes in importing and retailing drugs, medical instruments, perfumes, cosmetics, and hygiene products in specialized stores.

In accordance with the results of the MSI questionnaire (see Table 15), which assesses the relative importance of cost, quality, time, and flexibility, it is clear that in terms of past experience, quality was the most important factor for company D. Cost carries a weight of 18.9%, putting it as the second most important element after quality, which carries a weight of 64.3%. The average weight assigned to time is 12.2%, while the minimum weight assigned to flexibility is 4.5%. This demonstrates that there is a substantial difference between quality and flexibility.

Based on future expectations, it is evident that quality remains the most important factor, although there is a small decline that generates a value of 61.1%. In contrast, the cost weight will increase in the future, but not by a large amount. With a percentage of 24.6%, company D may expect minimal cost reductions to maintain its position in the hierarchy of these four criteria. Similar to the downward trend of quality percentage, the proportion of time will decrease from 12.2% to 10.1% in the future. Although the proportions of the factors vary, the order of priority for future expectations remains the same as for past experience. The consistency ratios for both the past and the future are less than 10%, indicating that the results are accurate and the comparisons are correct.

Table 15. AHP results from the MSI questionnaire – Company D

	Results using average numbers				
	Quality %	Cost %	Time %	Flexibility %	CR %
Experience in the past	64.3	18.9	12.2	4.5	5.4
Future expectations	61.1	24.6	10.1	4.2	6.5

Figure 26 represents the CFI calculations for company D. It is obvious that company D's future expectations for all 21 attributes are bigger than past experience. The experience ratings range from 4.5 to 6.5, while the expectations ratings range from 6.0 to 8.0. Attributes 1, 6, 8, 10, 15 have the largest gap between future expectations and past experience, with a gap value of 2.0. This means that company D may place high hopes on the development of these attributes. On the other hand, the smallest gap is found in attribute 12, with a difference of 0.5. This shows that company D may be satisfied with its current control of all types of inventories; therefore, the company finds no need to raise its rank significantly. In short, Figure 26 represents that the respondents are fairly optimistic about company D's future when evaluating its usage of resources, especially with the usability and functionality of information systems, which has the highest rate among the attributes in the future.

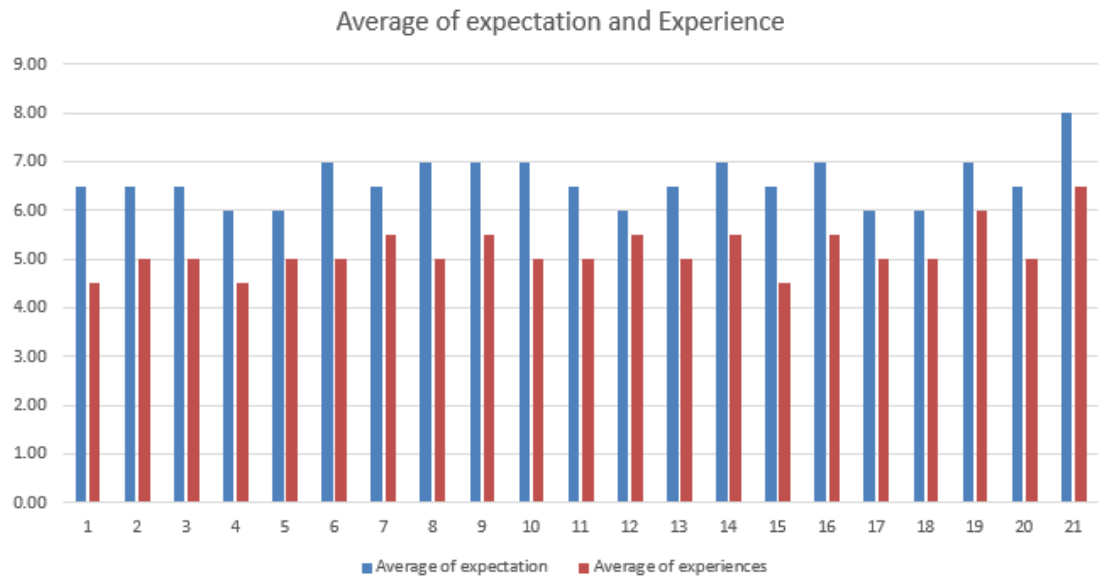


Figure 26. Average of Expectation vs Experience – Company D

Figure 27 illustrates resource allocations in the past. According to the BCFI model, ten attributes are under-resourced, two attributes are over-resourced, and nine attributes

achieve balance. The under-resourced attributes are 4, 5, 6, 7, 10, 11, 15, 16, 19, and 21, while the over-resourced attributes are 1 and 2. The SCFI model, however, produces slightly worse results, where only seven attributes are found to be in balance. According to the SCFI model, the under-prioritized and over-prioritized attributes are identical to those indicated by the BCFI model, the BCFI model's balanced attributes 8 and 12 here also become respectively under-prioritized and over-prioritized. By contrast, the NSCFI model provides significantly better results. Specifically, there are a total of fourteen balanced attributes, only three under-resourced attributes, and four under-resourced attributes. The NSCFI model's under-resourced attributes are 6, 10, and 15, and the over-resourced attributes are 2, 12, 17, and 18. While the results of these models differ, they all show that company D did not have efficient resource allocations of some common attributes, for example, the control and optimization of all types of inventories, and the different types of organizing systems used in the company.

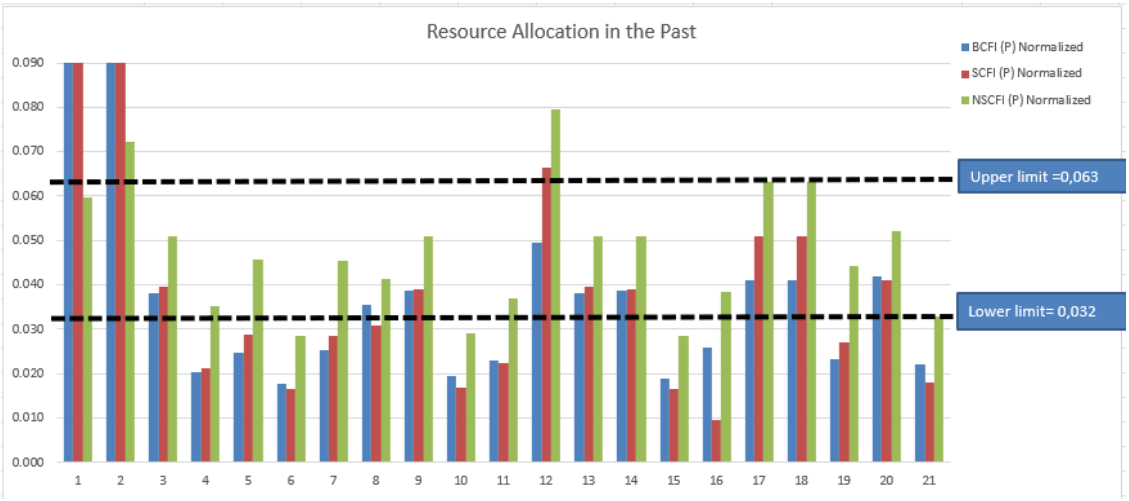


Figure 27. Resource allocation in the Past – Company D

Next, Table 16 and Figure 28 compare the same attributes in the future. The BCFI model clearly shows that company D's resource allocations in the future are much worse than in the past as no attributes achieve balance. Accordingly, there are up to nine over-resourced attributes, while the number of under-resourced attributes is twelve, which

slightly increases compared to those in the past. The SCFI model not only follows the same downtrend in the efficiency of resource allocations illustrated by the BCFI model but also provides accurately the same under-resourced and over-resourced attributes. Although the NSCFI model outperforms the CFI and SCFI models, there are no changes in the number of balanced attributes compared to the past. However, the attributes themselves are not exactly the same as those in the past. For instance, attribute 2 was in balance in the past but transfers to over-resourced in the future; conversely, attribute 11 used to be under-resourced in the past but achieves balance in the future.

Table 16. The number of resource allocations in the Past and in the Future – Company D

	Under	Balance	Over
P-BCFI	10	9	2
F-BCFI	12	0	9
P-SCFI	11	7	3
F-SCFI	12	0	9
P-NSCFI	3	14	4
F-NSCFI	4	14	3

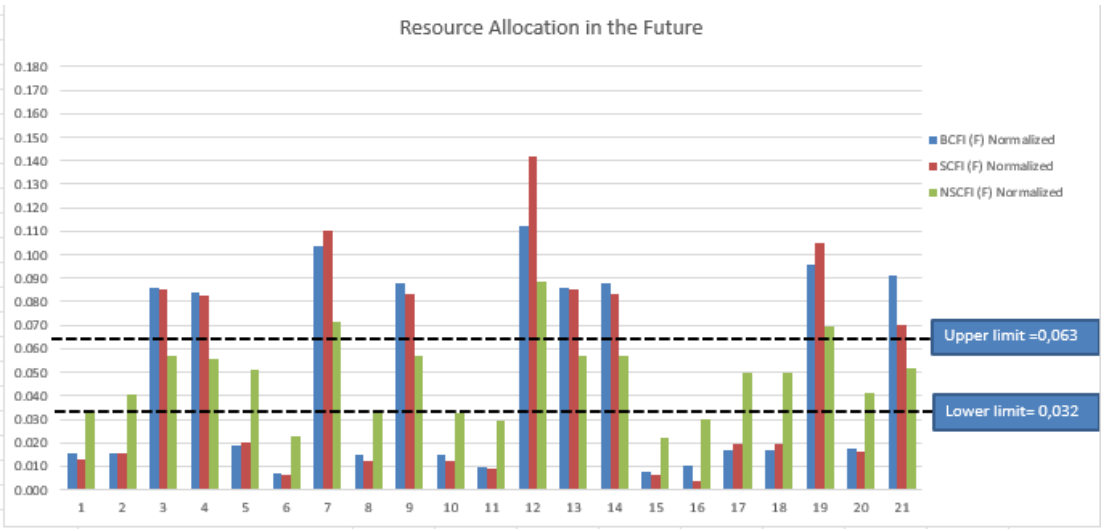


Figure 28. Resource allocation in the Future – Company D

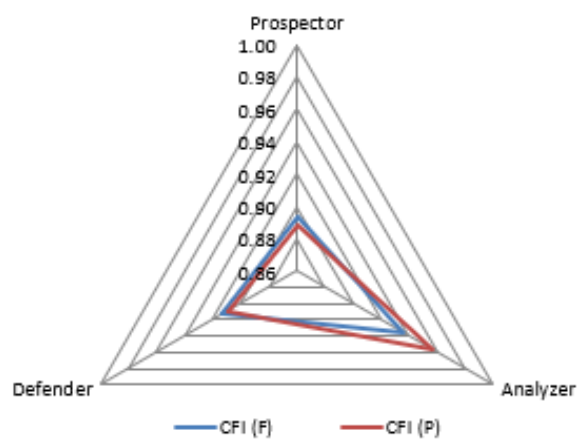
Table 17 compares resource allocation trends using the BCFI, SCFI, and NSCFI models. The BCFI model predicts that six attributes will experience negative development in the future, while fifteen will experience reverse development. As there are no attributes following positive future development, this result represents an unhealthy situation for the company. The SCFI model produces exactly the same trends as represented in the BCFI model, although there are a few differences in the efficiency of resource allocations between the two models. On the contrary, the NSCFI model predicts that only seven attributes will change negatively in the future, ten attributes will remain unchanged, and four attributes will change positively, and no attributes will reverse development. It is clear that the BCFI and SCFI models produce the most negative results, indicating that company D is in a bad situation. Although this is correct, the real situation is heavily influenced by respondents' optimism about their company's future. In contrast, the NSCFI model shows the most positive results.

Table 17. Comparisons of Past and Future BCFI, SCFI, and NSCFI – Company D

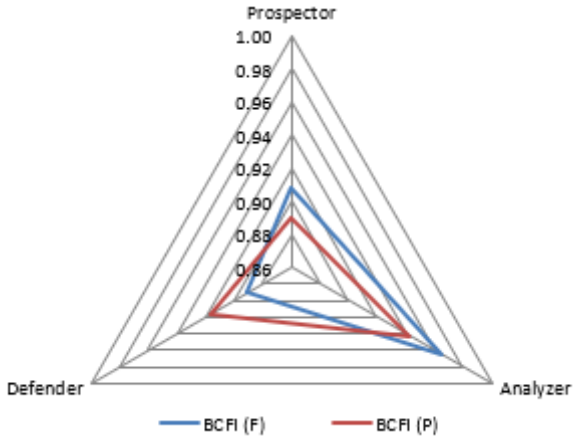
Attribute	BCFI(P)	BCFI(F)	Trend	SCFI(P)	SCFI(F)	Trend	NSCFI (P)	NSCFI (F)	Trend
1	Over	Under	180 degree reversed	Over	Under	180 degree reversed	Balance	Balance	Same
2	Over	Under	180 degree reversed	Over	Under	180 degree reversed	Over	Balance	Better
3	Balance	Over	Worse	Balance	Over	Worse	Balance	Balance	Same
4	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Balance	Same
5	Under	Under	Worse	Under	Under	Worse	Balance	Balance	Same
6	Under	Under	Worse	Under	Under	Worse	Under	Under	Worse
7	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Over	Worse
8	Balance	Under	Worse	Under	Under	Worse	Balance	Balance	Same
9	Balance	Over	Worse	Balance	Over	Worse	Balance	Balance	Same
19	Under	Under	Worse	Under	Under	Worse	Under	Balance	Better
11	Under	Under	Worse	Under	Under	Worse	Balance	Under	Worse
12	Balance	Over	Worse	Over	Over	Worse	Over	Over	Worse
13	Balance	Over	Worse	Balance	Over	Worse	Balance	Balance	Same
14	Balance	Over	Worse	Balance	Over	Worse	Balance	Balance	Same
15	Under	Under	Worse	Under	Under	Worse	Under	Under	Worse
16	Under	Under	Worse	Under	Under	Worse	Balance	Under	Worse
17	Balance	Under	Worse	Balance	Under	Worse	Over	Balance	Better
18	Balance	Under	Worse	Balance	Under	Worse	Over	Balance	Better
19	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Over	Worse
20	Balance	Under	Worse	Balance	Under	Worse	Balance	Balance	Same
21	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Balance	Same

Various trends are clearly reflected in the BCFI, SCFI, and NSCFI models. Nonetheless, respondents believe that the NSCFI model better represents their company's actual situation than the BCFI and SCFI models. Furthermore, they state that the trends, in their personal view, would be better compared to those shown in the NSFI model. To put it another way, company D may believe that its current resource allocations are acceptable and that they will remain the same or even improve in the future. Regardless, company D should thoughtfully create a strategic strategy to strengthen any inefficient attributes that may occur.

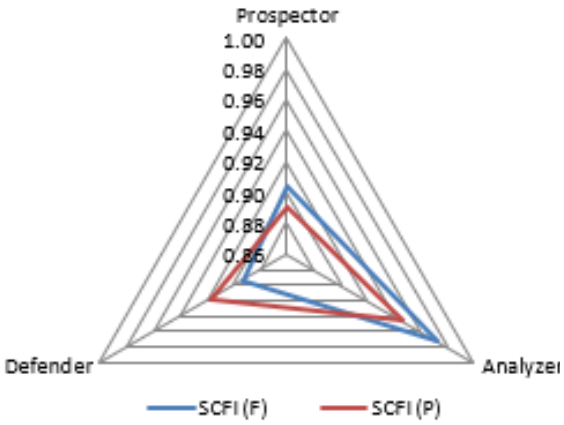
Figure 29 illustrates the evolution and comparison of MSI competitiveness using the CFI, BCFI, SCFI, and NSCFI techniques. Figure 29 demonstrates that the MSI values for the analyzer are high both in the past (values ranging from 0.94 to 0.98) and in the future (values ranging from 0.94 to 0.98). This suggests that company D's business strategy in the past was analyzer, and that the business strategy in the future is likewise expected to be analyzer, but slightly more dominant. It is worth noting that the CFI model in this case company provides similar results as other models, indicating that company D’s strategy is towards analyzer. When asked about the results, the respondents emphasized that analyzer best reflects company D’s operations strategy. As they say, a pharmaceutical company often prioritizes quality over other criteria; however, cost and time are also the company’s key elements. For example, the company has been keeping monitoring the market and follow market innovations and new developments thus far.



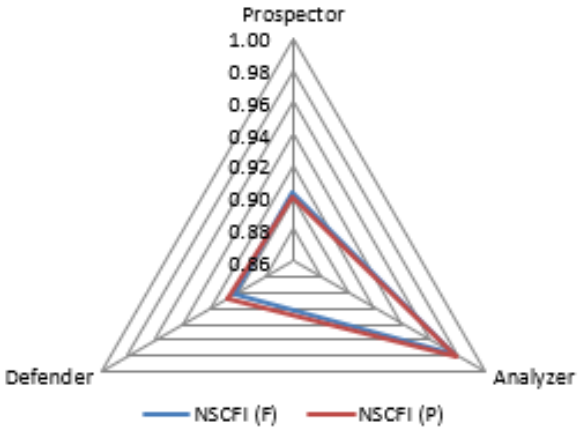
CFI	Prospector	Analyzer	Defender	Reactor
Past	0.89	0.96	0.91	0.90
Future	0.89	0.94	0.91	0.90



BCFI	Prospector	Analyzer	Defender	Reactor
Past	0.89	0.94	0.92	0.90
Future	0.91	0.97	0.89	0.90



SCFI	Prospector	Analyzer	Defender	Reactor
Past	0.89	0.95	0.92	0.90
Future	0.90	0.97	0.89	0.90



NSCFI	Prospector	Analyzer	Defender	Reactor
Past	0.90	0.98	0.91	0.90
Future	0.90	0.98	0.90	0.90

Figure 29. MSI competitiveness using CFI (top left), BCFI (top right), SCFI (bottom left) and NSCFI (bottom right) – Company D

The following step is to determine whether company D's resource allocations support its operations strategy by calculating SCA risk levels. Table 18 clearly demonstrates that nearly all the results based on the MAD method are above 0.9, while most results in accordance with the MAPE and RMSE methods are under 0.9. In addition, as can be seen from Table 18, most SCA values derived from future scenarios are greater than those derived from past scenarios. This illustrates that the operations strategy of company D

will receive more support in the future. All the results indicate that the operations strategy of company D was sustainable little in the past but will be a little more sustainable in the future. Nonetheless, company D stated that the MAD method seems to be better appropriate for identifying SCA risks as it gives more optimistic results. The company also thinks that the results based on the MAD quite match its circumstances. Regardless, development trends should be analyzed more closely to determine whether or not there is a lack of sustainability in the company's resource allocations in operations strategy.

Table 18. SCA result – Company D

	Normalized criteria weight				MSI values			Measures of SCA risk level		
	Q	C	T	F	Prospector	Analyzer	Defender	MAPE	RMSE	MAD
P-CFI	0.39	0.61	0.00	0.78	0.89	0.96	0.91	0.78	0.86	0.90
F-CFI	0.39	0.61	0.00	0.67	0.89	0.94	0.91	0.86	0.91	0.93
P-BCFI	0.24	0.52	0.24	0.33	0.89	0.94	0.92	0.80	0.88	0.91
F-BCFI	0.43	0.25	0.32	0.31	0.91	0.97	0.89	0.82	0.89	0.91
P-SCFI	0.22	0.51	0.27	0.31	0.89	0.95	0.92	0.80	0.87	0.91
F-SCFI	0.38	0.28	0.34	0.30	0.90	0.97	0.89	0.81	0.89	0.91
P-NSCFI	0.29	0.37	0.34	0.26	0.90	0.98	0.91	0.76	0.86	0.89
F-NSCFI	0.33	0.33	0.34	0.27	0.90	0.98	0.90	0.81	0.88	0.91

Figure 30 represents company D's orientation toward the various categories of basic, core, and spearhead technology and knowledge. Company D utilizes an average of 41.9% basic T&K, 38.57% core T&K, and 19.52% spearhead T&K. The results indicate that company D places the highest value on basic T&K and the lowest value on spearhead T&K. However, because they represent such a small proportion of T&K categories, the basic T&K applied to attributes 13, 17, 18, and 19 appear to be uncompetitive. Noticeably, the attributes are related to the information systems, thus, basic technological advancements in information systems may help to improve the competitiveness of these attributes to some degree.

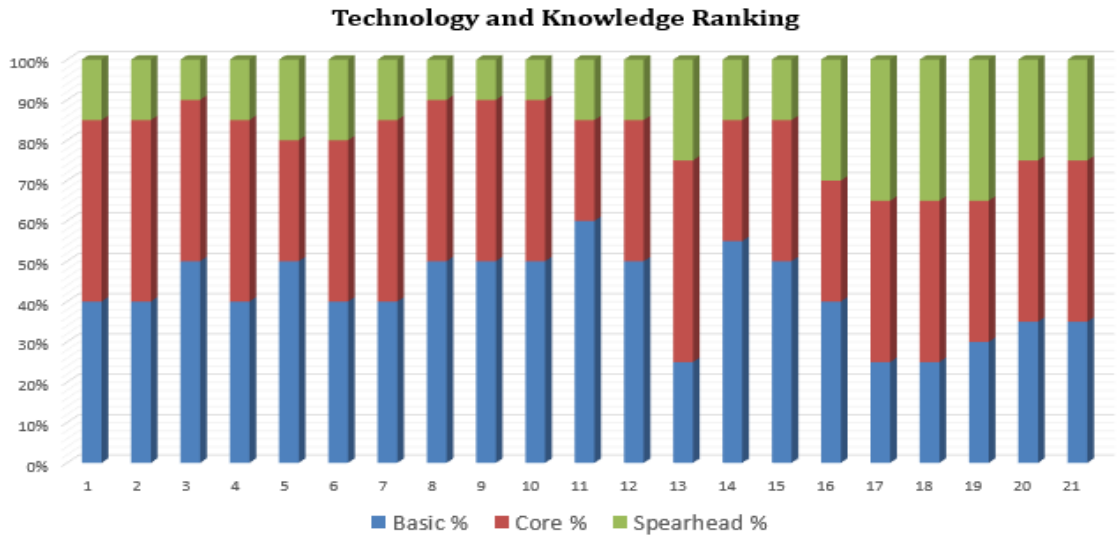


Figure 30. Ranking of Basic, Core, Spearhead Technology and Knowledge – Company D

The variance coefficient values for T&K are shown in Figure 31. In company D, the coefficients of variation for basic, core, and spearhead T&K are 0.35, 0.43, 0.5, respectively. This indicates that respondents' perspectives on spearhead T&K differ significantly, resulting in the greatest cause of uncertainty in establishing T&K inside the company.

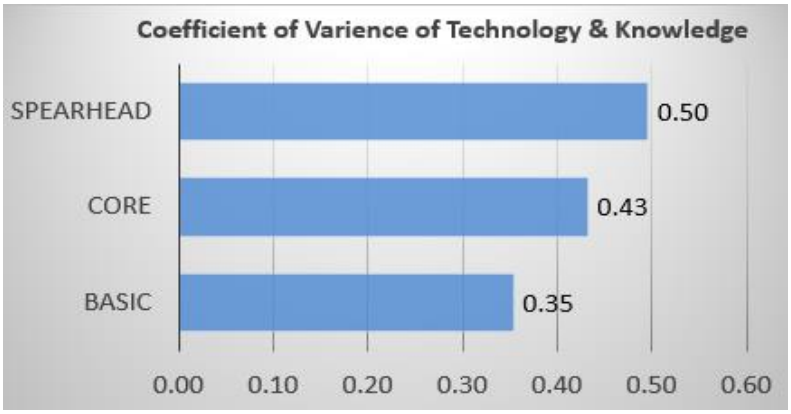


Figure 31. Coefficient of variance of T&K – Company D

The total and individual T&K risk levels for basic, core, and spearhead T&K are depicted in Figure 32. These risk levels are calculated by taking the coefficient of variation of 21 attributes into account. The level of T&K risks reflects the respondent's uncertainty about the company's share of basic, core, and spearhead T&K. As can be seen from Figure 32, T&K risks for basic, core, and spearhead are calculated to be 2.516, 2.53, and 4.31, respectively. This means that the highest risks of T&K correspond to spearhead T&K, while basic T&K and core T&K have the lowest risks. These findings are consistent with the findings shown in MSI triangles (see Figure 29), namely that company A's operations strategy was analyzer in the past and is expected to be analyzer in the future. Actually, an analyzer could take a higher risk in spearhead T&K because an analyzer studies the market and follows innovations and new developments but does not take the risk of being innovative. Consequently, it follows that company D's primary risk is the spearhead T&K. Company D also believed that these findings about T&K risks make sense of its situation to some extent.

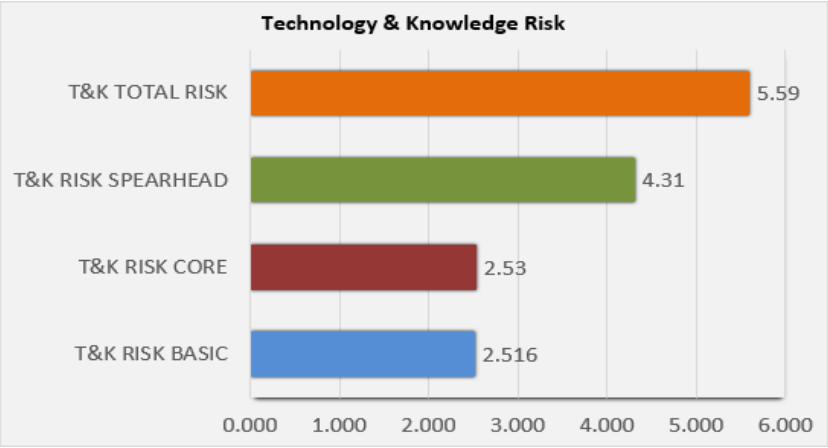


Figure 32. Technology & Knowledge risk – Company D

4.5 Company E

This is a small-sized pharmaceutical company with about 30 employees. The company was founded in 2019 and specializes in buying and selling drugs, medical instruments, cosmetics, and hygiene products.

According to the MSI questionnaire, it is clear that quality was the single most important factor in company E's past experience. The weight for quality is 63.9 %, while the weight for time is 19.2%, making it the second most essential factor. Cost is given an average weight of 9.7%, while flexibility is given the lowest weight of 7.3%, which is considered the least important.

In terms of future expectations, it can be seen that quality remains the most important criterion, but it receives an average value of 60.6%. This is entirely consistent with the pharmaceutical industry, where quality is always considered to be a top priority. Conversely, there is a significant increase in cost in the future, moving it to second place with a value of 22.1%. This means that company E may expect to cut costs in the future in order to have a greater impact. Time, on the other hand, is estimated to be the third most important factor in the coming years, with an average weight of 11.8%. The order of importance for future expectations differs from the order of importance for previous experience, as shown in Table 19. However, according to the theoretical framework in Chapter 2, the obtained results are reliable and the comparisons are accurate because the consistency ratio in both calculations is less than 10%.

Table 19. AHP results from the MSI questionnaire – Company E

	Results using average numbers				
	Quality %	Cost %	Time %	Flexibility %	CR %
Experience in the past	63.9	9.7	19.2	7.3	2.4
Future expectations	60.6	22.1	11.8	5.5	4.2

Figure 33 represents the CFI calculations for company E. It is clear that company E's expectations for all 21 attributes primarily exceed past experience. The experience ratings range from 6.0 to 8.0, while the expectations ratings range from 7.5 to 8.5. Attribute 3 has the largest difference between future expectations and past experience, with a gap value of 2.5. Besides, the smallest gaps are found in attributes 6, 7, 13, 15 and 17 with a gap value of 0.5. The ratings of attributes 11, 18, 20, and 21 are quite high and there are no differences between future expectations and experience in the past, which indicates that company E may consider them as effective attributes. In short, the findings suggest that the differences between future expectations and past experiences with the assigned attributes are not very significant; in other words, company E may believe that these attributes are currently effective to some extent; thus, a slight increase in the future may be sufficient for its operations.

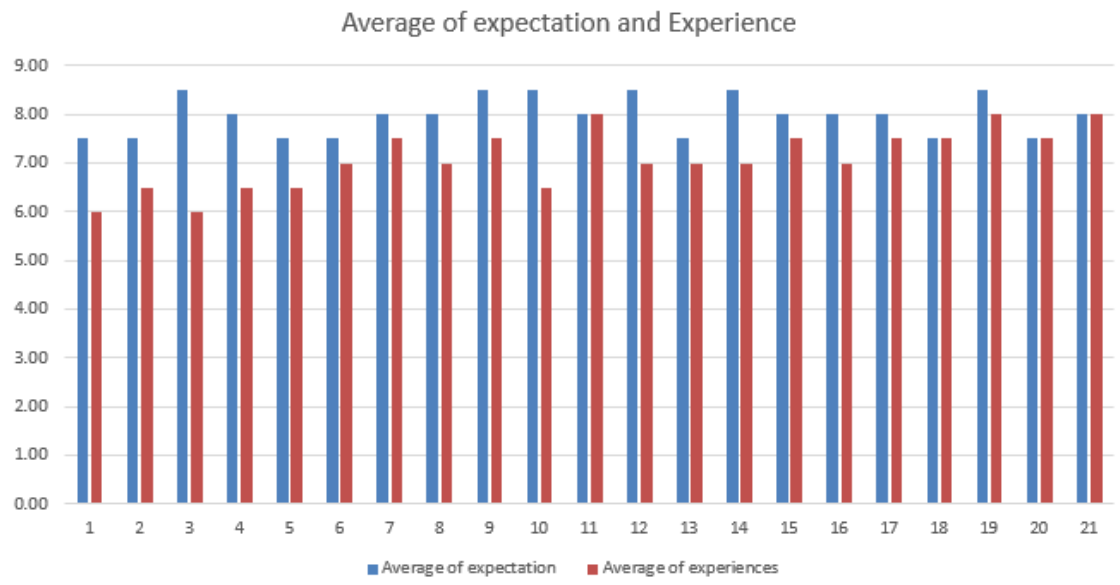


Figure 33. Average of Expectation vs Experience – Company E

Figure 27 depicts historical resource allocations. The BCFI model shows that four attributes are under-resourced, three attributes are over-resourced, and fourteen attributes

achieve balance. Specifically, 3, 10, 12, and 14 are the under-resourced attributes, while 7, 18, and 20 are the over-resourced attributes. The SCFI model, on the other hand, yields slightly worse results, with only nine attributes found to be in balance. According to the SCFI model, the under-resourced attributes are the same as those in the BCFI model, plus attributes 9 and 16. Similarly, the over-resourced attributes are the same as those in the BCFI model, plus attributes 11, 13, and 21. The NSCFI model produces slightly better results compared to the SCFI model. Namely, there are eleven balanced attributes, five under-resourced attributes, and five under-resourced attributes found in the NSCFI model. Attributes 16 and 13 are respectively under-resourced and over-resourced in the SCFI model, but both get balanced status in the NSCFI model. While the outcomes of these models differ, they all show that company E did not have efficient resource allocations for some attributes, especially those relating to organizational systems.

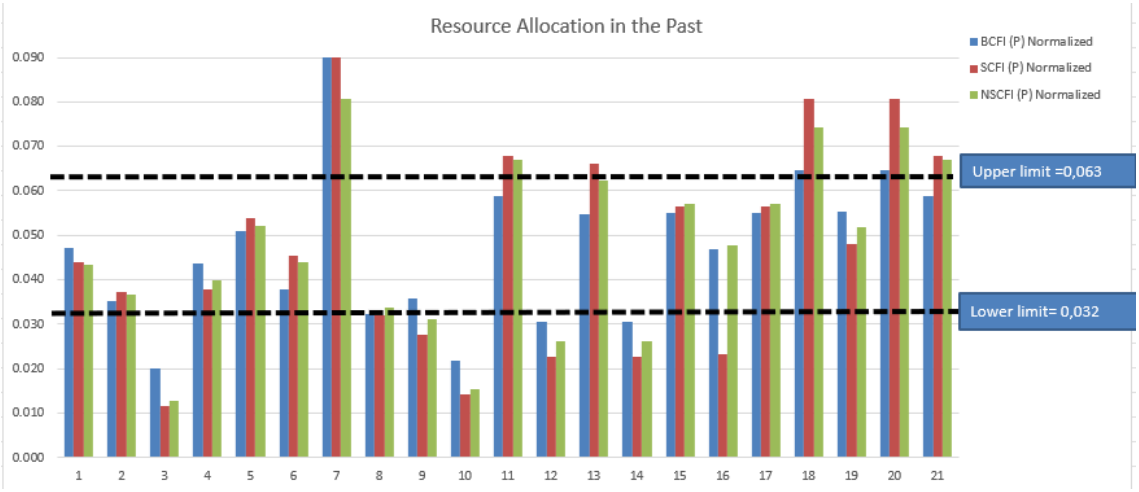


Figure 34. Resource allocation in the Past – Company E

Table 20 and Figure 35 compare the same attributes in the future. The BCFI model demonstrates obviously that company E's future resource allocations are substantially worse than in the past, as only one attribute achieves balance. Accordingly, there are up

to nine under-resourced attributes, and eleven over-resourced attributes found in the future. The SCFI model not only illustrates the same decline in resource allocation efficiency as the BCFI model, but also gives the exact same under-resourced attributes. On the other hand, the NSCFI model shows significantly better results, where fourteen attributes are found to be in balance. Accordingly, the under-resourced attributes that the NSCFI model depicts are attributes 3, 5, 16, and 19, while attributes 6, 11, and 17 are over-resourced.

Table 20. The number of resource allocations in the Past and in the Future – Company E

	Under	Balance	Over
P-BCFI	4	14	3
F-BCFI	9	1	11
P-SCFI	6	9	6
F-SCFI	9	4	8
P-NSCFI	5	11	5
F-NSCFI	4	14	3

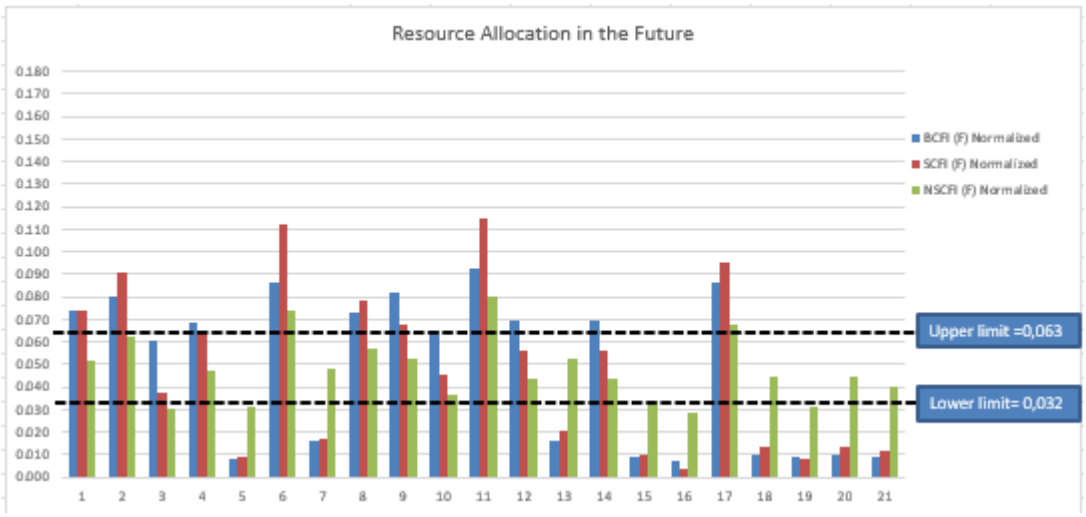


Figure 35. Resource allocation in the Future – Company E

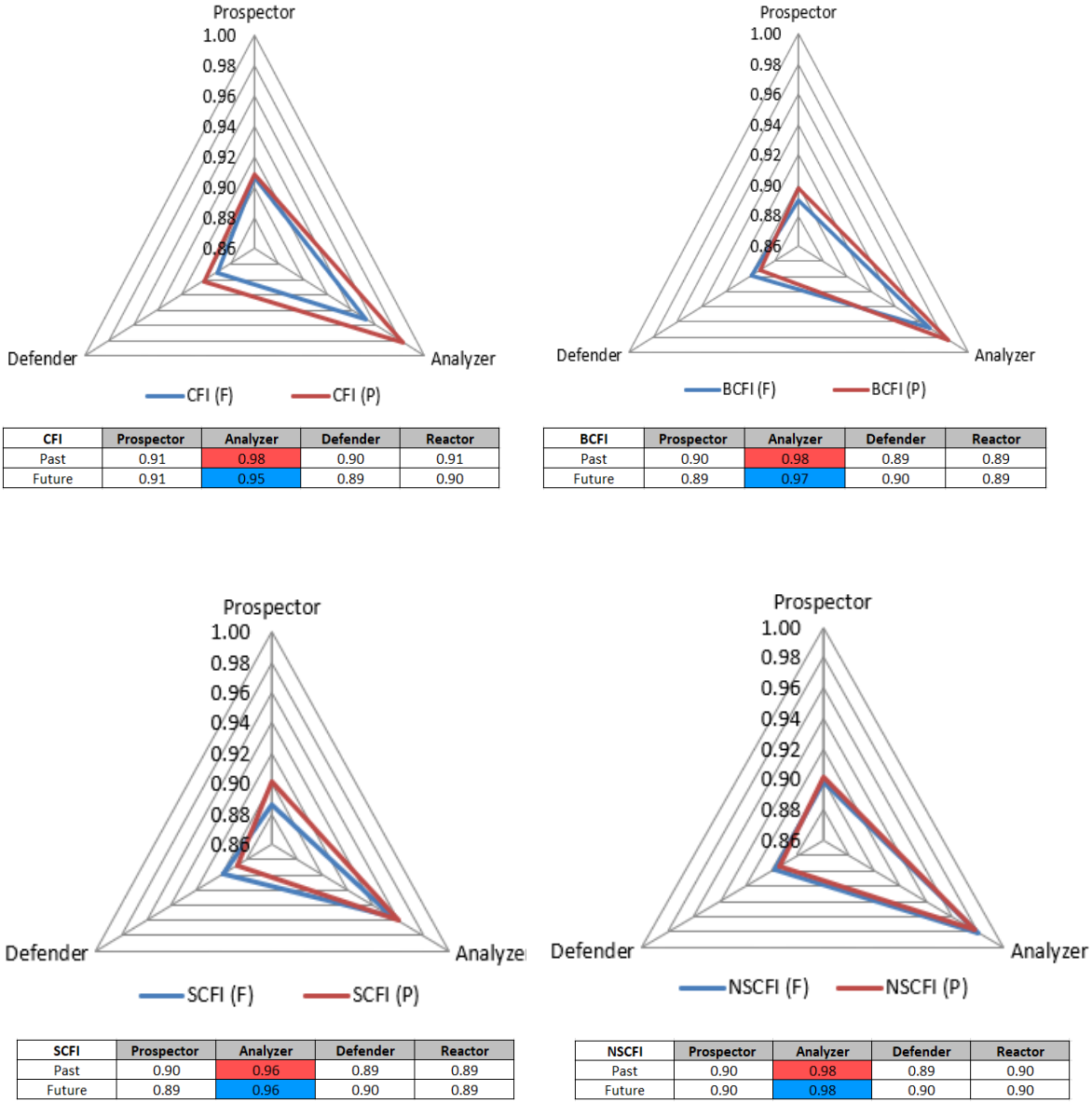
Table 21 compares resource allocation trends using the BCFI, SCFI, and NSCFI models. The BCFI model predicts that six attributes will experience negative development in the future, while fourteen will experience reverse development. As there is only one attribute following positive future development, this result represents an unhealthy situation for the company. The SCFI model produces slightly better results, where four attributes are found to follow positive future development. However, the SCFI model also indicates that there are up to seven attributes that will experience reverse development. On the contrary, the NSCFI model predicts that only seven attributes will change negatively in the future, six attributes will remain unchanged, and up to eight attributes will change positively, and no attributes will reverse development. It is clear that the BCFI model produces the most negative result, indicating that company E is in a bad situation. Although this is correct, the real situation is influenced by respondents' optimism about their company's future. In contrast, the NSCFI model shows the most positive results.

The BCFI, SCFI, and NSCFI models all clearly reflect various trends. Nevertheless, the respondents believe that the NSCFI model, rather than the BCFI and SCFI models, better represents their company's actual situation. However, they claim that the trends would be better in their opinion than those shown in the NSFI model. To put it differently, company E may believe that its current resource allocations are barely adequate and will remain so, if not improve, in the future. Regardless, company E should develop a strategic plan to strengthen any inefficient attributes that may arise.

Table 21. Comparisons of Past and Future BCFI, SCFI, and NSCFI – Company E

Attribute	BCFI(P)	BCFI(F)	Trend	SCFI(P)	SCFI(F)	Trend	NSCFI (P)	NSCFI (F)	Trend
1	Balance	Over	Worse	Balance	Over	Worse	Balance	Balance	Same
2	Balance	Over	Worse	Balance	Over	Worse	Balance	Balance	Same
3	Under	Balance	Better	Under	Balance	Better	Under	Under	Worse
4	Balance	Over	Worse	Balance	Over	Worse	Balance	Balance	Same
5	Balance	Under	Worse	Balance	Under	Worse	Balance	Under	Worse
6	Balance	Over	Worse	Balance	Over	Worse	Balance	Over	Worse
7	Over	Under	180 degree reversed	Over	Under	180 degree reversed	Over	Balance	Better
8	Balance	Over	Worse	Under	Over	180 degree reversed	Balance	Balance	Same
9	Balance	Over	Worse	Under	Over	180 degree reversed	Under	Balance	Better
19	Under	Over	180 degree reversed	Under	Balance	Better	Under	Balance	Better
11	Balance	Over	Worse	Over	Over	Worse	Over	Over	Worse
12	Under	Over	180 degree reversed	Under	Balance	Better	Under	Balance	Better
13	Balance	Under	Worse	Over	Under	180 degree reversed	Balance	Balance	Same
14	Under	Over	180 degree reversed	Under	Balance	Better	Under	Balance	Better
15	Balance	Under	Worse	Balance	Under	Worse	Balance	Balance	Same
16	Balance	Under	Worse	Under	Under	Worse	Balance	Under	Worse
17	Balance	Over	Worse	Balance	Over	Worse	Balance	Over	Worse
18	Over	Under	180 degree reversed	Over	Under	180 degree reversed	Over	Balance	Better
19	Balance	Under	Worse	Balance	Under	Worse	Balance	Under	Worse
20	Over	Under	180 degree reversed	Over	Under	180 degree reversed	Over	Balance	Better
21	Balance	Under	Worse	Over	Under	180 degree reversed	Over	Balance	Better

Figure 36 illustrates the evolution and comparison of MSI competitiveness using the CFI, BCFI, SCFI, and NSCFI techniques. Figure 36 demonstrates that the MSI values for the analyzer are high both in the past (values ranging from 0.96 to 0.98) and in the future (values ranging from 0.95 to 0.98). This suggests that company D's business strategy in the past was analyzer, and that the business strategy in the future is likewise expected to be analyzer. It is worth noting that the CFI model in this case company provides similar results as other models, indicating that company E's strategy is towards analyzer. When asked about the results, the respondents confirmed that analyzer best reflects company E's operations strategy. As they said, besides quality, cost and time are also their company's key elements.



CFI	Prospector	Analyzer	Defender	Reactor
Past	0.91	0.98	0.90	0.91
Future	0.91	0.95	0.89	0.90

BCFI	Prospector	Analyzer	Defender	Reactor
Past	0.90	0.98	0.89	0.89
Future	0.89	0.97	0.90	0.89

SCFI	Prospector	Analyzer	Defender	Reactor
Past	0.90	0.96	0.89	0.89
Future	0.89	0.96	0.90	0.89

NSCFI	Prospector	Analyzer	Defender	Reactor
Past	0.90	0.98	0.89	0.90
Future	0.90	0.98	0.90	0.90

Figure 36. MSI competitiveness using CFI (top left), BCFI (top right), SCFI (bottom left) and NSCFI (bottom right) – Company E

The next step is to calculate SCA risk levels to see if company E's resource allocations support its operations strategy. Table 22 clearly shows that all of the results obtained using the MAPE and RMSE methods are lower than 0.9, whereas over half of the results obtained using the MAD methods are higher than 0.9. Furthermore, as shown in Table 22, the majority of SCA values derived from future scenarios are greater than those

derived from past scenarios. This demonstrates that company E's operations strategy will be given more support in the future. All these results indicate that company E's operations strategy was not really sustainable in the past but will be a little more sustainable in the future. Nevertheless, company E stated that the MAD method appears to be more suitable for identifying SCA risks because it produces more optimistic results. The company also believes that the MAD results partly reflect its circumstances. However, development trends should be analyzed more closely to figure out whether or not the company's resource allocations in operations strategy are sustainable.

Table 22. SCA result – Company E

	Normalized criteria weight				MSI values			Measures of SCA risk level		
	Q	C	T	F	Prospector	Analyzer	Defender	MAPE	RMSE	MAD
P-CFI	0.37	0.29	0.33	0.25	0.91	0.98	0.90	0.77	0.86	0.89
F-CFI	0.39	0.24	0.36	0.30	0.91	0.95	0.89	0.82	0.89	0.92
P-BCFI	0.35	0.29	0.35	0.34	0.90	0.98	0.89	0.76	0.85	0.88
F-BCFI	0.27	0.35	0.37	0.33	0.89	0.97	0.90	0.80	0.88	0.90
P-SCFI	0.38	0.25	0.36	0.33	0.90	0.96	0.89	0.78	0.87	0.90
F-SCFI	0.24	0.36	0.40	0.34	0.89	0.96	0.90	0.81	0.88	0.91
P-NSCFI	0.36	0.29	0.35	0.31	0.90	0.98	0.89	0.77	0.86	0.89
F-NSCFI	0.32	0.32	0.36	0.30	0.90	0.98	0.90	0.79	0.87	0.90

Figure 37 depicts the orientation of company E toward the different categories of basic, core, and spearhead technology and knowledge. It can be noticed that company E uses an average of 33.10% basic T&K, 33.21% core T&K, and 33.69% spearhead T&K. T&K categories are in equal proportions, showing that the company does not prioritize one T&K over the others. Hence, it is suggested that company E conduct further analysis to see if the allocation of such strategies affects the competitiveness of the attributes.

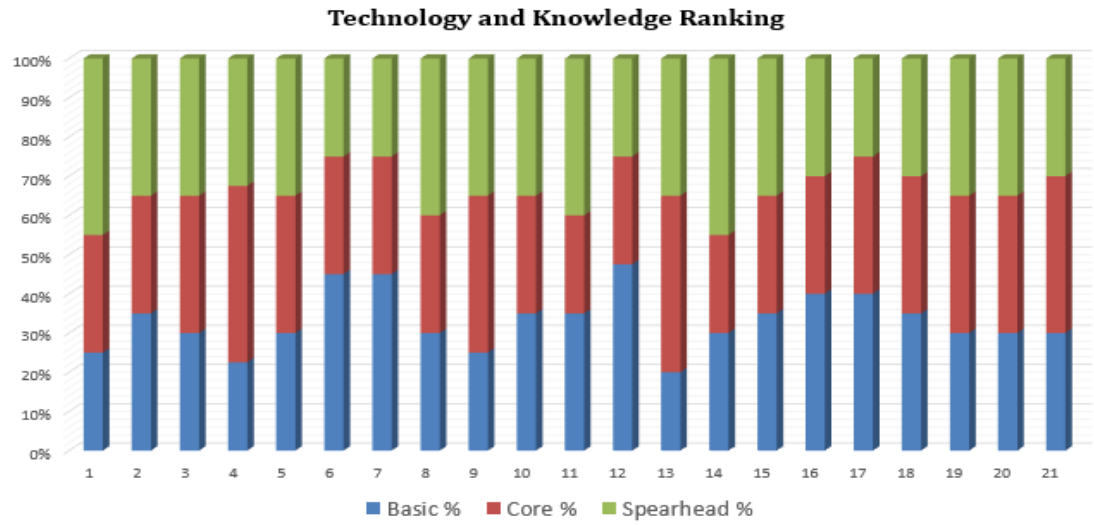


Figure 37. Ranking of Basic, Core, Spearhead Technology and Knowledge – Company E

The variance coefficient values for T&K are shown in Figure 38. In company E, the coefficients of variation for basic, core, and spearhead T&K are 0.29, 0.22, 0.54, respectively. This indicates that respondents' perspectives on spearhead T&K differ significantly, resulting in the greatest cause of uncertainty in establishing T&K inside the company.

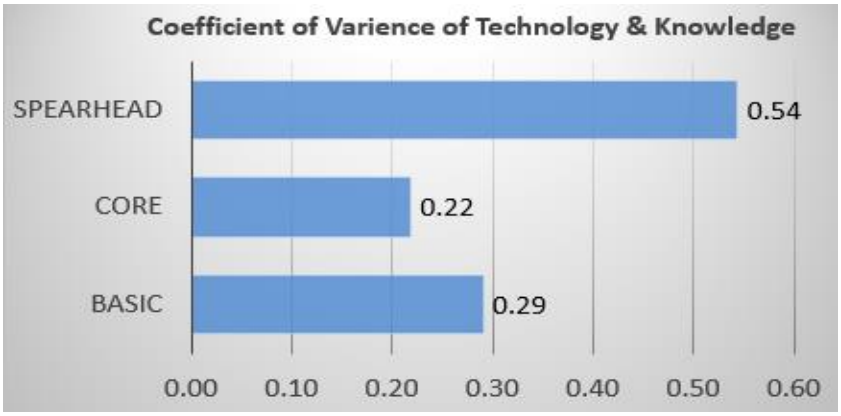


Figure 38. Coefficient of variance of T&K – Company E

Figure 39 depicts the total and individual T&K risk levels for basic, core, and spearhead T&K. As can be seen in Figure 39, T&K risks for basic, core, and spearhead are calculated to be 1.397, 1.13, and 3.83, respectively. This means that spearhead T&K has the highest risks, while core T&K has the lowest. These findings are consistent with the findings shown in MSI triangles (see Figure 36), namely that company E's operations strategy has been and will continue to be analyzer. As stated, an analyzer may take a higher risk in spearhead T&K because an analyzer studies the market and follows innovations and new developments but does not accept the risk of being innovative. However, company E thought that the findings about T&K risks seem not to match their real situation.

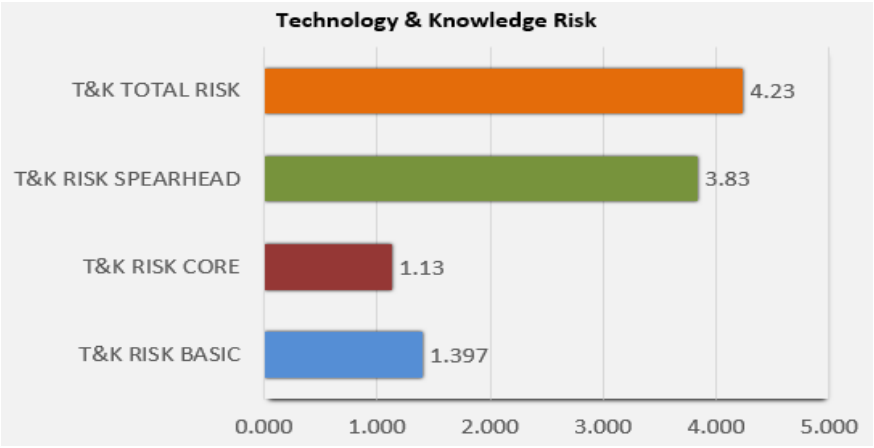


Figure 39. Technology & Knowledge risk – Company E

4.6 Company F

This is a medium-sized company with nearly 100 employees and was established in 2013. The main business of this company is exporting and importing drugs, wholesaling and retailing drugs, medical equipment, perfumes, cosmetics, and hygiene products.

In accordance with the results of the MSI questionnaire (see Table 23), which assesses the relative importance of cost, quality, time, and flexibility, it is clear that in terms of past experience, quality was the most important factor for company F. Time carries a weight of 18.3%, putting it as the second most important factor after quality, which carries a weight of 58.1%. The average weight assigned to cost is 16.4%, while the minimum weight assigned to flexibility is 7.2%. This indicates that there is a significant difference between quality and flexibility.

In terms of future expectations, it is obvious that quality remains the most important factor, although there is a small decline that creates a value of 56%. By contrast, cost weight will increase in the future and stand at a percentage of 26%. It means that company F may expect to reduce costs to enhance its position in the hierarchy of these four criteria. Time, on the other hand, falls to the third most major element in the upcoming years and gets an average weight of 12.4%. As demonstrated in Table 23, the order of importance for future expectations differs from the order of importance for previous experience. However, according to the theoretical frame in Chapter 2, the acquired results are reliable and the comparisons are accurate because the consistency ratio is less than 10% in both calculations.

Table 23. AHP results from the MSI questionnaire – Company F

	Results using average numbers				
	Quality %	Cost %	Time %	Flexibility %	CR %
Experience in the past	58.1	16.4	18.3	7.2	2.5
Future expectations	56	26	12.4	5.7	4.8

Figure 40 illustrates the results of the CFI calculations. It can be noticed that the expectations that company F set for the attributes are higher than the experience in the past. In particular, the ratings of experience range from 5.5 to 7.5, while the ratings of expectations range from 7.0 to 8.5. The greatest gaps between future expectations and past

experience can be found in attribute 7 with a gap value of 2.5. This points out that lead-times in order-fulfilment process of company F seems not to be inefficient in the past; therefore, the company wishes to highly enhance it in the future. The smallest gap is found in attribute 14 with a gap value of 0.5, which indicates that responsibilities and tasks for each operation in the company are currently well defined.

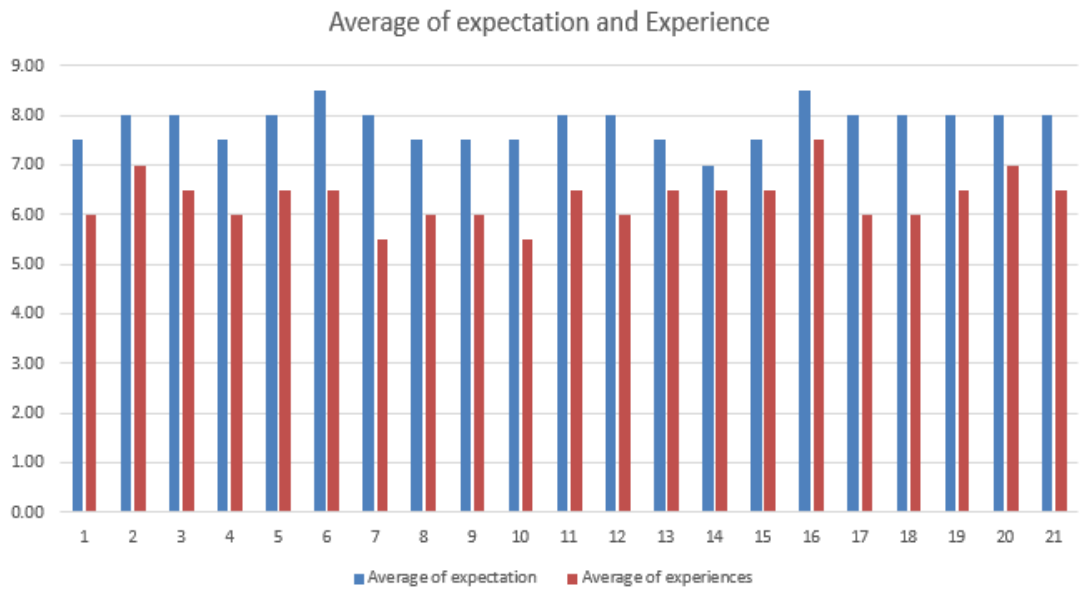


Figure 40. Average of Expectation vs Experience – Company F

Figure 41 demonstrates historical resource allocations. The BCFI model shows that six attributes are under-resourced, three attributes are over-resourced, and twelve attributes achieve balance. Specifically, the under-resourced attributes are attributes 3, 6, 9, 10, 19, and 21, while 1, 2, and 18 are the over-resourced attributes. The SCFI model, on the other hand, yields slightly worse results, as it produces one less balanced attribute than the number of such attributes produced by the BCFI model. According to the SCFI model, the over-resourced attributes are the same as those in the BCFI model, plus attribute 14. The NSCFI model provides much better results compared to the BCFI and SCFI models. Namely, there are only three under-resourced attributes, and three over-

resourced attributes found in the NSCFI model, while fifteen attributes are found to be in balance. Although the outcomes of these models differ, they all show that company F underestimated resource allocations for some attributes, for example, design and planning of the processes and products, while focused too much on innovativeness and performance of research and development.

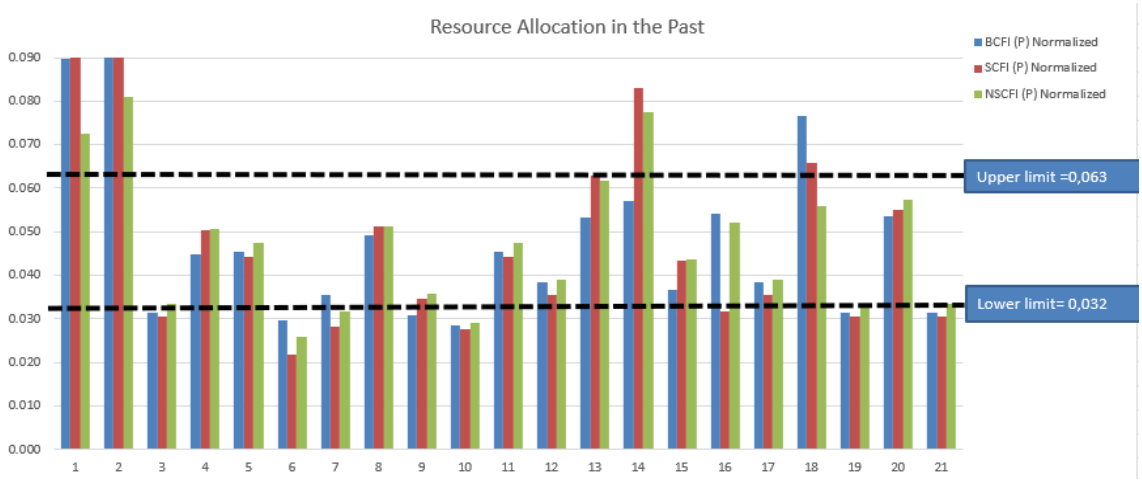


Figure 41. Resource allocation in the Past – Company F

Table 24 and Figure 42 compare the same attributes in the future. The BCFI model demonstrates obviously that company F's future resource allocations are substantially worse than in the past, as no attributes achieve balance. Accordingly, there are up to thirteen under-resourced attributes, and eight over-resourced attributes found in the future. The SCFI model not only illustrates the same decline in resource allocation efficiency as the BCFI model but also gives the exact same over-resourced attributes. Similarly, the SCFI model also provides the same under-resourced attributes as the BCFI model, however, attribute 14 shifts to be in balance. On the other hand, the NSCFI model shows significantly better results, where there are up to eighteen attributes found to be in balance. Accordingly, the under-resourced attribute that the NSCFI model depicts is attribute 5, while attributes 13 and 14 are over-resourced.

Table 24. The number of resource allocations in the Past and in the Future – Company F

	Under	Balance	Over
P-BCFI	6	12	3
F-BCFI	13	0	8
P-SCFI	6	11	4
F-SCFI	12	1	8
P-NSCFI	3	15	3
F-NSCFI	1	18	2

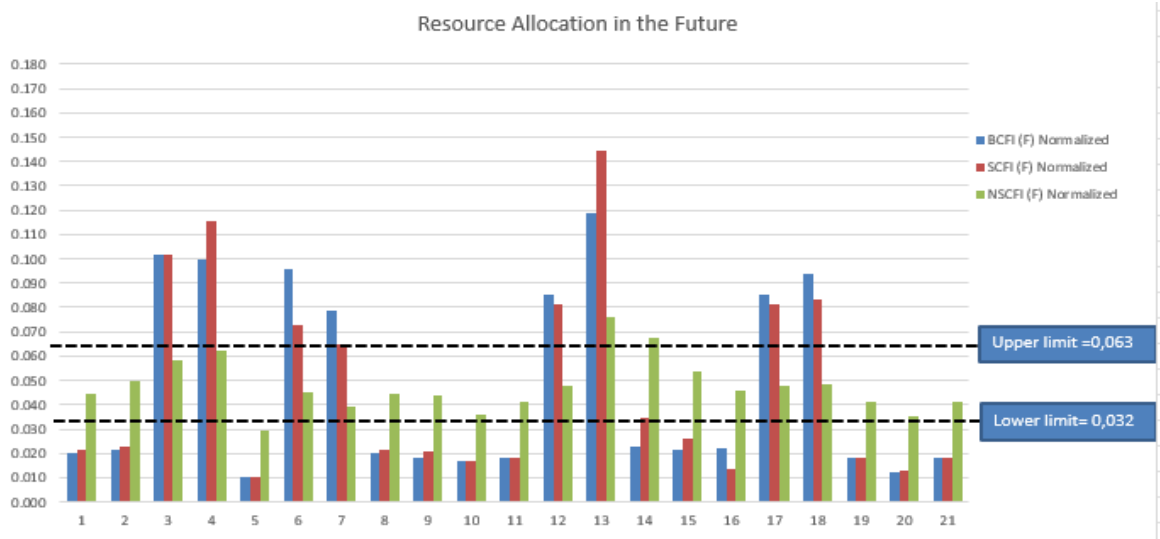
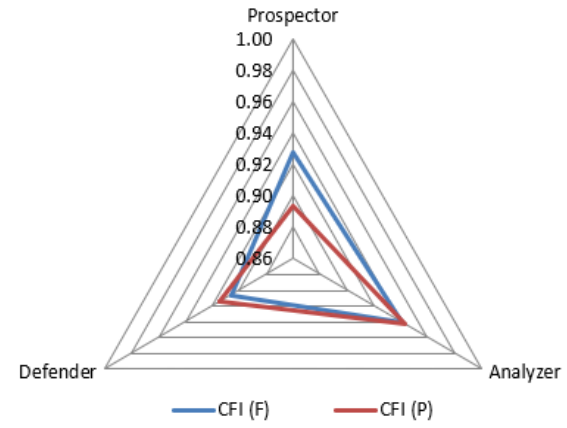


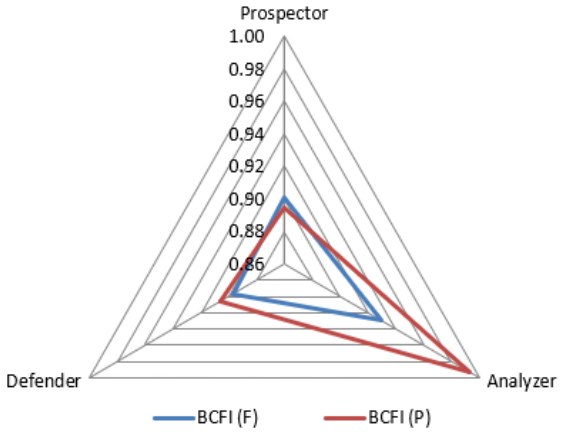
Figure 42. Resource allocation in the Future – Company F

Figure 43 illustrates the evolution and comparison of MSI competitiveness using the CFI, BCFI, SCFI, and NSCFI techniques. Figure 43 demonstrates that the MSI values for the analyzer are high both in the past (values ranging from 0.94 to 0.99) and in the future (values ranging from 0.93 to 0.98). This indicates that company F's business strategy in the past was analyzer, and that the business strategy in the future is also expected to be analyzer, but with a minor decrease. It is worth noting that the CFI model in this case company provides similar results as other models, indicating that company F's strategy is towards analyzer. When asked about the results, the respondents confirm that

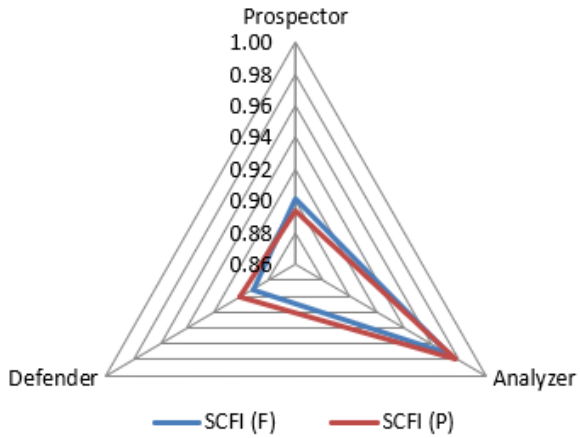
analyzer best reflects company F's operations strategy. As they say, their company tends to prioritize quality over other criteria; however, cost and time are also the company's key elements. As an illustration, the company has been keeping monitoring the market and follow market innovations and new developments for a long time.



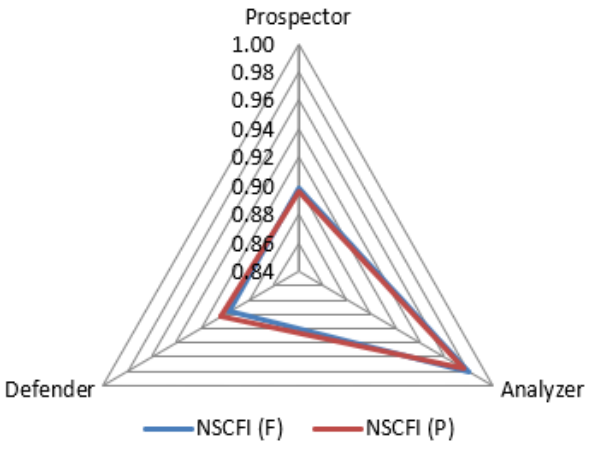
CFI	Prospector	Analyzer	Defender	Reactor
Past	0.89	0.94	0.91	0.90
Future	0.93	0.94	0.91	0.92



BCFI	Prospector	Analyzer	Defender	Reactor
Past	0.89	0.99	0.91	0.90
Future	0.90	0.93	0.90	0.90



SCFI	Prospector	Analyzer	Defender	Reactor
Past	0.89	0.98	0.90	0.90
Future	0.90	0.97	0.89	0.90



NSCFI	Prospector	Analyzer	Defender	Reactor
Past	0.90	0.98	0.90	0.90
Future	0.90	0.98	0.90	0.90

Figure 43. MSI competitiveness using CFI (top left), BCFI (top right), SCFI (bottom left) and NSCFI (bottom right) – Company F

Table 25 compares resource allocation trends using the BCFI, SCFI, and NSCFI models. The BCFI model predicts that four attributes will experience negative development in the future, while seventeen will experience reverse development. Because there is not an attribute following positive future development, this result represents an unhealthy situation for the company. The SCFI model also produces a downward trend, where five attributes are found to follow reverse development, fifteen attributes will get worse, and one attribute will follow positive future development. On the other hand, the NSCFI model predicts that only three attributes will change negatively in the future, up to twelve attributes will remain unchanged, five attributes will change positively, and even no attributes will reverse development. It is obvious that the BCFI and SCFI models produces the most negative result, indicating that company F is in a bad situation. Regardless, the real situation is influenced by respondents' optimism about their company's future. In contrast, the NSCFI model shows the most positive results.

Table 25. Comparisons of Past and Future BCFI, SCFI, and NSCFI – Company F

Attribute	BCFI(P)	BCFI(F)	Trend	SCFI(P)	SCFI(F)	Trend	NSCFI (P)	NSCFI (F)	Trend
1	Over	Under	180 degree reversed	Over	Under	180 degree reversed	Over	Balance	Better
2	Over	Under	180 degree reversed	Over	Under	180 degree reversed	Over	Balance	Better
3	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Balance	Balance	Same
4	Balance	Over	Worse	Balance	Over	Worse	Balance	Balance	Same
5	Balance	Under	Worse	Balance	Under	Worse	Balance	Under	Worse
6	Under	Over	180 degree reversed	Under	Over	180 degree reversed	Under	Balance	Better
7	Balance	Over	Worse	Under	Over	180 degree reversed	Under	Balance	Better
8	Balance	Under	Worse	Balance	Under	Worse	Balance	Balance	Same
9	Under	Under	Worse	Balance	Under	Worse	Balance	Balance	Same
19	Under	Under	Worse	Under	Under	Worse	Under	Balance	Better
11	Balance	Under	Worse	Balance	Under	Worse	Balance	Balance	Same
12	Balance	Over	Worse	Balance	Over	Worse	Balance	Balance	Same
13	Balance	Over	Worse	Balance	Over	Worse	Balance	Over	Worse
14	Balance	Under	Worse	Over	Balance	Better	Over	Over	Worse
15	Balance	Under	Worse	Balance	Under	Worse	Balance	Balance	Same
16	Balance	Under	Worse	Under	Under	Worse	Balance	Balance	Same
17	Balance	Over	Worse	Balance	Over	Worse	Balance	Balance	Same
18	Over	Over	Worse	Over	Over	Worse	Balance	Balance	Same
19	Under	Under	Worse	Under	Under	Worse	Balance	Balance	Same
20	Balance	Under	Worse	Balance	Under	Worse	Balance	Balance	Same
21	Under	Under	Worse	Under	Under	Worse	Balance	Balance	Same

The next step is to calculate SCA risk levels to examine whether or not company F's resource allocations support its operations strategy. According to Table 26, most the results obtained using the RMSE and MAD methods are higher than 0.9, whereas over half of the results obtained using the MAPE methods are lower than 0.9. What's more, the majority of SCA values derived from future outcomes are greater than those derived from past outcomes, as shown in Table 26. This demonstrates that the operations strategy of Company F will be given more priority in the future. These results indicate that company F's operations strategy was relatively sustainable in the past and will be more sustainable in the future. Nevertheless, company F says that the MAD method appears to be more suitable for identifying SCA risks because it produces the most optimistic results. The company also believes that the MAD results well match its situation. Regardless, development trends should be closely examined to determine whether the company's resource allocations in the operations strategy are sustainable.

Table 26. SCA result – Company F

	Normalized criteria weight				MSI values			Measures of SCA risk level		
	Q	C	T	F	Prospector	Analyzer	Defender	MAPE	RMSE	MAD
P-CFI	0.33	0.56	0.11	0.46	0.89	0.94	0.91	0.85	0.90	0.93
F-CFI	0.47	0.20	0.33	0.18	0.93	0.94	0.91	0.92	0.95	0.96
P-BCFI	0.29	0.41	0.30	0.31	0.89	0.99	0.91	0.79	0.87	0.90
F-BCFI	0.25	0.22	0.54	0.26	0.90	0.93	0.90	0.91	0.94	0.95
P-SCFI	0.32	0.40	0.28	0.34	0.89	0.98	0.90	0.80	0.88	0.90
F-SCFI	0.30	0.21	0.50	0.28	0.90	0.97	0.89	0.85	0.91	0.93
P-NSCFI	0.32	0.40	0.28	0.32	0.90	0.98	0.90	0.81	0.88	0.91
F-NSCFI	0.34	0.31	0.35	0.31	0.90	0.98	0.90	0.85	0.91	0.92

Figure 44 represents company F's orientation toward the various categories of basic, core, and spearhead technology and knowledge. Company D utilizes an average of 40.95% basic T&K, 40% core T&K, and 19.05% spearhead T&K. The results indicate that company F places the highest value on basic and core T&K and the lowest value on spearhead T&K. However, because it represents such a small proportion compared to that of spearhead T&K, the basic and core T&K applied to attribute 19 appear to be uncompetitive.

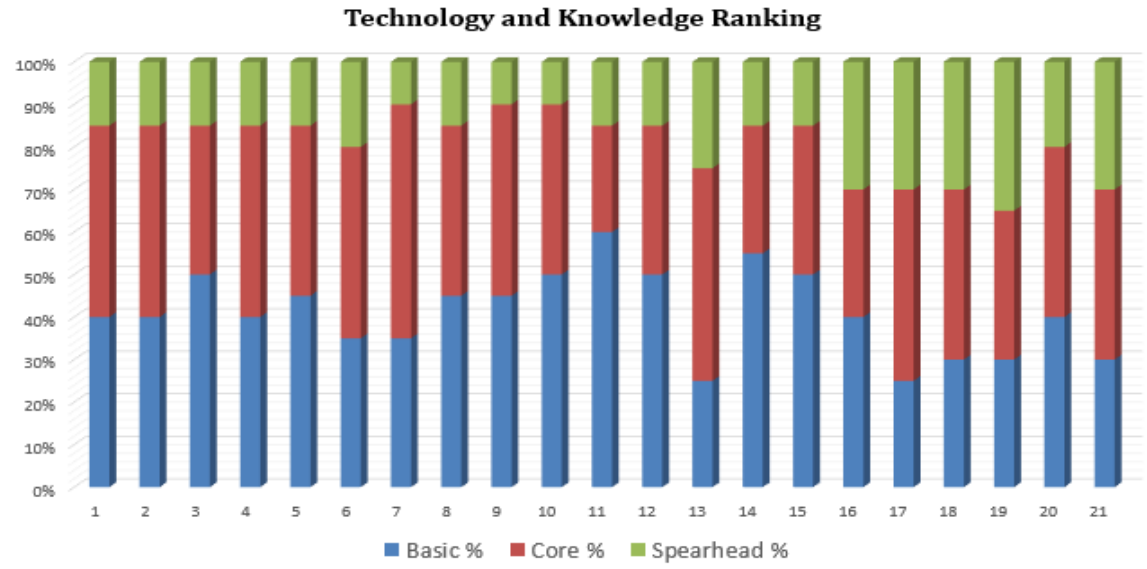


Figure 44. Ranking of Basic, Core, Spearhead Technology and Knowledge – Company F

The variance coefficient values for T&K are shown in Figure 45. In company F, the coefficients of variation for basic, core, and spearhead T&K are 0.33, 0.36, and 0.51, respectively. This indicates that respondents' perspectives on spearhead T&K differ significantly, resulting in the greatest cause of uncertainty in establishing T&K inside the company.

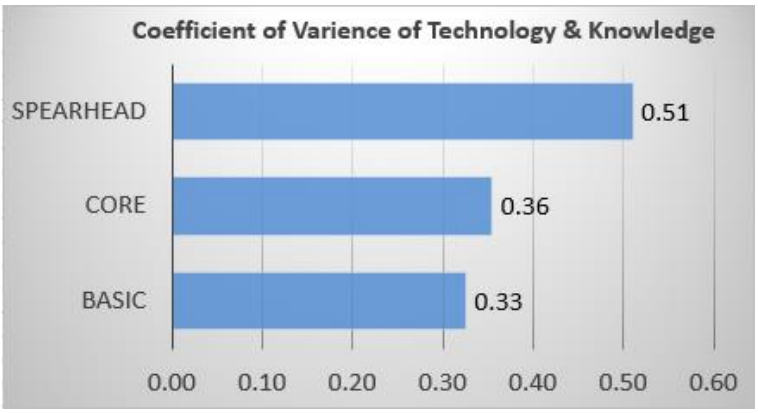


Figure 45. Coefficient of variance of T&K – Company F

Figure 46 represents the total and individual T&K risk levels for basic, core, and spearhead T&K. As can be seen in Figure 46, T&K risks for basic, core, and spearhead are calculated to be 2.39, 1.85, and 4.18, respectively. This means that spearhead T&K has the highest risks, while basic T&K has the lowest. These findings are consistent with the findings shown in MSI triangles (see Figure 43), namely that company F's operations strategy has been and will continue to be analyzer. Moreover, company F believed that the findings about T&K risks fit their real situation.

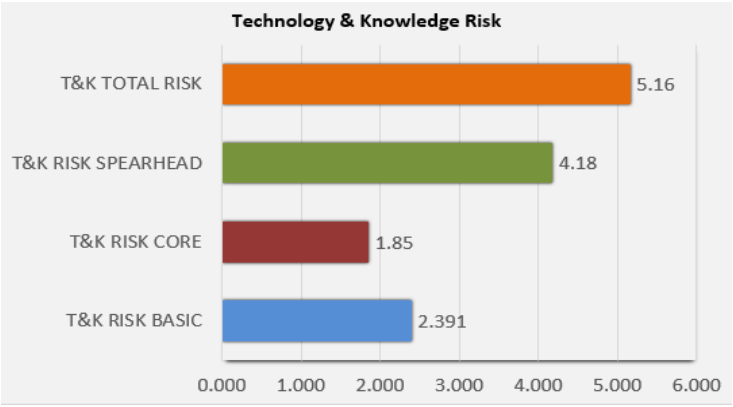


Figure 46. Technology & Knowledge risk – Company F

5 DISCUSSION AND CONCLUSIONS

The purpose of this study is to evaluate the sustainable competitive advantage of small and medium-sized pharmaceutical enterprises in Southern Vietnam in terms of their current orientation, the direction of development, and sustainability. This research primarily utilizes the Sense and Respond method, with the combination of a variety of tools and techniques, including the Analytic Hierarchy Process (AHP), Critical Factor Indexes (CFI), Manufacturing Strategy Index (MSI), and Sustainable Competitive Advantage (SCA), as well as the Technology & Knowledge Ranking and Risk Levels. To validate how closely the analyzed results correspond to the actual situations of the case companies, the second interview round was conducted. Then, the comparison was made to give answers to the set research questions.

According to the findings of the study, the current strategic orientation of all six companies falls under the category of Analyzer. When asked about this result, all the respondents from six companies also believe that the analyzer role best suits their company's strategy. As can be seen in Figure 47, despite the difference in the order of importance of quality, cost, time, and flexibility for the six companies on average, quality was found to be the most important factor in the past and will remain in place in the future. This result totally fits the nature of a pharmaceutical company, where the quality of products should always be a priority for the health of the consumers. Figure 47 also depicts that cost will take second place, while time will decline to become the third most important in the coming years. As stated by some of the respondents, under the impact of the Covid-19 pandemic, Vietnam's pharmaceutical industry faced certain difficulties when the supply chain broke, the price of raw materials and transportation increased, the change of habits, and the demand for drugs along with the government's regulations on disease prevention and control, has caused the pharmaceutical market to stagnate heavily, and income is not enough to cover costs. Therefore, the companies wish to reduce costs in an effort to restructure operations and supply chains. Regardless, the Covid-19 pandemic also highlights the critical importance of healthcare, creating numerous

opportunities to promote the growth of businesses in the pharmaceutical industry. As a result, the case companies wish to keep prioritizing quality, cost, and time in the upcoming years.

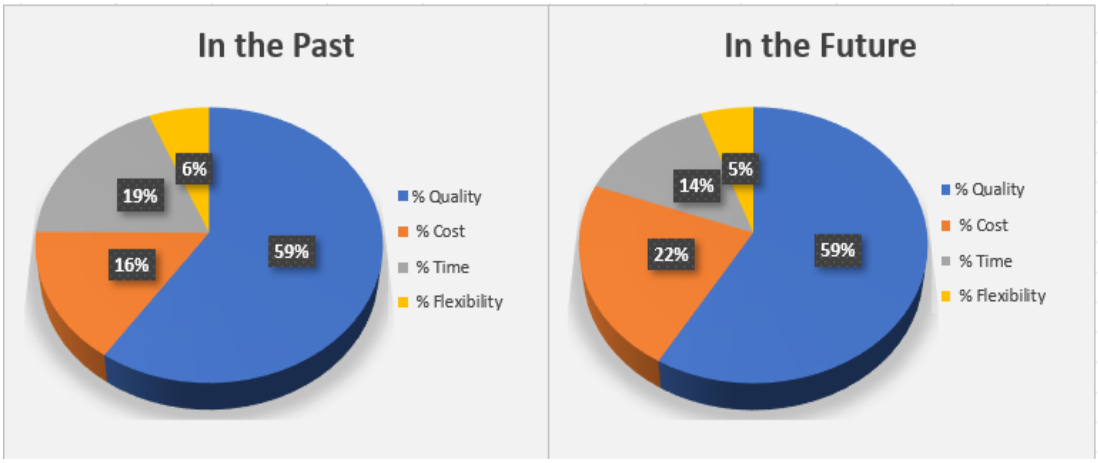


Figure 47. Percentage of Quality, Cost, Time, Flexibility for the 6 companies on average

In terms of the direction of development, all six companies believe that the NSCFI model, rather than the BCFI and SCFI models, better represents their company's actual situation as it offers the most optimistic trends. Regardless, companies A, C, D, and E claim that the trends should be better than those shown in the NSFI model, while companies B and F say that the trends perfectly fit their situations. In summary, based on the findings and feedback, the respondents are optimistic about the future, and the case companies' direction of development appears to be stable and is expected to remain the same, or even improve.

Regarding the sustainable competitive advantage, all six companies state that the MAD method and probably the RMSE method provide the best results for identifying SCA risks compared to the MAPE method. However, as Timilsina (2020) states, if the MAPE method shows an index under 0.9, it may indicate that there is a slight inconsistency existing between the resources. According to the results obtained, the strategy of

company E seemed not to be sustainable in the past but will be slightly sustainable in the future. For companies B, C, D, and F, the strategy was relatively sustainable in the past but will be more sustainable in the future. For company A, the strategy was significantly sustainable in the past but will be less sustainable in the future. When questioned about the results, companies B, C, D, E, and F believed that the results relatively fit their real situations, while company A emphasized that its strategy would be better in the future; therefore, the results for the future seem to be different from their thoughts.

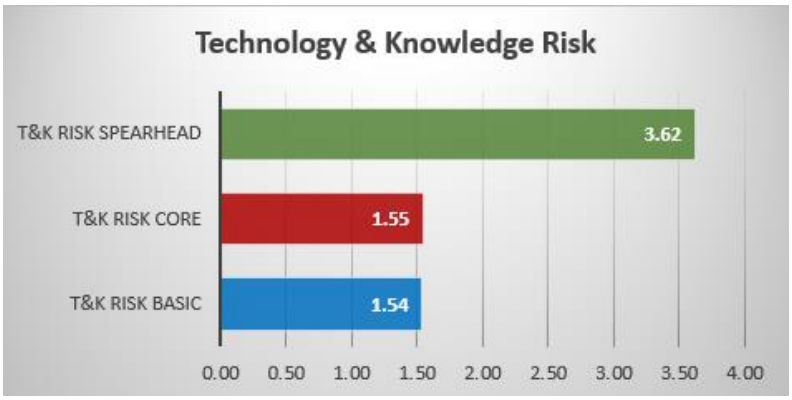


Figure 48. Technology & Knowledge Risk for the six companies on average

In accordance with technology & knowledge management, the case companies' division and risks of technology and knowledge used are classified into three categories based on the case companies' risk levels. As can be seen from Figure 48, based on average rates for six companies, basic technology, and core technology represent the least risk, while spearhead technology causes the most risk and uncertainty for the case companies. In particular, spearhead technology brings the most uncertainty for all six companies, core technology poses the least risk for companies C, E, and F, and basic technology causes the least risk for companies A, B, and D. Furthermore, the feedback from the case companies indicates that the results of technology and knowledge management highly fit the situation of company A, relatively fit the situation of companies B, C, D, F, and barely fit the situation of company E. However, it can be concluded that the order of technology

and knowledge risks appears to be normal and appropriate, because, as stated, companies considered to be an analyzer do not focus totally on spearhead technology.

Based on the CFIs chart of resource allocations in the past, especially where the results are indicated by the NSCFI model, over half of six companies underprioritized attribute 6 (Design and planning of the processes and products), attribute 10 (Control and optimization of all types of inventories), and attribute 19 (Availability of information in information systems), while two attributes are overprioritized, which are attribute 2 (Innovativeness and performance of research and development), and attribute 14 (Well defined responsibilities and tasks for each operation). Concerning the overprioritized and underprioritized attributes, the case companies should consider balancing the attributes based on their own perspectives, internal company strategies, and market requirements. In terms of technology and knowledge risk levels, the case companies should monitor the levels of risk associated with spearhead technology.

Because the data collection was based on the answers of only two respondents from each company, it is difficult to say whether the trustworthiness of the results is good or not. However, the positive aspect that can be noticed is that the correlation between the MSI (analyzer) and the CFIs (P) with the respondents' own thoughts was quite high. Regardless, the respondents seemed surprised at some unbalanced attributes shown in the analysis. Another point worth mentioning is that the definitions of technology and knowledge questions were quite complicated for the respondents to understand thoroughly, thus, may lead to uncertainty in the related results. Because the case companies wish to remain anonymous, it was difficult to provide a more detailed conclusion and analysis of the results.

To sum up, this research shows that studies on sustainable competitive advantage are essential for small and medium-sized pharmaceutical companies to some extent as they somewhat help the decision-makers to understand the business situation better as well as react more properly and more precisely in the turbulent business world.

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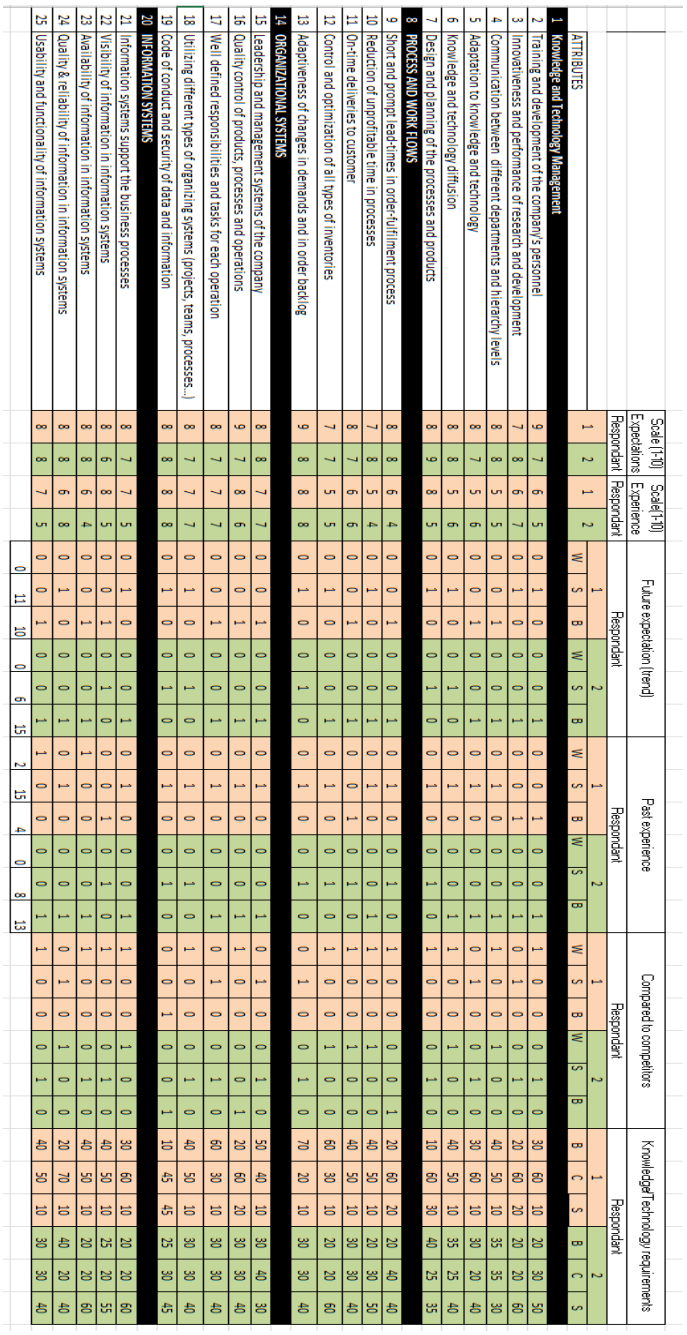
APPENDICES

Appendix 1. S&R-data – part 1.

Company A



	ATTRIBUTES	Scale (1-10) Expectations Respondent 1	Scale (1-10) Experience Respondent 2	Future expectation (trend) Respondent 1 W	S	B	Respondent 2 W	S	B	Past experience Respondent 1 W	S	B	Respondent 2 W	S	B	Compared to competitors Respondent 1 W	S	B	Respondent 2 W	S	B	Knowledge/Technology requirements Respondent 1 B	C	S	Respondent 2 B	C	S
1	**Knowledge and Technology Management**																										
2	Training and development of the company's personnel	9	7	6	5	0	1	0	0	0	0	1	0	0	1	0	0	0	1	0	0	30	60	10	20	30	50
3	Innovativeness and performance of research and development	7	8	6	7	0	1	0	0	0	0	1	0	0	1	0	0	0	1	0	0	20	60	20	20	20	60
4	Communication between, different departments and hierarchy levels	8	8	5	5	0	0	1	0	0	1	0	0	1	1	0	0	1	1	0	0	40	50	10	35	35	30
5	Adaptation to knowledge and technology	8	7	5	6	0	0	1	0	0	1	0	0	1	1	0	0	1	1	0	0	30	60	10	30	20	40
6	Knowledge and technology diffusion	8	8	5	6	0	1	0	0	0	0	1	0	0	1	0	0	1	1	0	0	40	50	10	35	25	40
7	Design and planning of the processes and products	8	9	8	5	0	1	0	0	0	0	1	0	0	1	0	0	1	1	0	0	10	60	30	40	25	35
8	**PROCESS AND WORK FLOWS**																										
9	Short and prompt lead-times in order-fulfilment process	8	8	6	4	0	0	1	0	0	1	0	0	1	0	0	0	0	1	0	0	20	60	20	20	40	40
10	Reduction of unprofitable time in processes	7	8	5	4	0	1	0	0	0	1	0	0	1	0	0	0	1	1	0	0	40	50	10	20	30	50
11	On-time deliveries to customer	8	7	6	6	0	0	1	0	0	1	0	0	1	1	0	0	1	1	0	0	40	50	10	30	30	40
12	Control and optimization of all types of inventories	7	7	5	5	0	1	0	0	0	1	0	0	1	0	0	0	1	1	0	0	60	30	10	20	20	60
13	Adaptiveness of changes in demands and in order backlog	9	8	8	5	0	1	0	0	0	1	0	0	1	0	0	0	1	1	0	0	70	20	10	30	30	40
14	**ORGANIZATIONAL SYSTEMS**																										
15	Leadership and management systems of the company	8	8	7	7	0	0	1	0	0	1	0	0	1	0	0	0	1	1	0	0	50	40	10	30	40	30
16	Quality control of products, processes and operations	9	7	8	6	0	0	1	0	0	1	0	0	1	1	0	0	1	1	0	0	20	60	20	30	30	40
17	Well defined responsibilities and tasks for each operation	8	7	7	7	0	0	1	0	0	1	0	0	1	1	0	0	1	1	0	0	60	30	10	30	30	40
18	Utilizing different types of organizing systems (projects, teams, processes...)	8	7	7	7	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	40	50	10	30	30	40
19	Code of conduct and security of data and information	8	8	8	8	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	10	45	25	30	45	45
20	**INFORMATION SYSTEMS**																										
21	Information systems support the business processes	8	7	7	5	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	30	60	10	20	20	60
22	Visibility of information in information systems	8	6	8	5	0	0	1	0	0	1	0	0	1	0	0	0	1	1	0	0	40	50	10	25	20	55
23	Availability of information in information systems	8	8	6	4	0	0	1	0	0	1	0	0	1	1	0	0	1	1	0	0	40	50	10	20	20	60
24	Quality & reliability of information in information systems	8	8	6	6	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	20	70	10	40	20	40
25	Usability and functionality of information systems	8	8	7	5	0	0	1	0	0	1	0	0	1	0	0	0	1	1	0	0	40	50	10	30	30	40
				0	11	10	0	6	15	2	15	4	0	8	13												

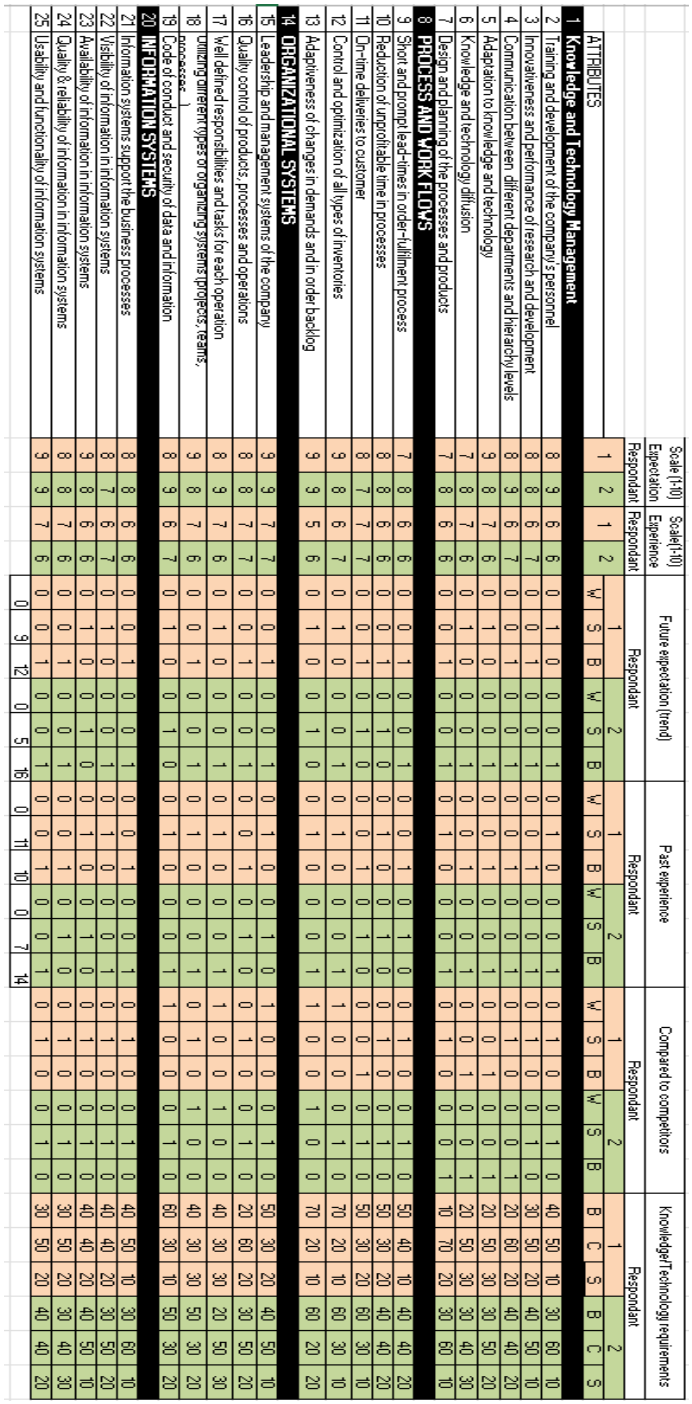
Appendix 2. S&R-data – part 2.

Company B

		Scale (1-10) Expectation		Scale(1-10) Experience		Future expectation (trend)						Past experience						Compared to competitors						Knowledge/Technology requirements					
		Respondant		Respondant		Respondant						Respondant						Respondant						Respondant					
		1	2	1	2	1			2			1			2			1			2			1			2		
	ATTRIBUTES					W	S	B	W	S	B	W	S	B	W	S	B	W	S	B	W	S	B	B	C	S	B	C	S
1	**Knowledge and Technology Management**																												
2	Training and development of the company's personnel	8	9	7	8	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	70	20	10	60	30	10
3	Innovativeness and performance of research and development	8	8	6	6	0	0	1	0	0	1	1	0	0	0	1	0	1	0	0	0	1	0	70	10	20	80	10	10
4	Communication between different departments and hierarchy levels	7	8	6	7	0	0	1	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	80	10	10	60	30	10
5	Adaptation to knowledge and technology	7	8	5	6	0	0	1	0	0	1	0	1	0	0	0	1	1	0	0	0	1	0	80	10	10	70	10	20
6	Knowledge and technology diffusion	8	9	6	7	0	0	1	0	0	1	0	1	0	0	0	1	0	1	0	0	1	0	60	20	20	50	30	20
7	Design and planning of the processes and products	9	9	8	7	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	40	50	10	40	40	20
8	**PROCESS AND WORK FLOWS**																												
9	Short and prompt lead-times in order-fulfilment process	9	8	7	8	0	0	1	0	1	0	0	0	1	0	1	0	0	1	0	0	1	0	50	20	30	60	30	10
10	Reduction of unprofitable time in processes	10	9	8	8	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	50	20	30	50	20	30
11	On-time deliveries to customer	9	10	8	7	0	0	1	0	0	1	0	0	1	0	1	0	0	1	0	0	0	1	50	30	20	40	40	20
12	Control and optimization of all types of inventories	8	8	8	7	0	1	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	1	40	50	10	40	50	10
13	Adaptiveness of changes in demands and in order backlog	9	8	7	6	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	50	25	25	40	30	30
14	**ORGANIZATIONAL SYSTEMS**																												
15	Leadership and management systems of the company	9	8	8	6	0	0	1	0	1	0	0	0	1	0	0	1	0	1	0	0	1	0	30	50	20	20	60	20
16	Quality control of products, processes and operations	9	8	8	7	0	0	1	0	0	1	0	0	1	0	0	1	0	1	0	0	1	0	30	50	20	30	40	30
17	Well defined responsibilities and tasks for each operation	8	8	8	7	0	1	0	0	0	1	0	1	0	0	0	1	0	0	1	0	1	0	30	60	10	20	50	30
18	Utilizing different types of organizing systems (projects, teams, processes...)	7	8	7	6	0	1	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	1	40	50	10	40	40	20
19	Code of conduct and security of data and information	10	9	8	8	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	0	0	1	20	30	50	30	30	40
20	**INFORMATION SYSTEMS**																												
21	Information systems support the business processes	9	10	7	7	0	0	1	0	0	1	0	1	0	0	1	0	1	0	0	1	0	0	50	10	40	50	20	30
22	Visibility of information in information systems	8	9	7	8	0	0	1	0	0	1	1	0	0	0	1	0	1	0	0	1	0	0	70	10	20	60	20	20
23	Availability of information in information systems	9	9	7	8	0	0	1	0	0	1	1	0	0	1	0	0	1	0	0	0	1	0	60	10	30	60	10	30
24	Quality & reliability of information in information systems	8	9	7	8	0	0	1	0	0	1	0	1	0	0	1	0	0	0	1	0	1	0	50	30	20	50	20	30
25	Usability and functionality of information systems	9	9	8	7	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	50	25	25	60	20	20
						0	3	18	0	4	17	3	12	6	1	14	6												

Appendix 3. S&R-data – part 3.

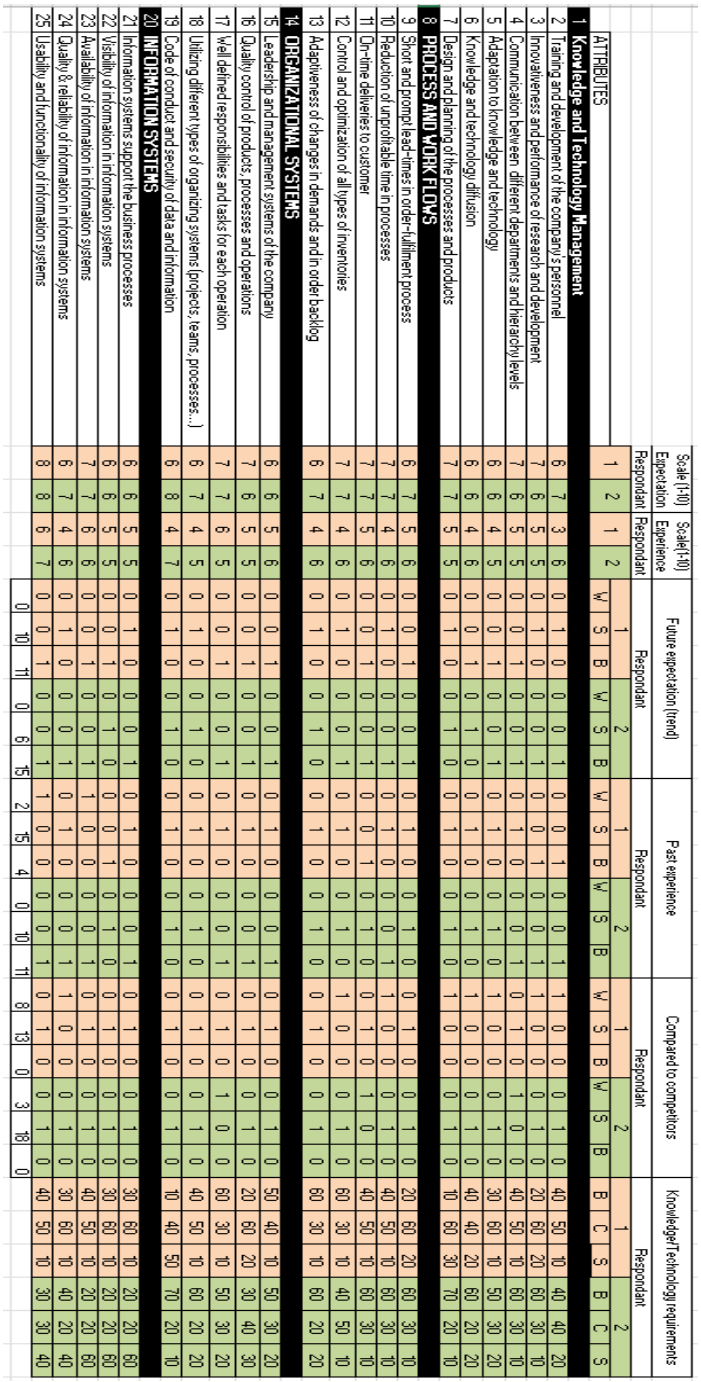
Company C



	ATTRIBUTES	Scale (1-10) Expectation Respondant 1	2	Scale (1-10) Experience Respondant 1	2	Future expectation (trend) Respondant 1 W	S	B	2 W	S	B	Past experience Respondant 1 W	S	B	2 W	S	B	Compared to competitors Respondant 1 W	S	B	2 W	S	B	Knowledge/Technology requirements Respondant 1 B	C	S	2 B	C	S
1	**Knowledge and Technology Management**																												
2	Training and development of the company's personnel	8	9	6	6	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	40	50	10	30	60	10
3	Innovativeness and performance of research and development	8	8	6	7	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	30	50	20	40	50	10
4	Communication between different departments and hierarchy levels	8	9	6	7	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	20	60	20	40	40	20
5	Adaptation to knowledge and technology	9	8	7	6	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	20	50	30	30	50	20
6	Knowledge and technology diffusion	7	8	7	6	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	20	50	30	30	40	30
7	Design and planning of the processes and products	7	8	6	6	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	10	70	20	30	60	10
8	**PROCESS AND WORK FLOWS**																												
9	Short and prompt lead-times in order-fulfilment process	7	8	6	6	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	50	40	10	40	40	20
10	Reduction of unprofitable time in processes	8	8	6	6	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	50	30	20	40	40	20
11	On-time deliveries to customer	8	7	7	7	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	50	30	20	60	30	10
12	Control and optimization of all types of inventories	9	8	6	7	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	70	20	10	60	30	10
13	Adaptiveness of changes in demands and in order backlog	9	9	5	6	0	1	0	0	1	0	0	1	0	0	1	0	1	0	0	1	0	0	70	20	10	60	20	20
14	**ORGANIZATIONAL SYSTEMS**																												
15	Leadership and management systems of the company	9	9	7	7	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	50	30	20	40	50	10
16	Quality control of products, processes and operations	8	8	7	7	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	20	60	20	30	50	20
17	Well defined responsibilities and tasks for each operation	8	9	7	6	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	40	30	30	20	50	30
18	Utilizing different types of organizing systems (projects, teams, processes...)	9	8	7	6	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	40	30	30	50	30	20
19	Code of conduct and security of data and information	8	9	6	7	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	60	30	10	50	30	20
20	**INFORMATION SYSTEMS**																												
21	Information systems support the business processes	8	8	6	6	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	40	50	10	30	60	10
22	Visibility of information in information systems	8	7	6	7	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	40	40	20	30	50	20
23	Availability of information in information systems	9	8	6	6	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	40	40	20	40	50	10
24	Quality & reliability of information in information systems	8	8	7	6	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	30	50	20	30	40	30
25	Usability and functionality of information systems	9	9	7	6	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	30	50	20	40	40	20
						0	9	12	0	5	16	0	11	10	0	7	14												

Appendix 4. S&R-data – part 4.

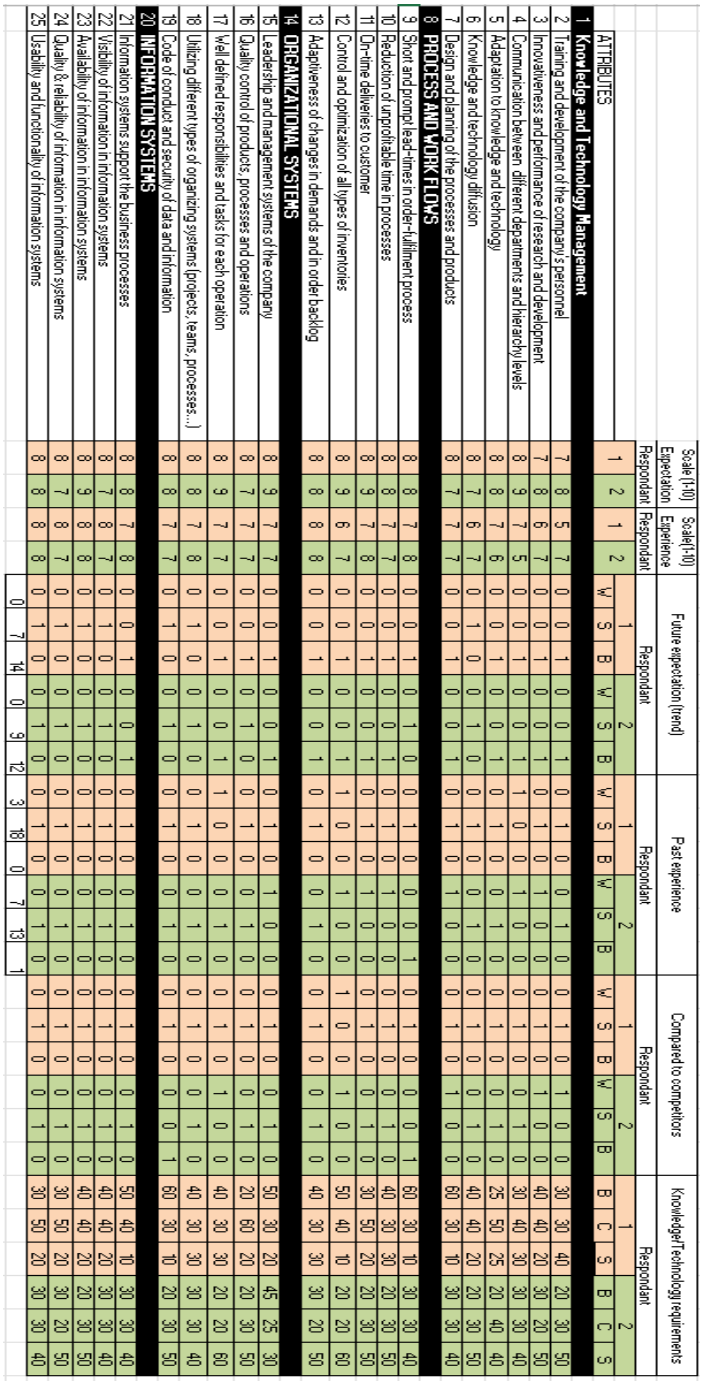
Company D



	ATTRIBUTES	Scale(1-10) Expectation Respondant 1	Scale(1-10) Expectation Respondant 2	Scale(1-10) Experience Respondant 1	Scale(1-10) Experience Respondant 2	Future expectation (trend) Respondant 1			Future expectation (trend) Respondant 2			Past experience Respondant 1			Past experience Respondant 2			Compared to competitors Respondant 1			Compared to competitors Respondant 2			Knowledge#Technology requirements Respondant 1			Knowledge#Technology requirements Respondant 2		
						W	S	B	W	S	B	W	S	B	W	S	B	W	S	B	W	S	B	B	C	S	B	C	S
1	**Knowledge and Technology Management**																												
2	Training and development of the company's personnel	6	7	3	6	0	1	0	0	1	0	0	1	0	0	1	0	0	0	1	0	0	1	40	50	10	40	40	20
3	Innovativeness and performance of research and development	7	6	5	5	0	1	0	0	1	0	0	1	0	0	1	0	0	0	1	0	0	1	20	60	20	60	30	10
4	Communication between different departments and hierarchy levels	7	6	5	5	0	0	1	0	0	1	0	0	1	0	0	1	0	1	0	0	0	1	40	50	10	60	30	10
5	Adaptation to knowledge and technology	6	6	4	5	0	0	1	0	0	1	0	1	0	0	1	0	0	0	1	0	0	1	30	60	10	50	30	20
6	Knowledge and technology diffusion	6	6	4	6	0	0	1	0	1	0	0	1	0	0	1	0	0	0	1	0	0	1	40	40	20	60	20	20
7	Design and planning of the processes and products	7	7	5	6	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	0	1	10	60	30	70	20	10
8	**PROCESS AND WORK FLOWS**																												
9	Short and prompt lead-times in order-fulfilment process	6	7	5	6	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	0	1	20	60	20	60	30	10
10	Reduction of unprofitable time in processes	7	7	4	6	0	1	0	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	40	50	10	60	30	10
11	On-time deliveries to customer	7	7	5	6	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	40	50	10	60	30	10
12	Control and optimization of all types of inventories	7	7	4	6	0	1	0	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	60	30	10	40	50	10
13	Adaptiveness of changes in demands and in order backlog	6	7	4	6	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	60	30	10	60	20	20
14	**ORGANIZATIONAL SYSTEMS**																												
15	Leadership and management systems of the company	6	6	5	6	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	50	40	10	50	30	20
16	Quality control of products, processes and operations	7	6	5	5	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	20	60	20	30	40	30
17	Well defined responsibilities and tasks for each operation	7	7	6	5	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	60	30	10	50	30	20
18	Utilizing different types of organizing systems (projects, teams, processes...)	6	7	4	5	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	40	50	10	60	20	20
19	Code of conduct and security of data and information	6	8	4	7	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	10	40	50	70	20	10
20	**INFORMATION SYSTEMS**																												
21	Information systems support the business processes	6	6	5	5	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	30	60	10	20	20	60
22	Visibility of information in information systems	6	6	5	5	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	30	60	10	20	20	60
23	Availability of information in information systems	7	7	6	6	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	40	50	10	20	20	60
24	Quality & reliability of information in information systems	6	7	4	6	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	30	60	10	40	20	40
25	Usability and functionality of information systems	8	8	6	7	0	0	1	0	0	1	1	0	0	1	0	0	1	0	0	1	0	0	40	50	10	30	30	40
		0	10	11	0	6	15	2	15	4	0	10	11	8	13	0	3	18	0										

Appendix 5. S&R-data – part 5.

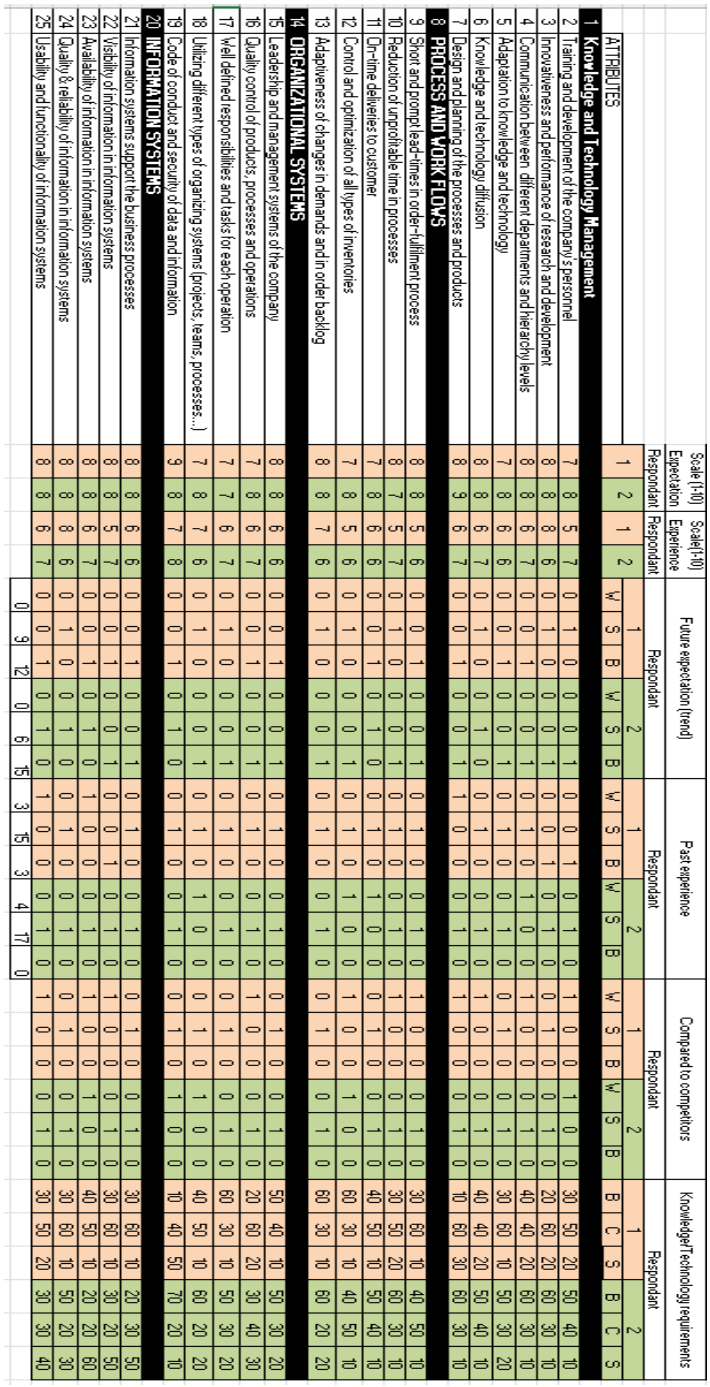
Company E



		Scale(1-10) Expectation	Scale(1-10) Experience	Future expectation (trend)								Past experience								Compared to competitors								Knowledge/Technology requirements							
		Respondant	Respondant	Respondant								Respondant								Respondant								Respondant							
	ATTRIBUTES	1	2	1				2				1				2				1				2				1				2			
					W	S	B	W	S	B		W	S	B		W	S	B		W	S	B		W	S	B		B	C	S		B	C	S	
1	**Knowledge and Technology Management**	7	8	5	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		30	30	40		20	30	50	
2	Training and development of the company's personnel	7	8	6	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		30	30	40		20	30	50	
3	Innovativeness and performance of research and development	7	8	6	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		40	40	20		30	20	50	
4	Communication between different departments and hierarchy levels	8	9	7	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		30	40	30		30	30	40	
5	Adaptation to knowledge and technology	8	8	7	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		25	50	25		20	40	40	
6	Knowledge and technology diffusion	8	7	6	0	1	0	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		40	40	20		20	30	50	
7	Design and planning of the processes and products	8	7	7	0	1	0	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		60	30	10		30	30	40	
8	**PROCESS AND WORK FLOWS**	8	8	7	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		60	30	10		30	30	40	
9	Short and prompt lead-times in order-fulfilment process	8	8	7	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		40	30	30		20	30	50	
10	Reduction of unprofitable time in processes	8	8	7	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		40	30	30		20	30	50	
11	On-time deliveries to customer	8	9	7	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		30	50	20		20	30	50	
12	Control and optimization of all types of inventories	8	9	6	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		50	40	10		20	20	60	
13	Adaptiveness of changes in demands and in order backlog	8	8	8	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		40	30	30		20	30	50	
14	**ORGANIZATIONAL SYSTEMS**	8	9	7	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		50	30	20		45	25	30	
15	Leadership and management systems of the company	8	7	7	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		20	60	20		20	30	50	
16	Quality control of products, processes and operations	8	7	7	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		20	60	20		20	30	50	
17	Well defined responsibilities and tasks for each operation	8	9	7	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		40	30	30		20	20	60	
18	Utilizing different types of organizing systems (projects, teams, processes...)	8	8	7	0	1	0	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		40	30	30		30	30	40	
19	Code of conduct and security of data and information	8	8	7	0	1	0	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		60	30	10		20	30	50	
20	**INFORMATION SYSTEMS**	8	8	7	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		50	40	10		30	30	40	
21	Information systems support the business processes	8	7	8	0	0	1	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		40	40	20		30	30	40	
22	Visibility of information in information systems	8	8	7	0	1	0	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		40	40	20		30	30	40	
23	Availability of information in information systems	8	8	8	0	1	0	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		40	40	20		20	30	50	
24	Quality & reliability of information in information systems	8	7	8	0	1	0	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		30	50	20		30	20	50	
25	Usability and functionality of information systems	8	8	8	0	1	0	0	1	0		0	1	0		0	1	0		0	1	0		0	1	0		30	50	20		30	30	40	
		0	7	14	0	1	0	0	1	0		3	12	9		0	7	13		0	7	18		0	7	14									

Appendix 6. S&R-data – part 6.

Company F



		Scale(1-10) Expectation	Scale(1-10) Experience	Future expectation (trend)						Past experience						Compared to competitors						Knowledge/Technology requirements					
		Respondant	Respondant	1			2			1			2			1			2			1			2		
	ATTRIBUTES	1	2	1	2	w	S	B	w	S	B	w	S	B	w	S	B	w	S	B	B	C	S	B	C	S
1	**Knowledge and Technology Management**																										
2	Training and development of the company's personnel	7	8	5	7	0	1	0	0	0	1	0	0	1	0	1	0	0	0	1	0	30	50	20	50	40	10
3	Innovativeness and performance of research and development	8	8	8	6	0	1	0	0	0	1	0	0	1	0	1	0	0	0	1	0	20	60	20	60	30	10
4	Communication between different departments and hierarchy levels	8	8	6	7	0	1	0	0	0	1	0	1	0	1	0	0	1	0	1	0	40	40	20	60	30	10
5	Adaptation to knowledge and technology	7	8	6	6	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	30	60	10	50	30	20
6	Knowledge and technology diffusion	8	8	6	6	0	1	0	0	0	1	0	1	0	0	1	0	0	1	0	0	40	40	20	50	40	10
7	Design and planning of the processes and products	8	9	6	7	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	10	60	30	60	30	10
8	**PROCESS AND WORK FLOWS**																										
9	Short and prompt lead-times in order-fulfilment process	8	8	5	6	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	30	60	10	40	50	10
10	Reduction of unprofitable time in processes	8	7	5	7	0	1	0	0	0	1	0	1	0	0	1	0	0	1	0	0	30	50	20	60	30	10
11	On-time deliveries to customer	7	8	6	6	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	40	50	10	50	40	10
12	Control and optimization of all types of inventories	7	8	5	6	0	1	0	0	0	1	0	1	0	0	1	0	0	1	0	0	60	30	10	40	50	10
13	Adaptiveness of changes in demands and in order backlog	8	8	7	6	0	1	0	0	0	1	0	1	0	0	1	0	0	1	0	0	60	30	10	60	20	20
14	**ORGANIZATIONAL SYSTEMS**																										
15	Leadership and management systems of the company	8	8	6	6	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	50	40	10	50	30	20
16	Quality control of products, processes and operations	7	8	6	7	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	20	60	20	30	40	30
17	Well defined responsibilities and tasks for each operation	7	7	6	7	0	1	0	0	0	1	0	1	0	0	1	0	0	1	0	0	60	30	10	50	30	20
18	Utilizing different types of organizing systems (projects, teams, processes...)	7	8	7	6	0	1	0	0	0	1	0	1	0	0	1	0	0	1	0	0	40	50	10	60	20	20
19	Code of conduct and security of data and information	9	8	7	8	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	10	40	50	70	20	10
20	**INFORMATION SYSTEMS**																										
21	Information systems support the business processes	8	8	6	6	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	30	60	10	20	30	50
22	Visibility of information in information systems	8	8	5	7	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	30	60	10	30	20	50
23	Availability of information in information systems	8	8	6	7	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	40	50	10	20	20	60
24	Quality & reliability of information in information systems	8	8	6	6	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	30	60	10	50	20	30
25	Usability and functionality of information systems	8	8	6	7	0	0	1	0	0	1	0	1	0	0	1	0	0	1	0	0	30	50	20	30	30	40
				0	9	12	0	6	15	3	15	3	4	17	0												

Appendix 7. MSI Questionnaires – part 1.

Company A

Respondent 1

Bảng 1. So sánh từng cặp bốn tiêu chí chính dựa trên kinh nghiệm **2-3 năm trong quá khứ**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	**5**	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	**3**	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	2	1	**2**	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	**4**	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	**6**	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	**4**	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Bảng 2. So sánh từng cặp bốn tiêu chí chính dựa trên kỳ vọng **2-3 năm trong tương lai**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	**4**	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	**2**	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	**4**	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	**6**	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	**7**	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	**4**	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Respondent 2

Bảng 1. So sánh từng cặp bốn tiêu chí chính dựa trên kinh nghiệm **2-3 năm trong quá khứ**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	**6**	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	**6**	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	**2**	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	**2**	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	**7**	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	**7**	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Bảng 2. So sánh từng cặp bốn tiêu chí chính dựa trên kỳ vọng **2-3 năm trong tương lai**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	**5**	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	**4**	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	**2**	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	**7**	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	**7**	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Appendix 8. MSI Questionnaires – part 2.

Company B

Respondent 1

Bảng 1. So sánh từng cặp bốn tiêu chí chính dựa trên kinh nghiệm **2-3 năm trong quá khứ**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Bảng 2. So sánh từng cặp bốn tiêu chí chính dựa trên kỳ vọng **2-3 năm trong tương lai**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Respondent 2

Bảng 1. So sánh từng cặp bốn tiêu chí chính dựa trên kinh nghiệm **2-3 năm trong quá khứ**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Bảng 2. So sánh từng cặp bốn tiêu chí chính dựa trên kỳ vọng **2-3 năm trong tương lai**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Appendix 9. MSI Questionnaires – part 3.

Company C

Respondent 1

Bảng 1. So sánh từng cặp bốn tiêu chí chính dựa trên kinh nghiệm **2-3 năm trong quá khứ**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Bảng 2. So sánh từng cặp bốn tiêu chí chính dựa trên kỳ vọng **2-3 năm trong tương lai**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Respondent 2

Bảng 1. So sánh từng cặp bốn tiêu chí chính dựa trên kinh nghiệm **2-3 năm trong quá khứ**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Bảng 2. So sánh từng cặp bốn tiêu chí chính dựa trên kỳ vọng **2-3 năm trong tương lai**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Appendix 10. MSI Questionnaires – part 4.

Company D

Respondent 1

Bảng 1. So sánh từng cặp bốn tiêu chí chính dựa trên kinh nghiệm **2-3 năm trong quá khứ**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	**5**	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	**4**	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	**6**	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	**8**	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	**5**	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Bảng 2. So sánh từng cặp bốn tiêu chí chính dựa trên kỳ vọng **2-3 năm trong tương lai**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	**5**	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	**6**	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	**6**	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	**9**	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Respondent 2

Bảng 1. So sánh từng cặp bốn tiêu chí chính dựa trên kinh nghiệm **2-3 năm trong quá khứ**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	**4**	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	**7**	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	**7**	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	**9**	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Bảng 2. So sánh từng cặp bốn tiêu chí chính dựa trên kỳ vọng **2-3 năm trong tương lai**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	**3**	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	**4**	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	**7**	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	**6**	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	**9**	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	**4**	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Appendix 11. MSI Questionnaires – part 5.

Company E

Respondent 1

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Bảng 2. So sánh từng cặp bốn tiêu chí chính dựa trên kỳ vọng **2-3 năm trong tương lai**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Respondent 2

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Bảng 2. So sánh từng cặp bốn tiêu chí chính dựa trên kỳ vọng **2-3 năm trong tương lai**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Appendix 12. MSI Questionnaires – part 6.

Company F

Respondent 1

Bảng 1. So sánh từng cặp bốn tiêu chí chính dựa trên kinh nghiệm **2-3 năm trong quá khứ**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	**4**	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	**2**	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	**4**	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	**6**	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	**2**	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Bảng 2. So sánh từng cặp bốn tiêu chí chính dựa trên kỳ vọng **2-3 năm trong tương lai**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	**3**	4	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	**5**	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	**7**	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	3	**2**	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Respondent 2

Bảng 1. So sánh từng cặp bốn tiêu chí chính dựa trên kinh nghiệm **2-3 năm trong quá khứ**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	4	5	**6**	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	3	2	1	**2**	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	5	4	3	**2**	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	8	7	**6**	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	**4**	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt

Bảng 2. So sánh từng cặp bốn tiêu chí chính dựa trên kỳ vọng **2-3 năm trong tương lai**

Tiêu chí chính	So sánh theo cặp tiêu chí																	Tiêu chí chính
Chi phí	9	8	7	6	5	4	3	2	1	2	3	**4**	5	6	7	8	9	Chất lượng
Chi phí	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Thời gian
Chi phí	9	8	7	6	**5**	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Chất lượng	9	8	7	6	5	**4**	3	2	1	2	3	4	5	6	7	8	9	Thời gian
Chất lượng	9	**8**	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt
Thời gian	9	8	7	6	5	4	**3**	2	1	2	3	4	5	6	7	8	9	Tính linh hoạt