

**UNIVERSITY OF VAASA  
FACULTY OF TECHNOLOGY  
INDUSTRIAL MANAGEMENT**

**Oba Oriekwo**

**COMPARING THE SURVIVAL OF NIGERIAN SOLAR ENERGY AND FINNISH  
MANUFACTURING COMPANIES IN TURBULENT BUSINESS  
ENVIRONMENTS**

Master's thesis in  
Science of Economics and Business Administration

Industrial Management

**VAASA 2014**

## TABLE OF CONTENTS

LIST OF FIGURES .....	5
LIST OF TABLES .....	6
SYMBOLS AND TERMS .....	8
ABSTRACT .....	9
ACKNOWLEDGEMENT .....	10
1. INTRODUCTION .....	11
1.1. Scope of the thesis .....	13
1.2. Structure of the thesis .....	13
1.3. Aims of the thesis .....	14
2. LITERATURE REVIEW .....	15
2.1. Economic crisis in Finland .....	16
2.2. How Finnish manufacturing companies survive in dynamic and turbulent business environments .....	18
2.3. Adaptation strategy of Finnish manufacturing companies in dynamic and turbulent business environments .....	21
2.4. Solar energy in Nigeria.....	24
2.5. Economic crisis in Nigeria .....	29
2.6. Challenges facing solar energy companies in Nigeria.....	30
2.7. How solar energy companies in Nigeria survive in dynamic and turbulent business environments .....	33
2.8. Comparison of how companies in Finland and Nigeria survive in dynamic and turbulent business environments .....	36
2.9. Outsourcing .....	36

3. RESEARCH METHODOLOGIES .....	40
3.1. Sense and respond methodology .....	40
3.2. Analytical Hierarchy Process (AHP).....	44
3.3. Decision making elements.....	49
4. CASE COMPANIES .....	51
4.1. Data collection.....	55
4.2. Sense and respond questionnaire.....	55
4.3. MSI questionnaire .....	56
4.4. Case study.....	58
5. RESULT AND ANALYSIS.....	59
5.1. Decision making elements for outsourcing production in Finnish manufacturing companies .....	91
5.2. Evaluation elements for choosing subcontractor suppliers in Finnish manufacturing companies .....	92
5.3. Decision making elements for outsourcing production in Nigerian Solar energy companies .....	94
5.4. Evaluation elements for choosing subcontractor suppliers in Nigerian Solar companies .....	95
6. FINDINGS .....	97
6.1. Discussion.....	99
6.2. Feedback from informants.....	101
6.3. Validity and reliability criteria .....	102
6.4. Research limitations .....	104
7. CONCLUSION .....	106

LIST OF REFERENCES .....	108
APPENDICES .....	112
APPENDIX 1. Sense and respond questionnaire .....	112
APPENDIX 2. MSI questionnaire.....	113
APPENDIX 3. Case study outsourcing questionnaire.....	117
APPENDIX 4. The combined micro level questionnaire.....	119
APPENDIX 5. The combined micro level questionnaire.....	126
APPENDIX 6. Cover letter to the respondents .....	128

## LIST OF FIGURES

Figure 1. Map of Finland (Beachcomberpete, 2011).....	16
Figure 2. Five categories of adaptation strategies .....	23
Figure 3. Annual average of daily sums of solar radiation across Africa (Chineke et al. 2010).....	26
Figure 4. Solar photovoltaic potential of some cities in Nigeria (Chineke et al. 2010) .....	27
Figure 5. Map of Nigeria showing its 36 states (Wikipedia, 2013).....	28
Figure 6. Critical factor of research index (Liu et al.2011).....	41
Figure 7. Analytical hierarchy process (AHP) (Liu et al 2011) .....	45
Figure 8. Manufacturing strategy (Takala et. al 2012).....	47
Figure 9. Decision-making elements for outsourcing production (Liu 2013).....	49
Figure 10. Evaluation elements for choosing subcontractor suppliers (Liu, 2013).....	50
Figure 11. Results of BCFI Vs SCFI Vs NSCFI (Case company NIG 10).....	63
Figure 12. Comparison of BCFI, MSI, SCFI and NSCFI (NIG10) .....	67
Figure 13. Results of BCFI Vs SCFI Vs NSCFI (Case company NIG 16).....	69
Figure 14. Comparison of BCFI, MSI, SCFI and NSCFI .....	71
Figure 15. Results of BCFI Vs SCFI Vs NSCFI (Case company NIG 8).....	73
Figure 16. Comparison of BCFI, MSI, SCFI and NSCFI (NIG8) .....	76
Figure 17. Results of BCFI Vs SCFI Vs NSCFI (Case company NIG 6).....	78
Figure 18. Comparison of BCFI, MSI, SCFI and NSCFI (NIG6) .....	81
Figure 19. Results of BCFI, SCFI and NSCFI (Veli et at.2012) FIN3 .....	83
Figure 20. Results of BCFI, SCFI and NSCFI (Oba et al. 2012) FIN2.....	87
Figure 21. Comparison of BCFI, MSI, SCFI and NSCFI (FIN2) .....	89

## LIST OF TABLES

Table 1. List of companies with temporary/permanent lay-offs (EMCC, 2009) .....	19
Table 2. Five categories of adaptation strategies.....	23
Table 3. Comparison of the strategies Finnish and Nigerian companies adopt in dynamic and turbulent business environments.....	36
Table 4. The summary equations of each model.....	43
Table 5. List of Nigerian solar companies interviewed.....	51
Table 6. List of Finnish manufacturing companies considered.....	54
Table 7. S&R sample questionnaire .....	56
Table 8. Sample of MSI questionnaire .....	57
Table 9. Sample of the combined level macro questionnaire.....	57
Table 10. List of solar energy companies.....	59
Table 11. Comparison of Past and Future BCFI, SCFI and NSCFI.....	64
Table 12. Integrated values of MSI .....	65
Table 13. Sum check and P, A, D results .....	66
Table 14. Angle result and MAPE, RMSE and MAD values .....	68
Table 15. Integrated values of MSI(NIG16) .....	69
Table 16. Sum check and P, A, D results .....	70
Table 17. Angle result and MAPE, RMSE and MAD values .....	72
Table 18. Comparison of Past and Future BCFI, SCFI and NSCFI.....	74
Table 19. Integrated values of MSI .....	75
Table 20. Sum check and P, A, D results .....	75
Table 21. Angle result and MAPE, RMSE and MAD values .....	77
Table 22. Comparison of Past and Future BCFI, SCFI and NSCFI (NIG6).....	79
Table 23. Sum check and P, A, D results .....	80
Table 24. Angle result and MAPE, RMSE and MAD values (NIG6) .....	82
Table 25. Comparison of Past and Future BCFI, SCFI and NSCFI (FIN3).....	84
Table 26. Integrated values of MSI (FIN3).....	85

Table 27. Sum check and P, A, D results (FIN3) .....	85
Table 28. Angle results and MAPE, RMSE and MAD values (FIN3).....	86
Table 29. Comparison of BCFI, SCFI and NSCFI.....	88
Table 30. SCA analysis (FIN2) .....	90
Table 31. Comparison of the decision making elements for outsourcing production in Finnish manufacturing companies and Nigerian solar companies .....	96
Table 32. Comparison of the evaluation elements for choosing subcontractor suppliers in Finish manufacturing companies and Nigerian Solar companies .....	96
Table 33. Research summary.....	98

## SYMBOLS AND TERMS

BCFI	Balanced critical factor index is referred to as the modified CFI which detects the most critical factors that affects the overall performance of a company.
CFI	Critical factor index is a supporting tool which is useful for strategic decision-making. CFI has to do with the detection of the attributes affecting the business performance.
M.A.P.E	Absolute percentage error
MAD	Maximum deviation
MSI	Manufacturing strategy index is a method used in detecting the strategy type that is preferred by a company
NSCFI	New scaled critical factor index
P.A.D	Prospector, analyzer and defender
S&R	Sense and respond is a scalable managerial framework developing ability to adjust to improvements
SCFI	Scaled critical factor index
SCA	Sustainable competitive advantage is a measurement of risk level
RMSE	Root means squared error is used to measure risk level of operation strategy for sustainable competitive advantage



---

**UNIVERSITY OF VAASA**

Faculty of Technology

Author: Oba Oriekwo

Topic of the thesis Comparing the Survival of Nigerian Solar energy and Finnish Manufacturing Companies in Turbulent Business Environments

Instructor: Professor Josu Takala

Degree: Master of Science in Economics and Business Administration

Major subject: Industrial Management

Year of Entering the University: 2012

Year of completing the Thesis: 2014 Pages: 128

---

**ABSTRACT**

In turbulent business environments, both solar energy companies and manufacturing companies are affected negatively. Turbulent business environments are accompanied by decrease of sales, reduction of profits, sudden shrinkage of domestic demands, political instability, and economic crisis. This thesis aims to compare the survival strategies of Nigerian solar energy companies and Finnish manufacturing companies in harsh business environments. In addition, the case study in the thesis will explain how solar energy companies and manufacturing companies formulate the evaluation elements for choosing subcontractor suppliers as well as the decisive elements in decision-making of manufacturing outsourcing. Methods such as sense and respond (S&R), analytical hierarchy process (AHP) and decision making elements are used. The analysis results show that quality and cost are indispensable survival attributes while time quality, flexibility are essential elements for evaluating subcontractor suppliers.

---

**KEYWORDS:** Sense and respond, Analytical hierarchy process, turbulent business.

## **ACKNOWLEDGEMENT**

I lack enough words to express my sincere gratitude to The Almighty God for establishing me to complete this paper. I wish to express my sincere thanks to my Parents for inspiring me to carry on with this thesis.

I place on record, my sincere gratitude to Professor Josu Takala for establishing the concept used in this work and his consistent guidance. I owe a debt of gratitude to Cintia the English Language instructor for the vision and foresight which inspired me to complete this work. I am particularly indebted to Dr Liu Yang who coined the concept used in this work. My numerous respondents from different states of Nigeria are not left out; your information formed the basis of the research. Special thanks goes to Joseph Solomon who worked tirelessly to make the thesis conform to the appropriate format.

Finally, I take this opportunity to acknowledge the enormous service and support of the total team of publisher and everyone who took part in making this project a success.

With best regards

Oba Oriekwo

## 1. INTRODUCTION

There is a compromise among managers of companies around the world on the appropriate measures to be taken in terms of economical means in turbulent business environments (Ahment et al. 2011). These measures comprises of establishing and managing capital structure in a way to cover the costs of long term losses incurred, loan payments, shun borrowing to finance losses, managing stock's levels efficiently by reducing inventories significantly, changing business strategies (Ahment et al. 2011).

Turbulent business environments determines a significant downward shift in performance trends (Antonioli et al. 2011), causing specific problems for SMEs (Chowdbury et al.1993; Van et al. 2000).In a more general perspective, dynamic and turbulent business environments are among the disrupting events with a low probability but a great impact, which can bring about adverse effect on both solar energy and manufacturing companies. Dynamic and turbulent business environments are characterized by natural disasters, terrorist attacks, political instability (Faulkner, 2001), sudden deterioration of competitive and market conditions, economic crisis, a sudden reduction of purchasing power and market demand, increased pressure from competitive firms, deregulated markets (Blecke, 1991) and declining sectors. Proper management of hostile environments can lead to success and improper management can cause bottleneck.

Conditions such as penetrating into new markets, advent of new disruptive technology, and economic crisis are categorized as difficult economic conditions which forces firms to re-design their business models and strategies. How is it done in Nigeria and Finland? Gulati et al studied carefully a total of 4700 publicly traded companies during an economic crisis periods in 1980, 1990 and 2000 by classifying the periods covering 3-years prior to the crisis, crisis years, and 3 years after the crisis. It was gathered that 17% of the companies either bankrupted or were taken over by their rivals and about 80% of the remaining companies were unable to breakeven, their sale and profit figures of 3

years prior to the crisis were not reached and it was not also reached 3 years after the crisis. At the end of the economic crisis periods, the percentage of companies adjusting their core financial indicators and key strategies to a reasonable level than the level prior to the crisis period, and performance in terms of sales and profit growth figures, about 10% of their competitors is just around 9%. To survive in dynamic and turbulent business environments, innovation is essential for companies and this involves proper implementation of diverse untested applications. It is also crucial to abandon the traditional methods that have been regularly used. Companies can hardly survive during economic crisis when considering only cost reduction strategy or invest much more than their rivals. During economic crisis periods, companies that take advantage of innovation and new strategies have been the most successful companies (Ahmet et al. 2011).

This thesis aims to compare how Manufacturing companies in Finland and Solar energy companies in Nigeria survive in dynamic and turbulent business environments through a comparative study. Comparative studies of how solar energy companies in Nigeria and manufacturing companies in Finland survive in dynamic and turbulent business environments are useful in this context since these studies explain both the similarities and differences in managing harsh business environments across two or more countries. It is reasonable to analyze and compare the approaches adopted by these countries during economic crisis in order to better grasp Finland-Nigeria relations (Takuo, 2012).

In addition, the study will explain how solar energy companies and manufacturing companies formulate the evaluation elements for subcontractor suppliers, how to evaluate and select subcontractor suppliers. Also, the decisive elements in decision-making of manufacturing outsourcing, how firms make decisions on manufacturing outsourcing will be explained.

## **1.1. Scope of the thesis**

The field of present research is relatively vast as it covers theories based on surviving during economic crisis, comparison of how companies from two different nations survive during economic crisis and decisive elements in decision-making during manufacturing outsourcing. This paper aims at answering the following research questions:

- 1) Are there some similarities between solar energy companies in Nigeria and manufacturing companies in Finland in terms of decision making during economic crisis?*
- 2) What are the impacts of manufacturing strategy index and sense and respond in dynamic and turbulent business environments?*
- 3) Do solar energy companies and manufacturing companies adopt similar strategies in terms of outsourcing manufacturing during economic crisis?*

The method employed is completely dependent on both theoretical and practical facets. The top managers of the case companies will be contacted after the analysis to ascertain whether the result of the thesis reflects the true situation of the case companies. The conclusions are made based on the validation of the case companies' results.

## **1.2. Structure of the thesis**

The IMRAD structure is employed in this thesis. The thesis comprises of the following parts: introduction, aim, methodology, literature review, research limitations, result, discussion and conclusion. The introduction of the thesis gives an overview of dynamic and turbulent business environments while the aim states clearly the objectives of the thesis. The methods used in the thesis are explained in the methodology and the shortcomings of the research are stated in the research limitation section. The literature review explains the research problems and the way out. This is based on previous

research.

Furthermore, results obtained from the research are stated in the result section while the significance of the thesis and the results obtained are discussed in the discussion section. The conclusion part summarizes the thesis deduction and the comparison made.

### **1.3. Aims of the thesis**

The thesis is aimed at comparing how solar energy companies in Nigeria and manufacturing companies in Finland survive in dynamic and turbulent business environments. Dynamic and turbulent business environments are inevitable to many businesses around the world.

The thesis is also going to explain how solar energy companies and manufacturing companies formulate the evaluation elements for choosing subcontractor suppliers, how to evaluate and select subcontractor suppliers as well as the decisive elements in decision-making of outsourcing production. In a nut shell how firms make decisions on outsourcing subcontractor suppliers.

## **2. LITERATURE REVIEW**

This chapter gives an overview of Finland and Nigeria. It also explains turbulent business environments in Nigeria and Finland and the survival strategies. Theory of outsourcing is explained as well. This is based on previous research.

### **Basic facts about Finland**

Finland is officially known as the Republic of Finland. Finland is a Nordic country which is situated in the Fennoscandic region of Northern Europe. It has common borders with Sweden (west), Norway (North), Russia (East) and Estonia (South across the Gulf of Finland). The population of Finland is 5.4 million people with bulk of the population residing in the southern regions.

The capital of Finland is Helsinki with 590,000 people. Finland is an advanced industrial economy. Both metal engineering and electronics industries accounts for 50% of their export revenues while the forest products industry is 30%. Therefore, there are more manufacturing companies in Finland when compared with other companies. The surface area covered by forest is 338 000 sq.km and there are approximately 190, 000 lakes in Finland (Ocro, 2013). The climate of Finland is usually marked by cold winters and moderately warm summers. During summer, the temperature rises to +20 Celsius, and it can also get to +30 Celsius around the southern and eastern parts of the country. Figure 1 below shows the map of Finland.



**Figure 1.** Map of Finland (Beachcomberpete, 2011)

## **2.1. Economic crisis in Finland**

In the early 1990s, Finland went through a sharp economic depression that was unforeseen in its severity when considering a modern and highly developed economy. One vital aspect of the depression was a banking crisis where the government was forced to grant huge supports to all the banks in order to guarantee their credibility. At the end of the crisis, a banking group was bankrupted; two prominent banks and many other smaller banks were



forced to merge in order to survive. Finnish banks-dominated system faced catastrophes and had to be reformed. Between 1991 and 1993, during the economic crisis period, new laws were introduced by the government which accounted for the transformation of Finland's financial system.

The change in securities law elevated the integrity of stock markets by introducing the new Financial Supervisory Authority with sufficient resources and regulatory powers. In a nutshell, the legal reforms contributed in the implementation of shareholders' rights while discouraging creditors' rights. At the end of 1990's, the financial system gave more priority to stock market since dependence on banks dwindled (Timo et al.2003).

During the economic crisis, it was observed that levered firms experienced great impact of the catastrophe. Many solvent companies were forced to liquidate because of strong dependency on banks. In dynamic and turbulent business environments where laws that weaken creditors' rights are implemented by the parliament, manufacturing companies are usually affected since they often depend on banks (Timo et al. 2007).

The Finnish government introduced an alternative bankruptcy procedure (as stated in government bill 182/1992) with the sole aim of reorganizing distressed companies easier and thereby saving them from liquidation, mainly economically viable companies. Scott and Smith (1986) argue that small businesses are prone to face a constrained credit market due to bankruptcy according to bankruptcy Reform Act of 1978 in the US.

The legal reform in Finland during the crisis accounted for a general growth in competitiveness index. Finland has been placed fifth in the IMD yearbook of 2005 for the state of the general and regulatory framework (IMD, 2005).The world Economic Foundation's Global Competiveness index has also placed Finland first in the general growth competitive index stating that judicial independence and property rights accounted for their competitive advantage (Porter et al., 2004).

## **2.2. How Finnish manufacturing companies survive in dynamic and turbulent business environments**

Based on the survey made by the Labor Force in Finland, there were 222, 000 unemployed in March 2009. In March 2008, there were 42,000 unemployed citizens more than it was in 2009 i.e. the number decreased by 42,000 in 2008. Between 2008 and 2009, economic crisis affected Finnish citizens, manufacturing companies and other companies in the country. A supplementary budget was approved by the Finnish government in 2009; this budget included a stimulus package. It also includes about 140 € in transport infrastructure projects. This was done in order to increase the spending of the state by € 1.2 billion. The Finnish Prime minister XXX envisaged that the package will account for the creation of 17,000 jobs directly and 25,000 jobs indirectly during 2009 and 2010. About € 70 million of the supplementary budget was for road and rail maintenance and another € 70 million for further transport infrastructure project. Also, the state is to provide guarantees and capital to banks operating in the country. In all, the state promises about € 60 billion in guarantees, loans and investments and is expecting an increment of €45 billion in corporate financing (EMCC, 2009).

The largest sums of money were put in the banks support package with the aim of securing the continuity of corporate credit. About € 40 was further approved by the parliament to assist banks in raising capital. These measures were taken in order to tackle the effects of economic crisis in the country. Many manufacturing companies that would have been bankrupted in the country survived during the recession period (EMCC, 2009).

Based on the information obtained from Finnvera, (a specialized financing company owned by the state of Finland), a total of 190 companies including manufacturing companies received funding during the crisis period. On the 22 of May 2009, Finnvera gave out funding of €72, 4 million out of the maximum €900 million of counter-cyclical loans and

guaranteed to be applied by companies in 2011. Mr XXX estimated that the number of jobs protected by Finnvera in 2009 is about 200 (EMCC, 2009).

Many other companies were not able to cope during the crisis; they considered other strategies in order to survive. During the 2009 crisis, many companies considered laying their employees off while some reduced their weekly working hours. It was gathered that thousands of temporary lay-offs were announced on a weekly basis. Metal and Engineering industry firms had the highest number of lay-offs (EMCC, 2009). Statistics gathered from news headlines in the early part of the year 2009 is as follows:

**Table 1.** List of companies with temporary/permanent lay-offs (EMCC, 2009)

Companies	Location	No. of employees	Temporary lay off	Redundancy
Pulp mill	Kaskinen	200	X	
Ahlstrom	Karhula, Mikkeli and Tampere	300	X	
Ensko Group (Electrification system manufacturing company)		700	X	
Salocomp (Manufactures mobile telephone chargers)		50		Shortened works hours

Nordkalk (Limestone manufacturing company)		184  (All its staffs were laid-off for 4 weeks)	X	
Orion (Pharmaceutical)		30 employees were laid off via pension arrangements		
Stora Enso Pulp and paper manufacturing company		Planned to lay off some 5,000 employees temporarily	X	
Nokia (Mobile technology)	Salo Factory	2,500 workers were temporarily laid off	X	

Many Finnish companies that could not survive during the economic crisis considered either temporary lay-off or permanent lay-off of their employees in order to survive. In 2009, the ministry of Employment and Economics estimated that 46,000 people in 4,100 companies were laid off. Apart from laying-off of employees, there are many other strategies Finnish companies considered in order to survive.

### **2.3. Adaptation strategy of Finnish manufacturing companies in dynamic and turbulent business environments**

Apart from receiving support from the government and laying staffs off, many Finnish companies survived during the 1990 crisis through adaptation strategy. Långström analyzed the success factors of the large companies that survived in Finland during 1990-1993 economic crisis. He observed that many companies cut staff and production cost in order to survive. When these strategies did not yield any positive result, they restructured profitability through reducing unrelated operations and increasing focusing more on their spearhead (core business). Långström noticed that marketing costs were not significantly cut during the crisis. Långström's research spanned for a short period of time and thus cannot evaluate whether the strategies were successful in the long term.

Strang carried out six different studies on turn round strategies, he noticed that three companies out of the six companies failed and the remaining three recovered in a successful way. He categorized the turnaround strategies into two on the basis of strategic and operational. The operational strategies includes: increase prices, focus more on sales, educate sales force, reduce costs, reduce personnel, control costs, replace key persons, manipulate accounting information, strengthen brands and increase capital turnover.

The strategic strategies includes expanding of the product range, new sales channels, new CEO, creditor on board, new chairman, analysis of facts, assess situation, sell assets, make realistic plans, use of consultants, focus power to CEO, and concentrate on chosen businesses. (Erkki, 2000)

The analysis result showed that the companies that failed during the downturn era had the same CEO and the successful companies adopted some changes in management.

However, boards that were not changed manipulated financial reports and a focus on a broader business area and sales were the reasons why some companies failed. In summary, during the turnaround period, the failed companies cost control was not so tense and price

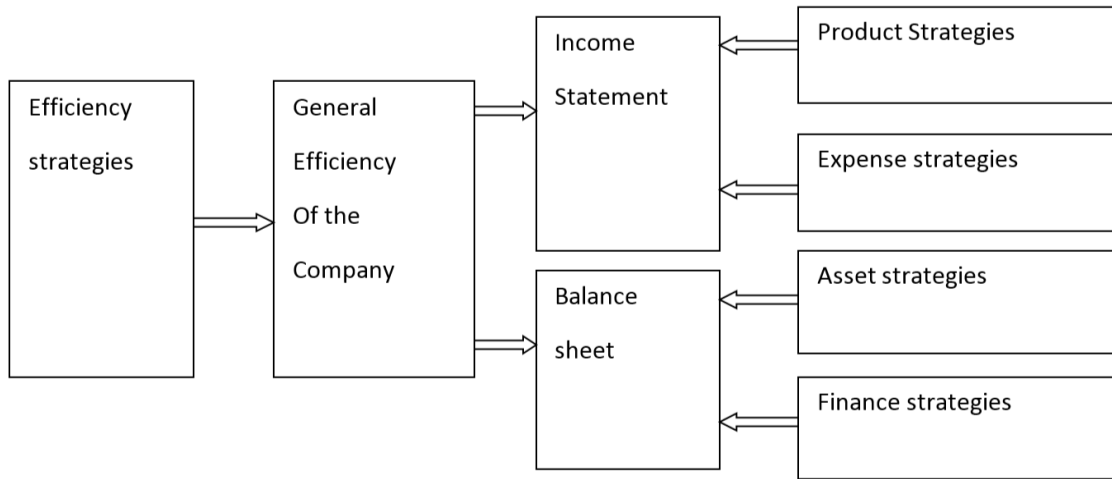
fluctuation were more often than in the successful firms. Therefore, successful companies concentrate mainly on their core businesses and they also sell their assets more frequently when compared with the failed companies (Erkki, 2000).

The adaptation strategy can be defined as a reaction strategy to the immediate environment. The effective adaptation strategy is a key strategy for the breakthrough of companies during recession. With the use of adaptation strategy, companies can respond to the changes and uncertainty in the environment and try to convert threats into opportunities (Erkki, 2000). The adaptation strategy is a change based strategy. Erkki studied the adaptation strategies of a total of 750 Finnish companies during the economic crisis of 1989-1993 classifying the adaptation strategy gained from the 750 questionnaires filled by companies into five different categories namely:

- 1) Efficient strategies
- 2) Product strategies
- 3) Expense strategies
- 4) Asset strategies
- 5) Finance strategies

Efficiency strategies are the actions taken to revive the overall efficiency of the company; this may result in the improvement of its economic condition. Product strategies takes into consideration the strategies adopted to change products or customer relationships.

These kinds of strategies are useful when it comes to increasing revenues so that profitability and growth will be improved. Expense strategies are used to reduce alternative types of expenses that may have an impact on profitability of the company. Asset strategies are used to reform asset turnover as well to obtain financing. Finance strategies are useful in renewing debt contracts, or obtaining new debt or equity capital (Erkki, 2000). See figure 2 below.



**Figure 2.** Five categories of adaptation strategies

**Table 2.** Five categories of adaptation strategies

Efficiency strategies	Product Strategies	Expense strategies	Asset Strategies	Finance Strategies
Reducing unnecessary business activities	Reducing unprofitable products	Reducing marketing expenses	Increasing financial assets turnover	Sourcing for governmental financial support
Renewing management staff	Reducing prices products	Increasing marketing expenses	Realizing financial assets	Negotiating about facilitation of finance contracts
Improving control of activities	Increasing product prices	Reducing production Expenses	Increasing inventory turnover	Postponing payment bills
Improving planning of activities	Improving existing products	Reducing administrative expenses	Realizing inventory	Restructuring debt structure

Renewing technology or way of production	Developing new products	Reducing financing expenses	Realizing fixed assets without lease back	Looking for new sources of debt
Shortening throughput time in production	Improving old customer acquirement		Realizing fixed assets with lease back	Obtaining new guarantees for debt
Adjusting employment by layoffs and cut working hours	Improving new customer acquirement			Sourcing for new debt guarantors Also getting new share equity from both old and new owners

(Erkki, 2000)

## 2.4. Solar energy in Nigeria

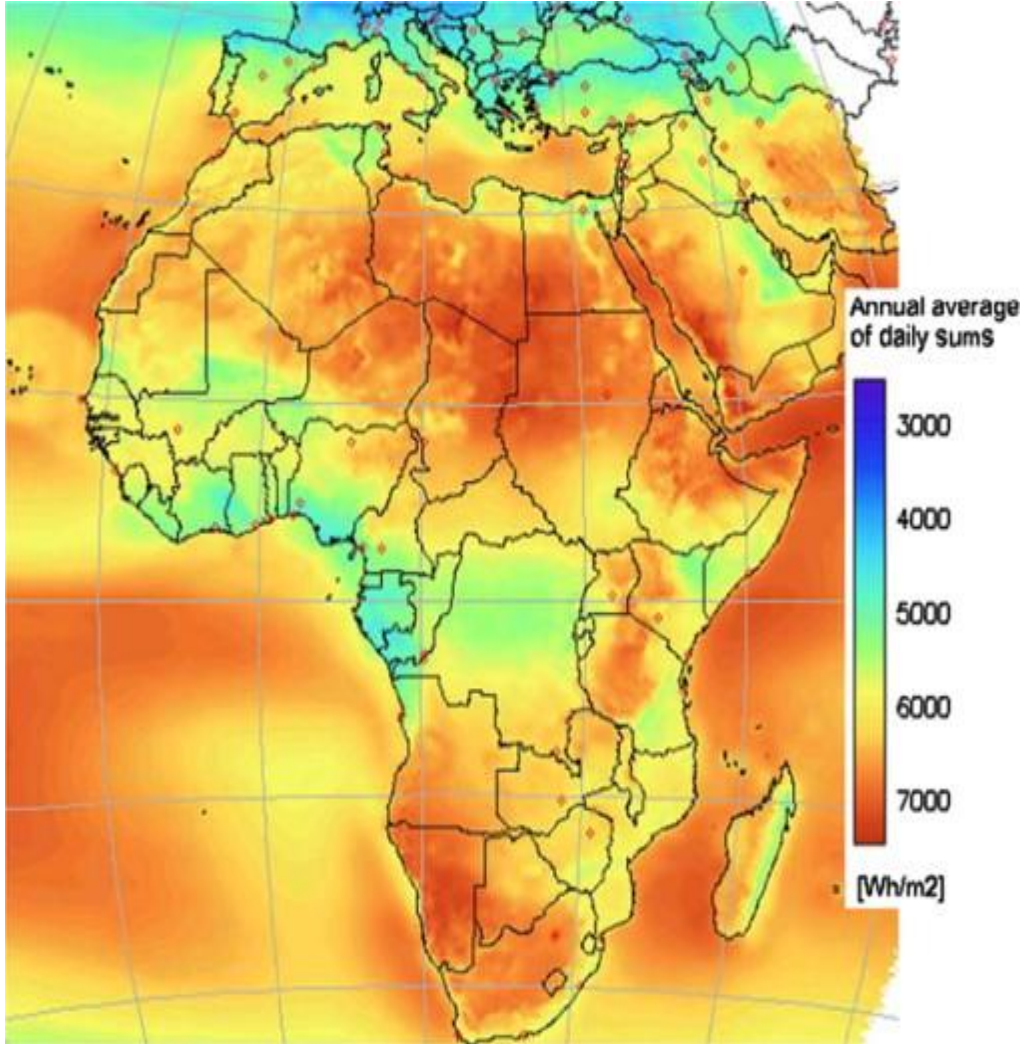
Nigeria is directly located in the tropics, it's land mass protruding between latitudes 5-degrees south and 15-degrees north of the equator (Kalu, 2010). Studies on the potential and visibility of solar energy sources in Nigeria reveal that Nigeria has about 290 days of sunlight per year. The solar radiation in Nigeria ranges from 4 KW h/m<sup>2</sup> in the south to 7 kW h/m<sup>2</sup> in the north, this is estimated to be relatively above the threshold average of 2.3 kW h/m<sup>2</sup> required for the operation of simple home load in the rural communities (Fig 3). The intensity of solar radiation in Nigeria varies significantly from North to South but the degree of intensity is remarkably higher in the northeastern axis. However, the whole country has adequate solar radiation to sustain the domestic local energy need especially in the rural areas with smaller load of electrical demand (Mohammet et al, 2013).



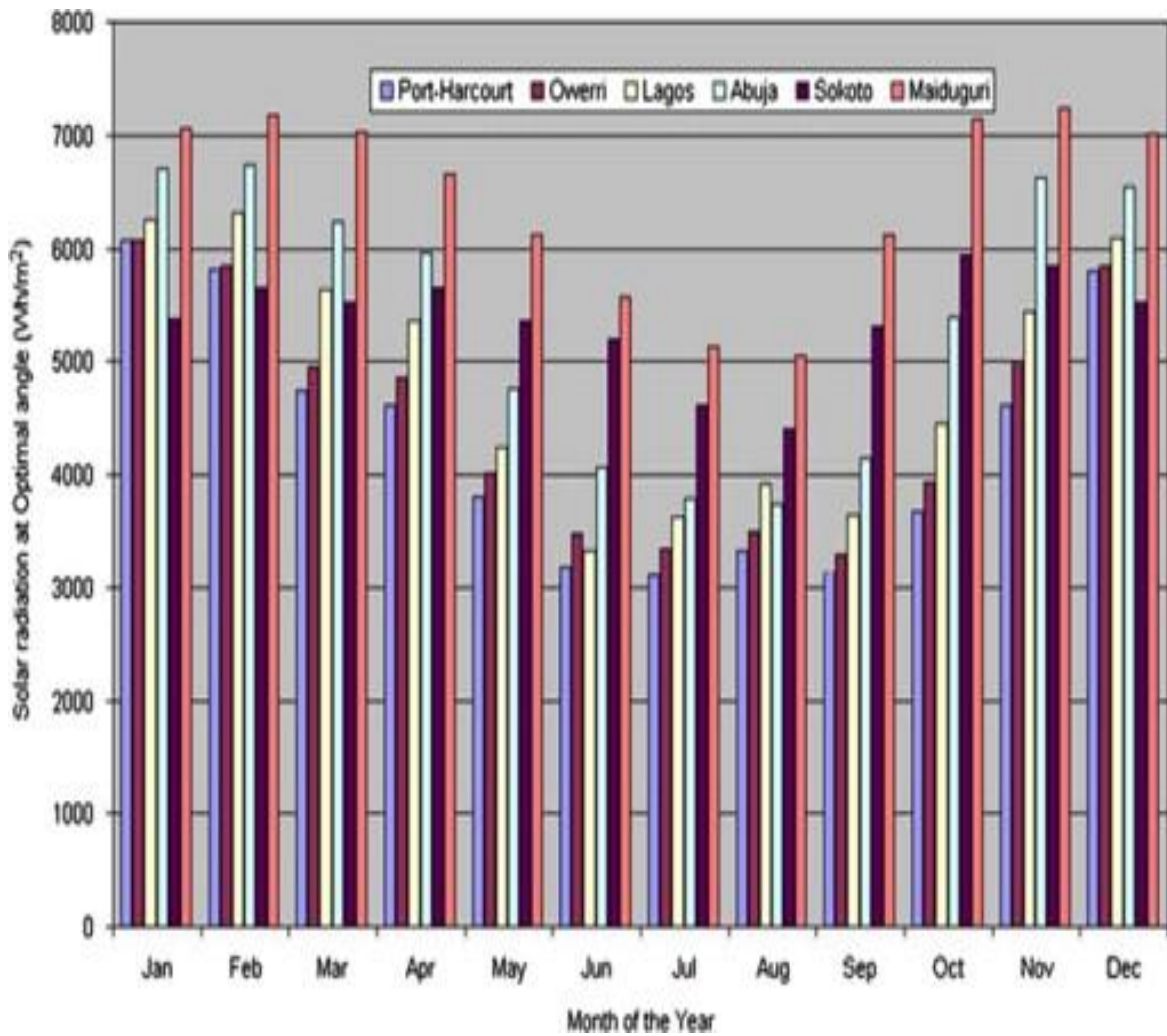
Figure 4 below represents the solar photovoltaic potential for some chosen cities in various geographical locations of Nigeria. Some of the selected cities are Port-Harcourt (South-South), Owerri (Southeast), Lagos (Southwest), Abuja (North central), Sokoto (Northwest) and Maiduguri (Northeast). The highest potential value of solar photovoltaic is exhibited by Maiduguri while Sokoto ranks second. The potential of solar photovoltaic in the state capital, Abuja is  $3000 \text{ W h/m}^2/\text{day}$ . Port-Harcourt displays the least in July but its values are significantly higher than the threshold.

Energy Commission of Nigeria (ECN) is a body responsible for harnessing solar energy in Nigeria via direct coordination of research and development activities of Sokoto Energy Research Centre (SERC) and National Center for Energy Research and Development (NCERD). Through this arrangement, solar oriented Pv-connected rural electrification of schools, domestic lighting, urban traffic lighting, water pumping, cottage hospitals, small-scale laboratory applications have been set up.

Previous research shows that the global power sector has generally exhibited a growth rate of 2% yearly, with about 50% of solar energy alone. This remarkable growth in solar energy has accounted for an increase in energy access and employment opportunities have been created for numerous job seekers in Nigeria and many developing countries (Mohammed et al, 2013).



**Figure 3.** Annual average of daily sums of solar radiation across Africa (Chineke et al. 2010)



**Figure 4.** Solar photovoltaic potential of some cities in Nigeria (Chineke et al. 2010)

## Basic facts about Nigeria



**Figure 5.** Map of Nigeria showing its 36 states (Wikipedia, 2013)

Nigeria is a federal constitutional republic consisting of 36 states with its federal capital Territory in Abuja. The country is located in West Africa and has common borders with Republic of Benin in the west, Chad and Cameroon in the east, and Niger in the north. The coast of Nigeria lies on the Gulf of Guinea on the Atlantic Ocean. Nigeria comprises of over 500 ethnic groups of which the three largest are Yoruba, Hausa and Igbo.

Nigeria is referred to as the giant of Africa and is the most populous nation in Africa. Nigeria is the seventh most populous nation in the world with a population of 170 million. English Language is the official language of Nigeria.

## **2.5. Economic crisis in Nigeria**

The Nigerian economy is not immune to economic crisis and global happenings; it is also susceptible to crisis like all other countries. The Nigerian economy is presently in crisis but not completely damaged. Nigerian government rely on oil for more than 60% of its total revenues, and over 90 % of the country's foreign earnings comes from oil as well. The state governments on the other hand are dependent on the Federal government for over 90% of their revenues and 10% from their internal generated revenues i.e. they get over 90% of their revenues from the Federal government. The fall in oil prices will surely have an immediate effect on the country's revenues; this will cause disastrous impact on the budgets of all the governments of the federation including the states and local governments (Benjamine, 2012).

Due to economic downturn, Nigerian Naira has been depreciating since 2008 against the American Dollar. The depreciation of Nigerian naira at an alarming rate against the US Dollar has affected the economy and has also accounted for the suffering of the Nigerian people as well as the companies operating there (Benjamin, 2012).

The economy of Nigeria has continued to depreciate steadily for the past few years with inadequate security, insufficient education, inadequate power supply, lack of good roads, inadequate health care services. The natural resources of the country are not judiciously utilized as well as manpower potential. These depreciating factors along with the country's economic crisis have created an un-conducive environment for solar energy companies in Nigeria (Benjamin, 2012).

## 2.6. Challenges facing solar energy companies in Nigeria

**Cumbersome importation procedure:** is one factor that accounts for crisis in the solar industries across the country. High port charges and taxes have continued to cause great pressures in the solar world. Most of the solar panels used in the solar industries are manufactured in China and have to be shipped into Nigeria. Due to the congestion and prolong clearance procedures at the Apapa sea port in Lagos, many solar companies cannot meet up with their obligations (Idris et. al, 2013). Customers are often lost as a result of delay in supply.

**Improper implementation of policies:** Improper implementation of policies has to do with administration of incentives and measures targeted at enhancing the growth and development of solar companies. This can account for a significant effect on the sub-sector. Improper implementation of policies during crisis and after crisis has caused serious failures for many solar companies in Nigeria. A company denoted by XXX came to Nigeria in 2005/2006; they started all the way from Angola, Zimbabwe, Cameroun, Chad and Nigeria. They did many installations in Port Harcourt (Southern Nigeria), Maiduguri (Northern Nigeria), Ilorin (Western Nigeria), Jos and Yobe (Northern Nigeria). These installations did not work as a result of improper implementation of policies. They were forced out because of failures they encountered (Idris et. al, 2013).

**Poor maintenance culture:** Many problems associated with power outages and shortages in the regions where there are solar power installations are as a result of poor maintenance culture. When solar concentrated systems are used, it means building a mini grid which requires building a solar farm for a community. Solar concentrated system is like a power plant. When there is a problem with one solar farm, the whole community will be in total blackout due to poor maintenance culture. A solar expert in Nigeria suggested that everyone depending on solar systems should be empowered with power kit in order to manage a solar farm (Idris et. al, 2013).

**Lack of administration and management knowledge:** Inadequate management know-how has always constituted failures for many enterprises in Nigeria (Lussier et al. 1996). Inadequate technical knowledge in the field of solar industry, lack of managerial skills, inadequate planning and lack of market research are major problems that should be address. In order to address these problems, identifying the essential issues is very important. Solar systems are designed for specific locations depending on the preferences of the customers. When designing a Solar system for Maiduguri ( Northern Nigeria), the weather condition of Maiduguri, the humidity, the rainfall are to be taken into account during the designing phase. The same situation applies to Port Harcourt (Southern Nigeria) and other regions.

The harnessing power of the panel used should be very long for the tropic regions of the country since the position of the sun moves from the equator during rainy season. Lights would go off at 3am in the morning as a result of this. It takes proper research and management knowledge to overcome many of the challenges faced. A company without administrative and management knowledge could install solar power but lights won't be on in June, July, August and September of the year (Idris et. al, 2013).

**Problems due to outsourcing and procurement:** Many products bought from suppliers do not meet the required standard. Some of the products are not customized for specific regions and they do not work. Many companies simply procure their products from China without customizing them to meet their requirement. It does not mean that Chinese products are substandard, many solar companies buy products from China but they are not manufactured based on their specifications.

Many successful solar companies do the design and give it to their factory in China to produce based on their specifications. These successful companies also inspect the products after they have been manufactured to ensure that it conforms to their specifications. Companies that go to shelves in China and buy solar panels for Nigeria do not usually

survive in the business (Idris et. al, 2013). The Chinese manufacturing company needs detail specifications of panels before they can be manufactured for Nigerian solar plants.

**Inadequate staff education and training:** Staff education and training are not always taken seriously in many solar companies across the country. This has resulted into poor implementation of policies in many of the companies. When staffs are properly trained and educated, they are bound to grow into expertise and they can manage dynamic and turbulent situations in the company properly. Over the years, some solar energy companies have implemented staff education and training very well.

A solar expert in Nigeria states that when solar panels are bought just from shelves in China, it does not always work as planned. The configuration of the panel should be properly defined so that it can be manufactured appropriately by the Chinese company (Idris et. al, 2013). Inadequate education and training can lead to poor specification of the required solar panels.

**Corruption:** has affected almost everything in Nigeria. Corruption in Nigeria is seen as inevitable phenomenon. Also, undermining the legal framework, national integrity, and regulatory system, corruption destabilizes the trust and confidence of entrepreneurs or business owners (Langseth et al. 1997). There has been massive failures in solar plant installations around the country as a result of corruption. A solar plant professional states that the lifespan of a solar panel is usually 25 years and a good battery last for 10 years (Idris et. al, 2013). This should account for reliable and dependable solar plants around the country but reverse is the case.

The solar plant professional further states that: Most major importers based in Lagos who import batteries for solar systems, can import a whole ship of batteries, they cannot bring those batteries (gel) because of the risks involved. They don't know if government will award a contract. The point is that what they have been importing are car batteries. They



are filled car batteries. They take the car batteries and label them as solar batteries. When people drive to Lagos to get batteries, two months from now, people are jumping for solar and they just pay. These batteries will give you one or two years and they fail. Therefore most failures in solar plants are as a result of corruption on the part of the importers (Idris et. al, 2013).

**Inadequate support from the state and federal government:** Based on the information gathered from Finnvera, a specialized company owned by the state of Finland, many companies in Finland as well as manufacturing companies receives funding during economic crisis but reverse is the case with a lot of companies operating in Nigeria. Solar companies in Nigeria depend so much on their resources for survival. Solar companies that cannot adjust their strategy to cope during dynamic and turbulent business environments don't usually survive.

There is also a great dependency on the government for solar plant installation projects. When solar plant installation projects are not forth coming, there is bound to be a significant drop in their turnover because great percentages of their projects are for the government.

## **2.7. How solar energy companies in Nigeria survive in dynamic and turbulent business environments**

**Executive vision for globalization:** is an idealized aim or image that leaders establish to achieve in future that emphasizes to actualize organizational outcome from opportunity of globalization (Ussahawanitchakit et al. 2009; Jones, 2010). Townsend et al. (2004) states that leadership global orientation has a positive impact on the execution of a global marketing structure. Therefore leaders' vision has a positive effect on global marketing and can take the company to the next level. Many solar companies in Nigeria adopt the executive vision concept and new strategies to survive during crisis.

**Research and Development:** Some solar energy companies do not usually undertake research and development programmes (R&D), they consider these programmes to be very expensive (Onyenekenwa, 2010). The solar companies in Nigeria that often consider research and development as a survival strategy in harsh business environments always succeed. New strategies and innovations are essential for the survival of businesses in dynamic and turbulent business environments.

**Technology Adaptation competency:** is defined as the ability of a company to consider and change information technology during business operations, emergence of an ideology-tree world as a global competition (Hitt et al, 2005), (Philips et al. 2009). It means that in dynamic global marketing strategy, companies have to introduce new technology or product almost simultaneously all over the world as soon as possible with the use of technology as a major tool for development (Sheth et al. 2001). This has compelled many solar companies in Nigeria to be ready to compete with other competitors. This is done by considering the state of the art i.e. current trends of technology.

**Continuous innovation improvement concentration:** has to do with the continuous intention to develop new creative idea and new ways of marketing themselves to potentially or continuously exiting customers (Dean, 1994), (Morgan, 2002).

According to Stater and Näver (1995), service companies innovate by developing new services or remodeling the ones that are currently used, establishing new distribution channels and discovering new ways of management. Many solar energy companies in Nigeria survive through continuous improvement, redesigning their strategies and mode of operation.

**Employee education and training:** Staff education and training has accounted for a significant success in both solar industry and other industry around the country. Many companies in Nigeria empower their employees by providing them with relevant training. According to (Onyenekenwa, 2010), to survive in the prevailing dynamic and turbulent

business environments in Nigeria, 78% of the micro, 86% of the small and 89% of the medium enterprises surveyed heightened staff education or training by consultants, business support centers, solar companies and so on survived with the aid of staff education and the right strategy.

**Market acceptance Quality:** Market acceptance quality can be defined as the successful development and market improvement to new products and services that respond to the change in technology, evolving industry standards as well as the requirements of customers (Chung et al. 2009). The quality of services provided by companies' matters a lot when it comes to customer delight. Solar companies that take advantage of market acceptance quality are bound to survive during economic crisis.

**Diversified customer behavioral learning:** Can be defined as the ability of firms to understand the requirements of customers. Also the expectation for creating response process in terms of product type and benefits (Jaworski et al. 2000; Li et al, 1999; Narver et al. 2004). Solar companies in Nigeria seek for information from customers in order to obtain better understanding of their differences, expectation, requirements and respond accordingly. This is the way they can compete favorable during economic crisis (Ooncharoen et al. 2009).

## 2.8. Comparison of how companies in Finland and Nigeria survive in dynamic and turbulent business environments

**Table 3.** Comparison of the strategies Finnish and Nigerian companies adopt in dynamic and turbulent business environments

<b>Comparison of survival strategies</b>	
<b>Finland</b>	<b>Nigeria</b>
Efficiency strategies	Executive vision for globalization
Product strategies	Research and development
Expense strategies	Technology adaptation competency
Asset strategies	Continuous improvement concentration
Finance strategies	Employee education and training
	Market acceptance quality
	Diversified market behavioral learning

The comparison table above was generated on the basis of the information gathered from previous research.

## 2.9. Outsourcing

Outsourcing can be defined as the act of contracting out certain tasks or business to another company referred to as third party. Throughout the industrialized world, outsourcing has grown significantly. For many firms, outsourcing is considered as a way of organizing their production in order to achieve competitiveness easily. Many manufacturing companies do not manufacture all the parts needed for a certain machine; some vital parts are outsourced to other companies (Domberger, 1999). The same situation is applicable to solar energy companies.

An interview with solar personnel in Nigeria revealed that some parts required for solar installations are outsourced to Chinese companies. These parts are outsourced so that the company can focus more on their core competency. The confederation of Finnish industry and employers came up with the statistics that in 1996, subcontracting amounted for about 50 percent of the sales of Finnish manufacturing firms (apart from those operating in energy industries).

Outsourcing has been widely used in different industries and sectors across many companies for example, in administration, sales, IT and business services, market intelligence, logistics, product and development. (Freytag et al. 1999). Outsourcing can be both risky and strategic ( Diromualdo et al. 1998).

Furthermore, the rate at which activities were outsourced was estimated to have risen by 30 percent during 1993-1996. For example, Nokia depend on more than 300 domestic (Finnish) subcontractors and about 300 foreign subcontractors (Shy, 2003).

Outsourcing is considered as a way of improving the overall scheduling performance in different firms especially in manufacturing companies. When non-critical activities are outsourced to subcontractors, this paves way for the firm to concentrate more on high value operations. One of the reasons why many manufacturers subcontract their activities to other companies is due to the fact that demand requested from customers are often too much to be fulfilled. In situations like this, they transfer most of their activities to subcontractors in order to handle fluctuations due to demand. This way, there won't be any need to store more inventories. An efficient outsourcing plan can improve lead times; bring about a reduction in total costs thereby making the company competitive.

Nowadays, interest has been developed when it comes to finding an appropriate outsourcing policy that is necessary for a company to compete favorably with other companies and possibly emerge over their rivals. A manufacturer can benefit from

outsourcing and a maximum benefit can be achieved when there is sufficient production plan that can cope with the challenges and complexity of outsourcing.

In order to achieve this benefit, the company's management needs to know what quantities of the various products that should be outsourced to other companies.

Outsourcing is not all about purchasing products or services from other companies that are external to the company, transfers of certain responsibility of the physical business function and both tacit and codified knowledge to the external company. It involves the adaptation which has to do with driven cost rewards, competitiveness, and strategic development. (Ian et al.2004).

There are many advantages associated with outsourcing, these are:

- 1) Cost advantage
- 2) More focus on core competency
- 3) Quality and capability
- 4) Labor flexibility

**Cost advantage:** Cost is often negotiable between the company and the third party involved; this makes it cheaper for the company that is outsourcing services.

**More focus on core competency:** Companies usually have many activities to take off for example marketing, accounting, finance, production, transportation, logistics, and security among others. Some of these activities are not the core competency of the company. Handling non-core activities can cause some distractions for the company.

**Quality and capability:** When activities are outsourced to companies, these companies handle such activities properly since they are in to such businesses and the quality of such services are often high.

**Labor flexibility:** Is often guaranteed when services are outsourced to a third part. For example it is not feasible for a company to hire workers for a fixed term project, when these services are outsourced to other companies, there won't be any need to hire employees.

### **Problems with outsourcing subcontractors**

There are also some risks associated with outsourcing services to subcontractors. These risks are:

- 1) Project failure
- 2) Changes in economic policy of government
- 3) Vendor's inadequate familiarity with their client's business

**Project failure:** Is as a result of poor communication. This can arise due to language barrier. Many companies outsource their services to companies in other countries and this creates bottleneck in communication. Nowadays, many companies outsource their services to subcontractor suppliers that can communicate in their preferred language.

**Changes in economic policy of government:** is another risk associated with outsourcing subcontractors especially from abroad. Some government policies can account for certain restrictions on small and medium size enterprise and multinational companies as well. Inadequate infrastructure on the other hand can bring about poor quality and timeliness will not be guaranteed. When outsourcing is not done abroad, government policy may not have any impact on timeliness or quality.

**Vendor's inadequate familiarity with their client's business:** Is a critical factor which can bring about risk in outsourcing. When a vendor does not have a good understanding of what is required by their clients, they won't meet all the conditions specified by them. Therefore, it is necessary for vendors to have proper understanding of their client's needs.

### **3. RESEARCH METHODOLOGIES**

Methods such as sense and respond, Analytical hierarchy process and decision making elements for choosing subcontractors and outsourcing manufacturing are used in this thesis. The Sense and respond method is used to analyze dynamic business strategies while the AHP method is used to analyze questionnaires and weight calculation of both main criteria and sub-criteria.

The decision making elements for choosing subcontractors and outsourcing manufacturing are benchmarking tools used for making decision and evaluating subcontractors.

#### **3.1. Sense and respond methodology**

Sense and respond (S&R) is a business concept which first featured in 1992 Management Review article written by Heackle (1992). The sense and respond concept is established by Brandley and Nolan (1998) and Markindes (2000) to analyze dynamic business strategies (Liu et al.2011).

The sense and respond concept was used by Ranta and Takala in 2007 to establish the operative management system by including critical factor index (CFI). Ever since, the S&R model has undergone three different stages of development namely:

- 1) CFI model
- 2) BCFI model
- 3) SCFI model

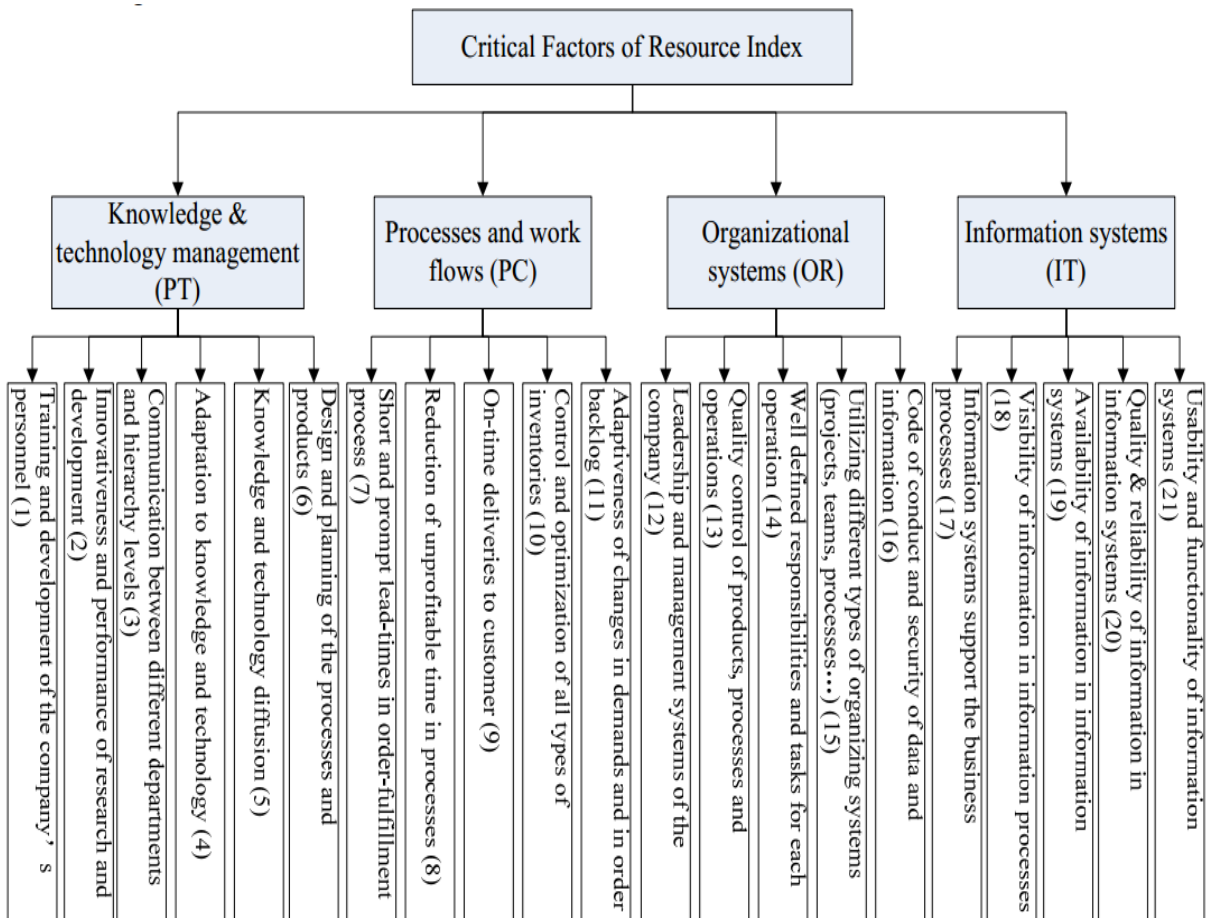
See table 4 below.

There are common parts that exist between the three models; this can be seen in equation (1) and (4). There is also a significant difference which can be seen in the numerator. There are four critical factors in the S&R model, these are knowledge and technology management (PT), process & work flows (PC), organizational systems (OR) and



information systems (IT) are used in the S&R model to analyze CFI of the case companies.

In addition, there are 21 different critical factor attributes which are included to analyze four basic factors of enterprise resource, see the figure below (Liu et al.2011).



**Figure 6.** Critical factor of research index (Liu et al.2011)

The general part of CFI, BCFI and SCFI are listed in equations 1 to 4 below.

$$\text{Importance index} = \frac{\text{Average of expectation}}{10} \dots\dots\dots(1)$$

$$\text{Performance index} = \frac{\text{Average(experience)}}{10}; \dots\dots\dots(2)$$

$$\text{Gap index} = \left| \frac{\text{Average(experience)} - \text{Average(expectation)}}{10} \right|; \dots\dots\dots(3)$$

$$\text{Development index} = |(\text{better-worse}) * 0,9 - 1| \dots\dots\dots (4)$$

**Table 4.** The summary equations of each model

Name	Model
CFI	$\text{CFI} = \frac{\text{Std}\{\text{experience}\} \cdot \text{Std}\{\text{expectation}\}}{\text{Importance index} \cdot \text{Gap index} \cdot \text{Development index}} \dots\dots\dots(5)$
BCFI	$\text{SD Experience index} = \frac{\text{Std}\{\text{experience}\}}{10} + 1 \dots\dots\dots (6)$ $\text{SD Expectation} = \frac{\text{Std}\{\text{expectation}\}}{10} + 1 \dots\dots\dots(7)$ $\text{BCFI} = \frac{\text{Expectation index} \cdot \text{SD Experience index} \cdot \text{Performance index}}{\text{Importance index} \cdot \text{Gap index} \cdot \text{Development index}} \dots\dots\dots(8)$
SCFI	$\text{SCFI} = \frac{\sqrt{\frac{1}{n} \cdot \sum_1^n [\text{experience}(i)]^2} \cdot \sqrt{\frac{1}{n} \cdot \sum_1^n [\text{expectation}(i) - 11]^2} \cdot \text{Performance index}}{\text{Importance index} \cdot \text{Gap index} \cdot \text{Development index}} \dots\dots(9)$

(Liu et. 2011)

CFI is a model introduced by Ranta and Takala (2007) to translate and evaluate the critical factors of strategic adjustment which can help in strategic decision-making phase. The BCFI model is developed by Nadler and Takala (2010) on the basis of the CFI model principle. The summary equations of each model are shown in the table above (Table 4).

### 3.2. Analytical Hierarchy Process (AHP)

Analytical Hierarchy Process otherwise known as AHP method is referred to as a multi-attribute instruments that makes it possible to consider quantitative, qualitative measures and making tradeoffs (Saaty 1980). The AHP is an instrument that is used in the empirical part of this study. It is used to analyze questionnaires and weight calculation of main criteria and sub-criteria (Liu et al. 2010) as shown in figure 7 below.

The AHP instrument is aimed at integrating different quantities into single overall score for the purpose of ranking decision alternatives with pair wise comparison of selected attributes (Rangone, 1996).It makes use of pair wise comparisons by conducting interviews for the experts within the entire organization.

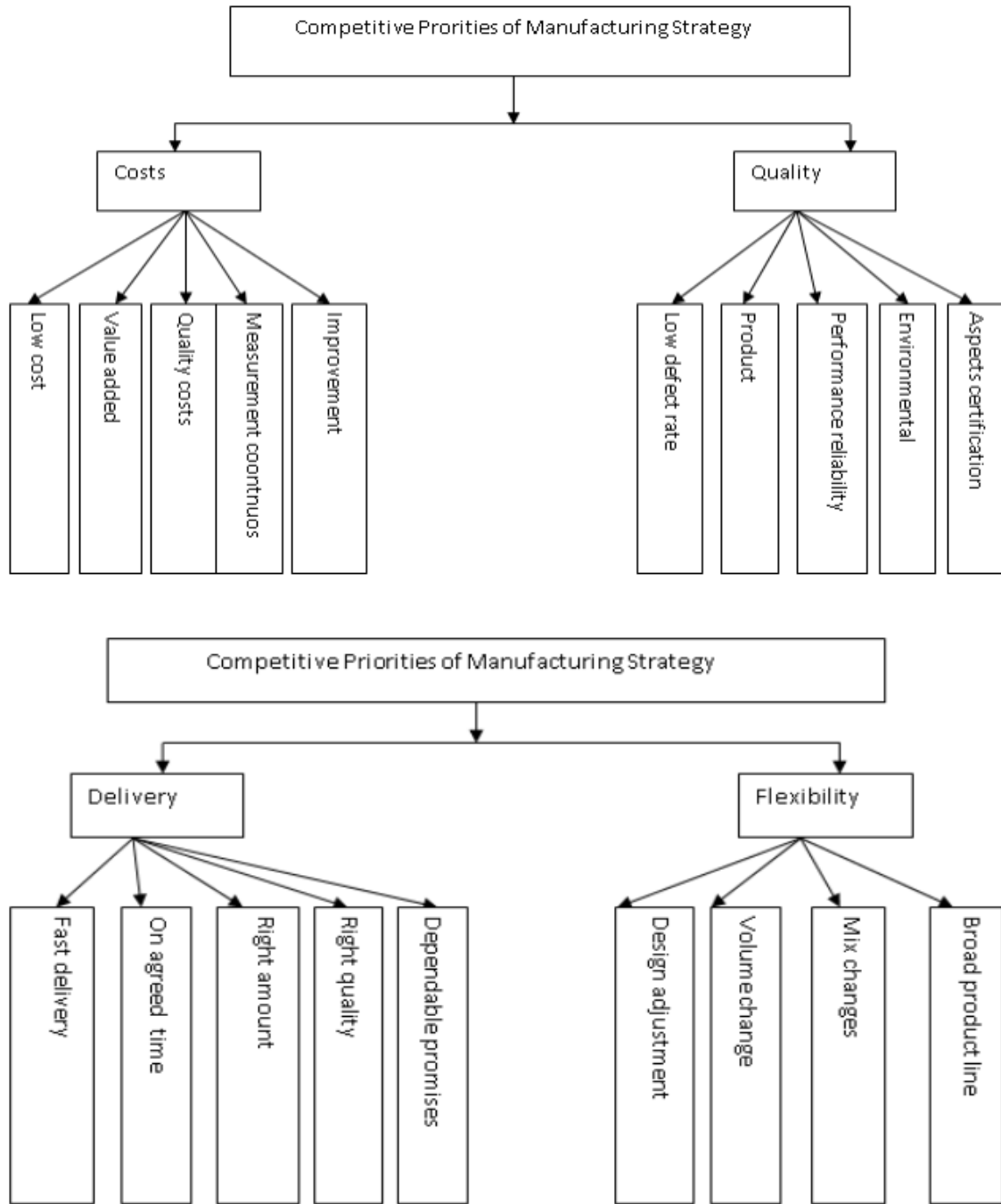
The AHP-based models can explore the varying degrees of importance of the indicators and drivers of competitiveness in a comprehensive way (Sirikari et al. 2006).The results obtained from the AHP methods have been proven to be reliable and valid. There is a step by step procedure involved in using the AHP method, these steps are:

- 1) To design the model of hierarchy structure for the goal. This hierarchy models are constructed for the evaluation of manufacturing strategy in this study. This approach was formulated by Takala et al. (2007b) and also, the transformational leadership Takala et al.(2008), which serves as a theoretical frame work (Liu et al. 2010)
- 2) The second step involves the comparison of both the alternatives and criteria. These are pair wise when compared with respect to each element of the next higher level.
- 3) The third step has to do with the comparisons to obtain the priorities of the alternatives with respect to each criterion and the weights of each criterion with respect to the goal.

Finally, the local proprieties are then extrapolated by the weights of the respective criteria. The results obtained are summed up to obtain the overall priority of each alternative. The goal of AHP is competitive priority of manufacturing strategy where the

main criteria are cost, quality, delivery and flexibility. The main criteria yield the sub criteria. See figures 7 below.

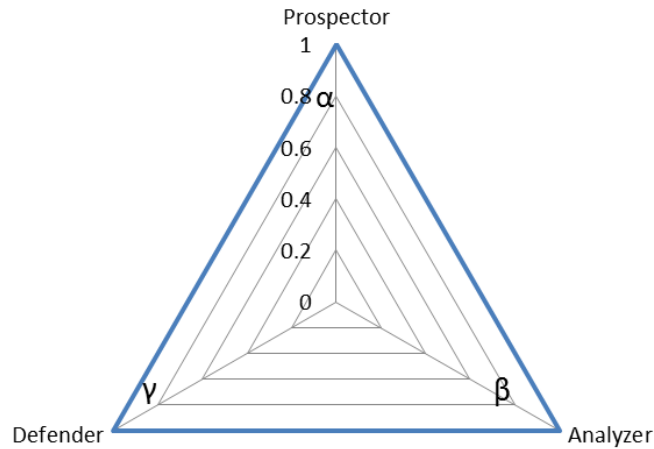
The S&R questionnaire used in this thesis comprises of the above priorities.



**Figure 7.** Analytical hierarchy process (AHP) (Liu et al 2011)

**Manufacturing strategy:** The analytical models for manufacturing strategy are used to extrapolate the operational competitiveness indexes of companies existing in different competitive groups such as prospector, analyzer and defender. The manufacturing strategy index is denoted by (MSI). Manufacturing strategy index is modelled on the basis of the existing multi criteria priority weights of Q (Quality), C (Cost), T (Time/delivery) and F (Flexibility), as function  $MSI=f_{MSI}(Q,C,T,F)$  (Takala et al. 2012).

**Sustainable competitive advantage (SCA):** is achieved by a company when all the attributes that are necessary for the company to perform at a higher level than their rivals are available. A company can be categorized as prospector, analyzer or defender depending on its survival strategy i.e. Prospector, analyzer and defender are sustainable competitive advantages companies can adopt. A company that adopts the defender strategy seeks to protect their market from new competitors thereby improving the efficiency of their existing operations. On the other hand, companies that innovate, take advantage of new strategies and opportunities, take risk in order to grow is said to be utilizing the prospector strategy. Companies adopting the analyzer strategy tend to maintain their current businesses and innovative as well (Ryszard et al, 2005). The figure below illustrates operation strategy.



**Figure 8.** Manufacturing strategy (Takala et. al 2012)

In this thesis, the manufacturing strategy index for prospector is calculated using the equation:

$$MSI_P = 1 - (1 - Q^{1/3})(1 - 0.9T)(1 - 0.9C)F^{1/3} \dots\dots\dots (10)$$

While the MSI model for analyzer group is calculated by:

$$MSI_A = 1 - (1 - F)((0.95Q^2 - 0.285)(0.95T^2 - 0.285)(0.95C^2 - 0.285))^{1/3} \dots\dots\dots (11)$$

And MSI model for defender group is calculated by:

$$MSI_D = 1 - (1 - C^{1/3})(1 - 0.9T^2)(1 - 0.9Q^2)F^{1/3} \dots\dots\dots (12)$$

Where Q=Quality, C=Cost, T=Time/delivery and F=Flexibility.

Equations 13, 14, 15 and 16 below are used for the calculations of normalized weights of four main criteria in the analytical models.

$$Q\% = \frac{Q}{Q + C + T} \dots\dots\dots(13)$$

$$C\% = \frac{C}{Q + C + T} \dots\dots\dots(14)$$

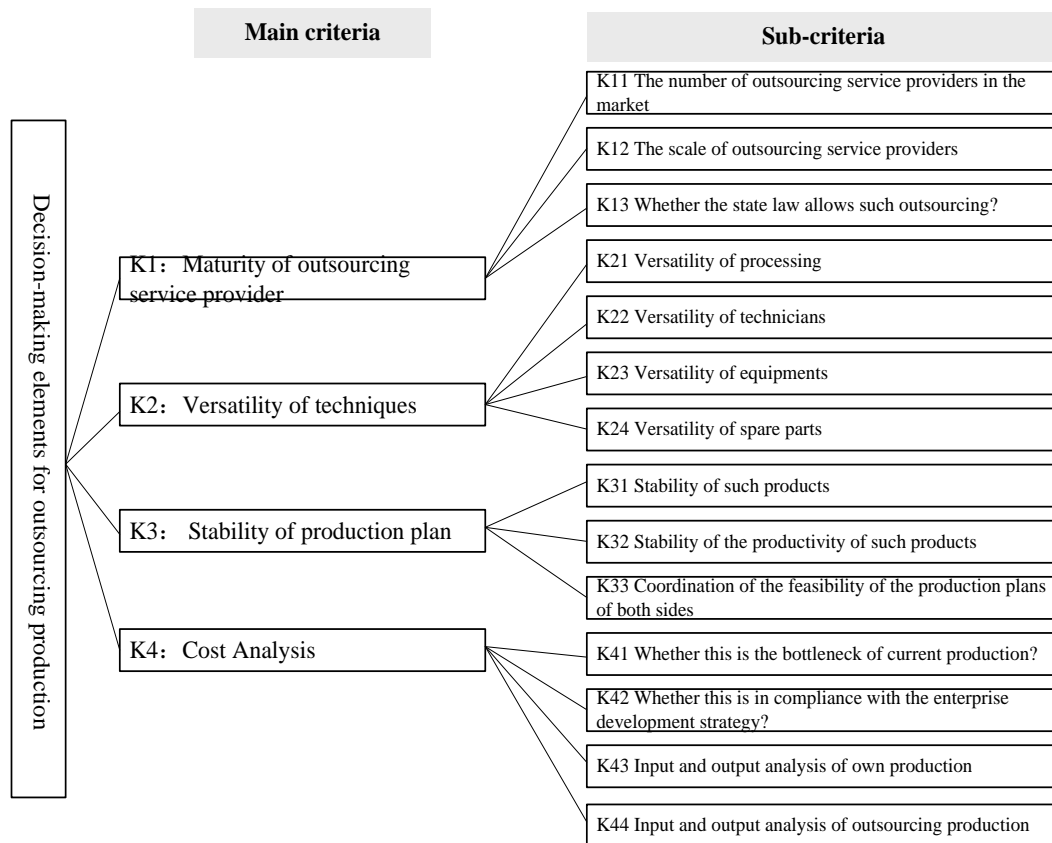
$$T\% = \frac{T}{Q + C + T} \dots\dots\dots(15)$$

$$F\% = \frac{F}{Q + C + T + F} \dots\dots\dots(16)$$



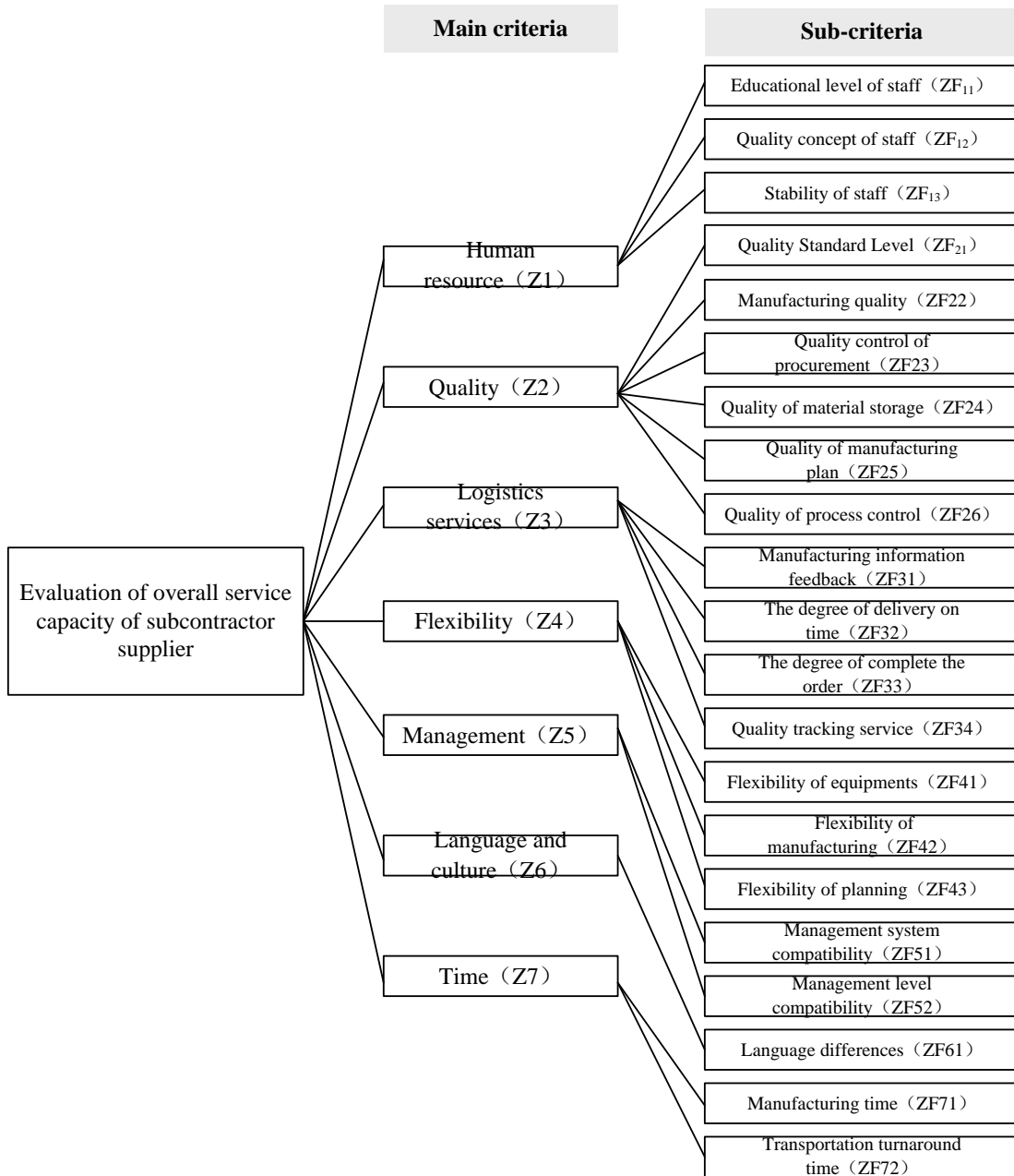
### 3.3. Decision making elements

Decision-making elements for outsourcing production comprises of both main criteria and sub-criteria. Similarly, evaluation elements for choosing subcontractor suppliers comprises of both main criteria and sub-criteria. Both main and sub-criteria of the decision-making elements for outsourcing production can be seen in figure 9 below



**Figure 9.** Decision-making elements for outsourcing production (Liu 2013)

Main and sub-criteria evaluation elements for choosing subcontractor suppliers can be seen in the figure below.



**Figure 10.** Evaluation elements for choosing subcontractor suppliers (Liu, 2013)

## 4. CASE COMPANIES

The study of this thesis is based on the information gathered from 20 solar energy companies in Nigeria and 3 manufacturing companies in Finland. Some of the solar energy companies are into the manufacturing of solar energy components like high tech inverters while some are mainly into the design and installation of solar panels and solar energy equipment. Solar energy companies from different regions of Nigeria were interviewed to get a broader view of the research problem. The manufacturing companies interviewed in Finland are manufacturers of low voltage products, power systems and engine spare parts while some are into maintenance services, process automation and process designs. In the case of the Finnish manufacturing companies, the data were obtained from previous research.

**Table 5.** List of Nigerian solar companies interviewed

	Name of company	Location	Business area	Interviewee
1	NIG1	Lagos-Nigeria	Wind energy/solar	Chief executive officer
2	NIG2	Abuja-Nigeria	Solar/Bio energy	Chief executive officer
3	NIG3	Abuja-Nigeria	Solar energy, battery charger	Manager
4	NIG4	Kaduna-Nigeria	Solar energy and power backup	Manager
5	NIG5	Lagos-Nigeria	Inverters, solar lamps, street light poles	Manager
6	NIG6	Lagos-Nigeria	Solar/wind energy	Chief executive

				officer
7	NIG7	Lagos-Nigeria	Hydro, solar and wind energy	Personnel officer
8	NIG8	Lagos-Nigeria	Alternative power systems/Solar energy	(4 Managers)
9	NIG9	Lagos-Nigeria	Alternative power systems/Solar energy	Managing director
10	NIG10	Warri-Nigeria	Solar powered bore hole, design, solar energy	(4 managers)
11	NIG11	Lagos-Nigeria	LED fittings, batteries and accessories	Managing director
12	NIG12	Lagos-Nigeria	Solar photovoltaic systems/backup power system	Personnel officer
13	NIG13	Lagos-Nigeria	Alternative power systems/solar energy	Managing director
14	NIG14	Port Harcourt-Nigeria	Wind energy/electric vehicles/solar energy	Managing director
15	NIG15	Lagos-Nigeria	Bio energy, solar and wind energy	Manager
16	NIG16	Lagos-Nigeria	Bug detector, cctv camera & solar	(4 managers)

17	NIG17	Kwara-Nigeria	Solar energy	Chief executive officer
18	NIG18	Port Harcourt-Nigeria	Inverters and solar equipment	Personnel officer
19	NIG19	Edo-Nigeria	Inverter and solar	Managing director
20	NIG20	Port Harcourt-Nigeria	Batteries, inverters and solar panels	Manager

The Nigerian solar energy companies are denoted with NIG while the Finnish manufacturing companies are denoted with FIN. Solar energy has not been a well known source of energy in Nigeria but presently, it is beginning to gain popularity due to the high rate of power outages and shortages in the country.

**Table 6.** List of Finnish manufacturing companies considered

	Name of company	Location	Business area	Interviewee
1	FIN1	Vaasa	Gas engines, control automation components and its assembly parts, softwares and manufacturing execution systems	Project manager
2	FIN2	Vaasa	Low Voltage Products Process Automation Power Systems Power Products	(3 different Managers)
3	FIN3	Oulu	Material handling services	2 different managers

## **4.1. Data collection**

The data used in this thesis are obtained via the answering of questionnaires from interviewee of the case companies' general managers, chief executive officers, manufacturing engineering sector personnel, project manager and entrepreneur with more than 4 years working experience. A total of 5 questionnaires were used in the data collection, they are:

- 1) Sense and respond questionnaire
- 2) MSI questionnaire
- 3) Case study outsourcing questionnaire
- 4) The combined micro level questionnaire
- 5) The combined macro level questionnaire

A web tool consisting of both MSI and S&R questionnaires was used to collect the data for dynamic and turbulent business environments. The past and future values of NSCFI and MSI were calculated by the web tool software. Case study outsourcing questionnaire, combined micro level questionnaire and combined macro level questionnaire were used to collect the data necessary to evaluate:

- 1) How solar energy companies and manufacturing companies formulate the evaluation elements for choosing subcontractor suppliers
- 2) How solar energy companies and manufacturing companies make decisions on manufacturing outsourcing.

## **4.2. Sense and respond questionnaire**

The Sense and respond questionnaire comprises of 20 attributes within Quality (Q), Cost (C), Time (T) and Flexibility (F). To get a better understanding of the S&R model, the value of each index in the models from (1) to (20) can be obtained from the sample questionnaire

below. The values of all the attributes in figure 7 can be calculated using the models. The smaller values have more critical attributes than the bigger ones. Table 7 below shows the direction of development and development experience.

Direction of development refers to the prediction of development trend in the next three years based on enterprise performance in the past two years while development experience refers to the summary of business development during the past two years (Liu et al. 2011).

**Table 7.** S&R sample questionnaire

ATTRIBUTES	Expectations	Experience	Past Development			Future Development		
	(1-10)	(1-10)	Worse	Same	Better	Worse	Same	Better
Resource impute in	Multi-Criteria		Operations Strategy					
Quality								
Cost								
Time								
Flexibility								

### 4.3. MSI questionnaire

A pairwise comparison on a scale from 9 on the left hand side up to 9 on the right hand side is employed in the MSI questionnaire. The full questionnaire comprises of 6 top-level questions of both past and future MSI and 46 detained questions. Table 8 below shows a sample of the MSI questionnaire.



**Table 8.** Sample of MSI questionnaire

Cost (C)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Quality (Q)
Cost (C)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Delivery(D)
Cost (C)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Flexibility (F)
Quality (Q)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Delivery (D)
Quality (Q)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Flexibility (F)
Deliver (D)	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Flexibility (F)

If cost has much effect on the company's service strategy than quality, the evaluation will be done on the left hand side by making an (x) mark at 9 and vice versa. If both cost and quality have equal effect on the company's operation strategy, (x) will be put on 1. The same condition applies to other rows.

**Table 9.** Sample of the combined level macro questionnaire

	Scale: 1=low, 10 = high	
	Expectations (1-10)	Experience (1-10)
1. Evaluate the benefits of cooperation with R&D sector for your company	5	5
2. Evaluate the risks which you share with your partner	5	5
3. Do your organization and your partner have common vision and goal	10	10
4. Evaluate the resource providing to your partner	8	7

#### **4.4. Case study**

The collected S&R data from 4 solar energy companies have been analyzed thoroughly while the remaining 16 companies have been partially analyzed. This is due to the fact that 4 informants each were interviewed in the 4 analyzed solar energy companies while a few informants were interviewed in the rest of the companies. The past and future values of BCFI, SCFI, CFI, MSI and NSCFI have been calculated. The results of the analysis are compared with the results obtained from the analysis of some Finnish manufacturing companies. The evaluation elements for choosing subcontractor suppliers and decision-making elements of outsourcing production are analyzed separately using different questionnaires.

## 5. RESULT AND ANALYSIS

**Table 10.** List of solar energy companies

<b>NIG1</b>	<b>Q</b>	<b>C</b>	<b>T</b>	<b>F</b>	<b>P</b>	<b>A</b>	<b>D</b>
P-MSI	0.27155	0.2456	0.2865	0.19639			
F-MSI	0.18832	0.3406	0.1987	0.27239			
P-NSCFI	0.21127	0.2433	0.3868	0.1586	0.91335	0.96491	0.9168
F-NSCFI	0.27039	0.2441	0.3263	0.1592	0.91797	0.97895	0.91534

<b>NIG2</b>	<b>Q</b>	<b>C</b>	<b>T</b>	<b>F</b>	<b>P</b>	<b>A</b>	<b>D</b>
P-MSI	0.30504	0.1525	0.3218	0.22061			
F-MSI	0.22215	0.2222	0.2344	0.32132			
P-NSCFI	0.19166	0.2563	0.3596	0.19252	0.90586	0.95854	0.9135
F-NSCFI	0.30716	0.2032	0.3141	0.17559	0.9197	0.94673	0.90876

<b>NIG3</b>	<b>Q</b>	<b>C</b>	<b>T</b>	<b>F</b>	<b>P</b>	<b>A</b>	<b>D</b>
P-MSI	0.27168	0.1941	0.317	0.21728			
F-MSI	0.32285	0.2306	0.1883	0.2582			
P-NSCFI	0.25282	0.1733	0.3589	0.21499	0.91113	0.95153	0.90095
F-NSCFI	0.30704	0.1523	0.3515	0.18914	0.91956	0.91864	0.90139

<b>NIG4</b>	<b>Q</b>	<b>C</b>	<b>T</b>	<b>F</b>	<b>P</b>	<b>A</b>	<b>D</b>
P-MSI	0.50056	0.2145	0.1738	0.11116			
F-MSI	0.25956	0.445	0.1802	0.11529			
P-NSCFI	0.20744	0.2846	0.2793	0.22866	0.90239	0.96259	0.91165
F-NSCFI	0.22279	0.2886	0.30001	0.18862	0.90893	0.96437	0.91603

<b>NIG12</b>	<b>Q</b>	<b>C</b>	<b>T</b>	<b>F</b>	<b>P</b>	<b>A</b>	<b>D</b>
P-MSI	0.15009	0.1939	0.3167	0.33931			
F-MSI	0.22334	0.2886	0.2356	0.25246			
P-NSCFI	0.23631	0.2665	0.2542	0.243	0.90432	0.97965	0.90798
F-NSCFI	0.25627	0.2121	0.2976	0.23403	0.90799	0.96992	0.90247

<b>NIG7</b>	Q	C	T	F	P	A	D
P-MSI	0.16933	0.0624	0.3841	0.38413			
F-MSI	0.15938	0.1175	0.3616	0.36156			
P-NSCFI	0.26036	0.2452	0.2261	0.2683	0.90526	0.98189	0.90335
F-NSCFI	0.27535	0.2935	0.2391	0.19204	0.9141	0.98322	0.91593

<b>NIG9</b>	Q	C	T	F	P	A	D
P-MSI	0.08725	0.3758	0.26847	0.26847			
F-MSI	0.12871	0.2772	0.19803	0.39605			
P-NSCFI	0.25567	0.2734	0.23181	0.23916	0.9071	0.98443	0.90915
F-NSCFI	0.21684	0.2318	0.34848	0.20283	0.90737	0.97519	0.90918

<b>NIG11</b>	Q	C	T	F	P	A	D
P-MSI	0.17539	0.3172	0.25369	0.25369			
F-MSI	0.20087	0.3633	0.29055	0.14527			
P-NSCFI	0.26268	0.2907	0.20904	0.23754	0.90839	0.96713	0.91154
F-NSCFI	0.25264	0.3565	0.22679	0.16411	0.91613	0.98405	0.9255

<b>NIG14</b>	Q	C	T	F	P	A	D
P-MSI	0.18912	0.24434	0.16749	0.39905			
F-MSI	0.23626	0.30524	0.20924	0.24926			
P-NSCFI	0.2368	0.26028	0.22957	0.27336	0.90185	0.98009	0.90487
F-NSCFI	0.20873	0.25602	0.23968	0.29557	0.89635	0.98587	0.90295

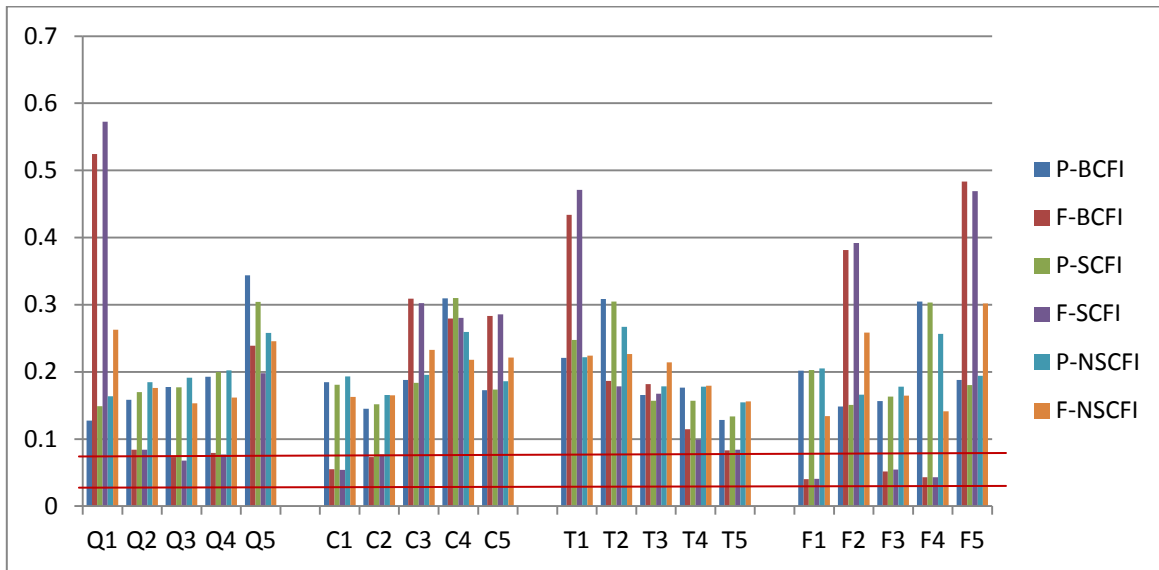
<b>NIG15</b>	Q	C	T	F	P	A	D
P-MSI	0.25766	0.25766	0.18406	0.30061			
F-MSI	0.30324	0.30324	0.21662	0.17689			
P-NSCFI	0.2407	0.28677	0.23909	0.23344	0.9059	0.98317	0.91121
F-NSCFI	0.20397	0.34529	0.21756	0.23318	0.90272	0.9682	0.91859

<b>NIG17</b>	Q	C	T	F	P	A	D
P-MSI	0.31211	0.31211	0.22295	0.15283			
F-MSI	0.33793	0.33793	0.2414	0.08274			
P-NSCFI	0.25964	0.25027	0.3246	0.16549	0.91601	0.99633	0.91506
F-NSCFI	0.24617	0.26301	0.34604	0.14477	0.91797	0.98274	0.9196

<b>NIG5</b>	Q	C	T	F	P	A	D
P-MSI	0.17098	0.22091	0.24732	0.36079			
F-MSI	0.19511	0.25208	0.14111	0.4117			
P-NSCFI	0.24683	0.22718	0.2404	0.2856	0.90224	0.97894	0.89958
F-NSCFI	0.24767	0.234	0.28735	0.23098	0.90699	0.98605	0.90532
<b>NIG18</b>	Q	C	T	F	P	A	D
P-MSI	0.30176	0.21557	0.24133	0.24133			
F-MSI	0.30176	0.21557	0.24133	0.24133			
P-NSCFI	0.21277	0.28083	0.26949	0.23691	0.90213	0.96922	0.9104
F-NSCFI	0.20115	0.30031	0.2434	0.25514	0.89912	0.96917	0.91146
<b>NIG19</b>	Q	C	T	F	P	A	D
P-MSI	0.25181	0.23984	0.23984	0.26851			
F-MSI	0.25181	0.23984	0.23984	0.26851			
P-NSCFI	0.24071	0.25931	0.27304	0.22693	0.90641	0.9796	0.90861
F-NSCFI	0.2042	0.26565	0.28168	0.24846	0.89992	0.96547	0.9078
<b>NIG13</b>	Q	C	T	F	P	A	D
P-MSI	0.21041	0.21041	0.34363	0.23556			
F-MSI	0.23514	0.11757	0.38403	0.26325			
P-NSCFI	0.24541	0.2414	0.25515	0.25804	0.90412	0.97711	0.90361
F-NSCFI	0.20121	0.20984	0.28707	0.30188	0.89536	0.99395	0.89668
<b>NIG20</b>	Q	C	T	F	P	A	D
P-MSI	0.13872	0.40975	0.20065	0.25089			
F-MSI	0.15419	0.45544	0.11151	0.27887			
P-NSCFI	0.28023	0.21354	0.26007	0.24616	0.90954	0.97293	0.9013
F-NSCFI	0.28924	0.19272	0.33255	0.18548	0.91714	0.94404	0.90636
<b>NIG10</b>	Q	C	T	F	TOTAL		
P-BCFI	0.236483	0.279686	0.236181	0.24765	1		
F-BCFI	0.399686	0.472705	0.051507	0.076102	1		
P-SCFI	0.249266	0.278853	0.240011	0.231871	1		
F-SCFI	0.414582	0.463791	0.051508	0.070118	1		
P-CFI	0.238343	0.238052	0.254808	0.268798	1		
F-CFI	0.061621	0.061545	0.494615	0.382219	1		
P-MSI	0.29665	0.29665	0.20335	0.20335	1		
F-MSI	0.37237	0.37237	0.12763	0.12763	1		
P-NSCFI	0.22452	0.24817	0.231	0.29631	1		
F-NSCFI	0.20307	0.27322	0.26434	0.25937	1		

<b>NIG16</b>	Q	C	T	F	SUM
P-BCFI	0.174215	0.331038	0.272726	0.222021	1
F-BCFI	0.322817	0.1476	0.414391	0.115192	1
P-SCFI	0.188331	0.350066	0.268753	0.19285	1
F-SCFI	0.344335	0.15401	0.402928	0.098727	1
P-CFI	0.261752	0.266036	0.209243	0.262969	1
F-CFI	0.126806	0.294587	0.12362	0.454987	1
P-MSI	0.18988	0.18988	0.31012	0.31012	1
F-MSI	0.22473	0.22473	0.18351	0.36703	1
P-NSCFI	0.19032	0.22127	0.33827	0.25014	1
F-NSCFI	0.23874	0.22475	0.36036	0.17615	1
<b>NIG8</b>	Q	C	T	F	TOTAL
P-BCFI	0.272628	0.259968	0.251278	0.216125	1
F-BCFI	0.11951	0.11396	0.60583	0.160699	1
P-SCFI	0.269359	0.263846	0.245714	0.221081	1
F-SCFI	0.11925	0.11681	0.598303	0.165637	1
P-CFI	0.238093	0.238247	0.260889	0.26277	1
F-CFI	0.350628	0.350854	0.069854	0.228663	1
P-MSI	0.169328	0.062419	0.384126	0.384126	1
F-MSI	0.15938	0.1175	0.36156	0.36156	1
P-NSCFI	0.26036	0.24524	0.2261	0.2683	1
F-NSCFI	0.27535	0.2935	0.23911	0.19204	1
<b>NIG6</b>	Q	C	T	F	TOTAL
P-BCFI	0.245517	0.222691	0.228986	0.302805	1
F-BCFI	0.233803	0.259781	0.21806	0.288357	1
P-SCFI	0.260926	0.235741	0.236679	0.266655	1
F-SCFI	0.247839	0.274216	0.22474	0.253204	1
P-CFI	0.230441	0.269458	0.250063	0.250038	1
F-CFI	0.24244	0.231419	0.263084	0.263057	1
P-MSI	0.169328	0.062419	0.384126	0.384126	1
F-MSI	0.15938	0.1175	0.36156	0.36156	1
P-NSCFI	0.26036	0.24524	0.2261	0.2683	1
F-NSCFI	0.27535	0.2935	0.23911	0.19204	1

### BCFI Vs SCFI Vs NSCFI (Case company NIG10)



**Figure 11.** Results of BCFI Vs SCFI Vs NSCFI (Case company NIG 10)

The collected sense and respond data from NIG10 is shown in the above figure. The figure illustrates the trend of how critical factors change and their development directions. The figure also shows the calculated S&R results of past and future values of the following models; BCFI, SCFI and NSCFI. The range of the attributes are of three different categories namely; resourced, balanced and under resourced. Attributes that falls within the range of  $\frac{1}{3}$  and  $\frac{2}{3}$  of the average resource level are considered to be balanced while the attributes that are below  $\frac{1}{3}$  are considered under resourced. All the attributes that are higher than  $\frac{2}{3}$  are over resourced. In this thesis, the average level is  $100\%/20=5\%$ , this implies that the judging values are 3.333% and 6.667%. Therefore, any attribute that is lower than 3.333% is under resourced and any attribute that is higher than 6.667% is over resourced. The resourced levels are marked with a red line in figure 11 above.

Table 11 below shows a comparison of past and future BCFI, SCFI and NSCFI. All the attributes have been analyzed one by one.

**Table 11.** Comparison of Past and Future BCFI, SCFI and NSCFI

Attribute	P-BCFI	F-BCFI	Trend	P-SCFI	F-SCFI	Trend	P-NSCFI	F-NSCFI	Trend
1	Over	Over	better	over	over	better	Over	Over	Better
2	Over	Over	better	over	over	better	Over	Over	Better
3	Over	over	better	over	over	better	Over	Over	Better
4	Over	over	better	over	over	better	Over	Over	Better
5	Over	over	better	over	over	better	Over	Over	Better
6	Over	over	better	over	over	better	Over	Over	Better
7	Over	over	better	over	over	better	Over	Over	Better
8	Over	over	better	over	over	better	Over	Over	Better
9	Over	over	better	over	over	better	Over	Over	Better
10	Over	over	better	over	over	better	Over	Over	Better
11	Over	over	better	over	over	better	Over	Over	Better
12	Over	over	better	over	over	better	Over	Over	Better
13	Over	good	better	over	good	better	Over	Over	Better
14	Over	good	better	over	good	better	Over	Over	Better
15	Over	good	better	over	good	better	Over	Over	Better
16	Over	good	better	over	over	better	Over	Over	Better
17	Over	good	better	over	good	better	Over	Over	Better
18	Over	over	better	over	over	better	Over	Over	Better
19	Over	over	better	over	over	better	Over	Over	Better
20	Over	over	better	over	over	better	Over	Over	Better

The figure illustrates how the attributes change before crisis and during crisis. This is based on the analysis of 20 attributes. The change before economic crisis and during economic crisis has been depicted clearly in table 11 above. The trend shows how different attributes change from past to future. When the value of an attribute in both before and during are good, the trend is considered to be no change and marked with “-”. The values that change from good to other show a worse trend and if values change from other to good, the trend is better. On the contrary, if the values change from other to good, the trend is better. If the values are both over or under, the trend still depicts that their direction is going better or worse. For example, over goes lower or under goes higher means better whereas over goes higher or under goes lower means worse. When comparing the results, a deduction can be made for the values. It can be seen clearly that all the values are valid. The trends of BCFI,



SCFI and NSCFI are marked with “better”. Therefore the trend in turbulent environments shows good result. There are no cases of zero index values. Zero index values often occur as a result of zero standard deviation in the data collected, this occurrence is not uncommon. The BCFI and SCFI have been proven to be useful tools in solving problems related to dynamic and turbulent business environments. If there is inconsistent result in CFI than in BCFI and SCFI, this implies that critical factor index as the benchmark will be considered incorrect in real case study analysis. Therefore, the derived formulas such as BCFI and SCFI are considered the best alternative.

### **Manufacturing strategy index (MSI)**

**Table 12.** Integrated values of MSI

	Q	C	T	F	SUM
P-MSI	0.29665	0.29665	0.20335	0.20335	1
F-MSI	0.37237	0.37237	0.12763	0.12763	1

Table 12 above shows the integrated values of the MSI results from the company. Both past and future manufacturing index values for Q, C, D and F equals 1. From the above table, it can be seen clearly that the case company is focusing more on quality and cost. One of the respondents from the company said “With poor quality, you cannot enjoy the money paid by your clients”. He further stated that poor quality is usually accompanied by series of complaints from the clients. Therefore, when good quality is guaranteed, the clients are satisfied and the company is satisfied as well. Cost is another attribute that is taken into consideration. In order to survive in hostile business environments, both quality and cost are essential ingredients.

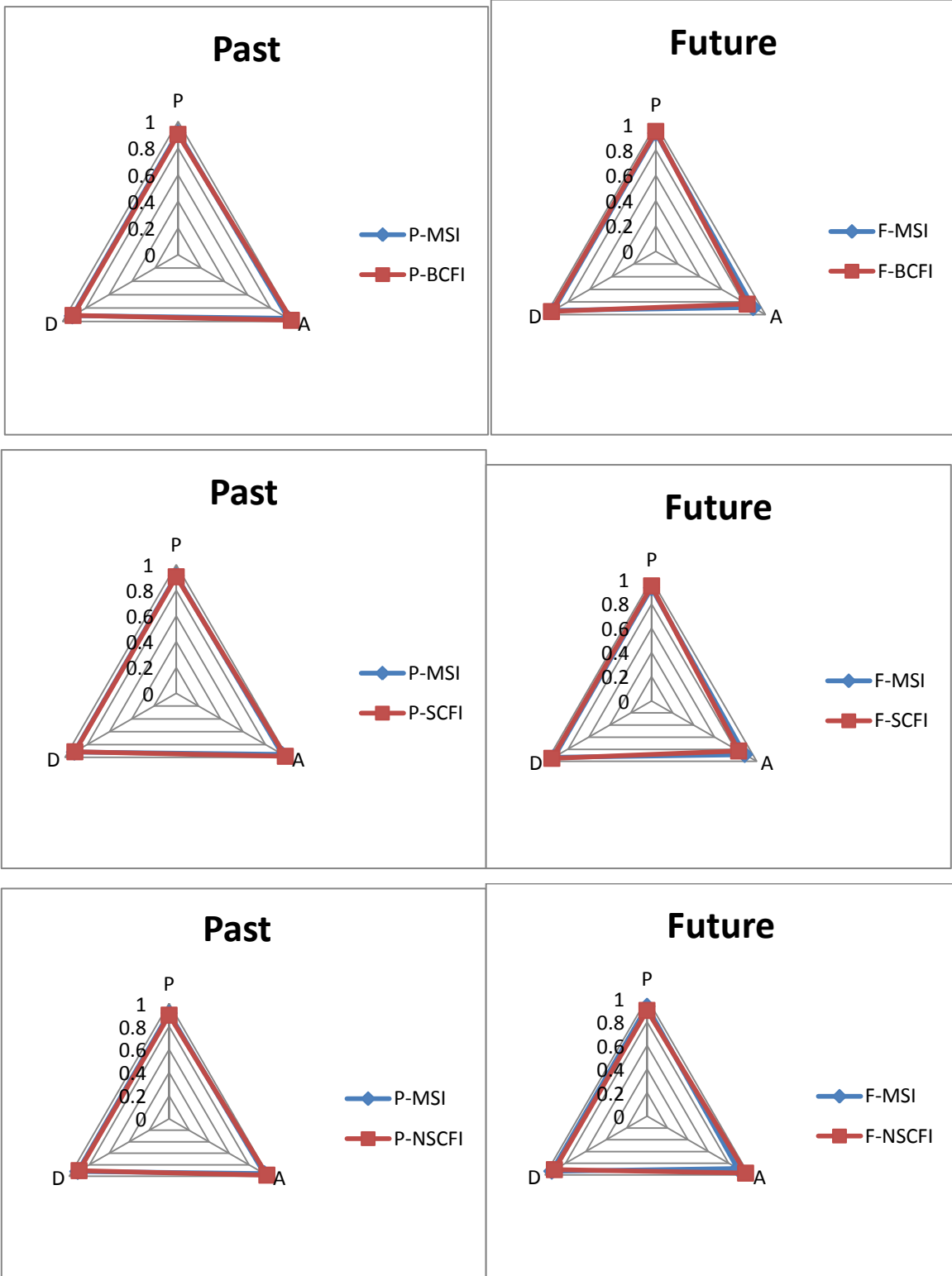
**Sustainable competitive advantage (SCA):** The integrated MSI and S&R results were substituted in the SCA-calculation; the sum check was true for each variable. When the sum check is false, the calculation has not been properly done. SCA values are usually between 0 and 1. The values that are very close or greater than 0.79 are considered to be

high. On the other hand, values ranging from 0.93-0.97 are considered “medium high” while values <0.93 are “low” values.

**Table 13.** Sum check and P, A, D results

	Q	C	T	F	Check	P	A	D
P-MSI	0.29665	0.29665	0.20335	0.20335	TRUE	0.915507	0.95334	0.915507
F-MSI	0.37237	0.37237	0.12763	0.12763	TRUE	0.933481	0.887926	0.933481
P-BCFI	0.236483	0.279686	0.236181	0.24765	TRUE	0.904037	0.982647	0.909221
F-BCFI	0.399686	0.472705	0.051507	0.076102	TRUE	0.947079	0.833269	0.950796
P-SCFI	0.249266	0.278853	0.240011	0.231871	TRUE	0.906999	0.980443	0.910394
F-SCFI	0.414582	0.463791	0.051508	0.070118	TRUE	0.949029	0.830286	0.951451
P-NSCFI	0.22452	0.24817	0.231	0.29631	TRUE	0.898465	0.979609	0.901732
F-NSCFI	0.20307	0.27322	0.26434	0.25937	TRUE	0.898694	0.967209	0.907788

The SCA calculations based on the MSI questionnaire (shown in purple background) resulted in “medium high” value for analyzer strategy in the past and low values for the other strategies. There is also a great emphasis on quality. Calculations based on the S&R questionnaire regarding the orientation gave a high analyzer values for both past and future NSCFI. Also, both P-BCFI and P-SCFI have high analyzer values. There is also a high tendency of prospector and defender strategies for F-BCFI and F-SCFI. The figures below clearly illustrate the relationship between MSI and BCFI, SCFI and NSCFI.



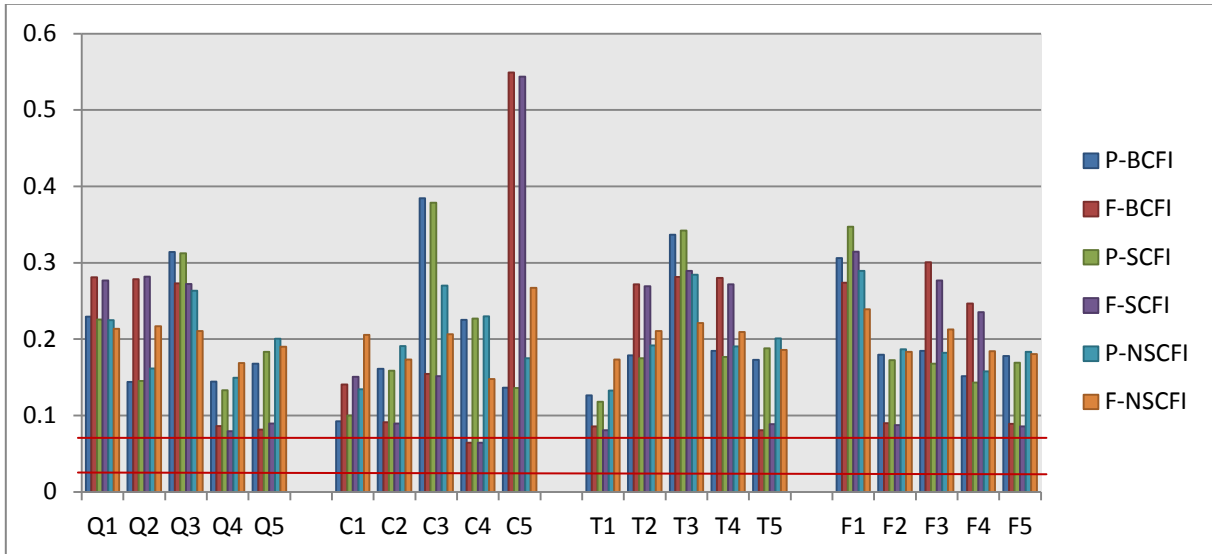
**Figure 12.** Comparison of BCFI, MSI, SCFI and NSCFI (NIG10)

**Table 14.** Angle result and MAPE, RMSE and MAD values

A	B	$\Gamma$	$\alpha$ Degree	$\beta$ Degree	$\gamma$ Degree	Check	MAPE	RMSE	MAD
1.058885	1.023823	1.058885	60.66964	58.66072	60.66964	TRUE			
1.032758	1.076076	1.032758	59.1727	61.6546	59.1727	TRUE			
1.072899	1.000743	1.067951	61.47258	57.33834	61.18908	TRUE	0.955661	0.972493	0.977457
1.011437	1.122104	1.008052	57.95108	64.29181	57.75711	TRUE	0.912658	0.94682	0.957226
1.070738	1.00335	1.067504	61.34878	57.48773	61.16349	TRUE	0.960669	0.975681	0.980004
1.009423	1.12495	1.00722	57.83568	64.45487	57.70945	TRUE	0.907258	0.943565	0.954581
1.073185	0.998364	1.070044	61.48899	57.20202	61.309	TRUE	0.95109	0.969804	0.975133
1.071301	1.007706	1.062586	61.38102	57.73731	60.88167	TRUE	0.870263	0.920856	0.936464

The way of business strategy implementation is clearly reflected by the above angles. Also, the sum check gave a true result for all the angles. There is a possibility that the calculations may have an outcome that will prompt the case company to change their operations strategy. The SCA-method can provide stability, flexibility as well as sustainability for the company and improve its performance and competitiveness. The result of this research can provide the case companies with the insight needed to forecast their future strategy and business performance.

### BCFI Vs SCFI Vs NSCFI (Case company NIG16)



**Figure 13.** Results of BCFI Vs SCFI Vs NSCFI (Case company NIG 16)

The collected sense and respond data from solar energy company NIG16 is shown in the above figure. The figure illustrates the trend of how critical factors change and their development directions. The calculated S&R results of past and future values using BCFI, SCFI and NSCFI models are also shown in the figure. The same judging values are applied here. The resourced levels are marked with a red line in the above figure.

**Table 15.** Integrated values of MSI(NIG16)

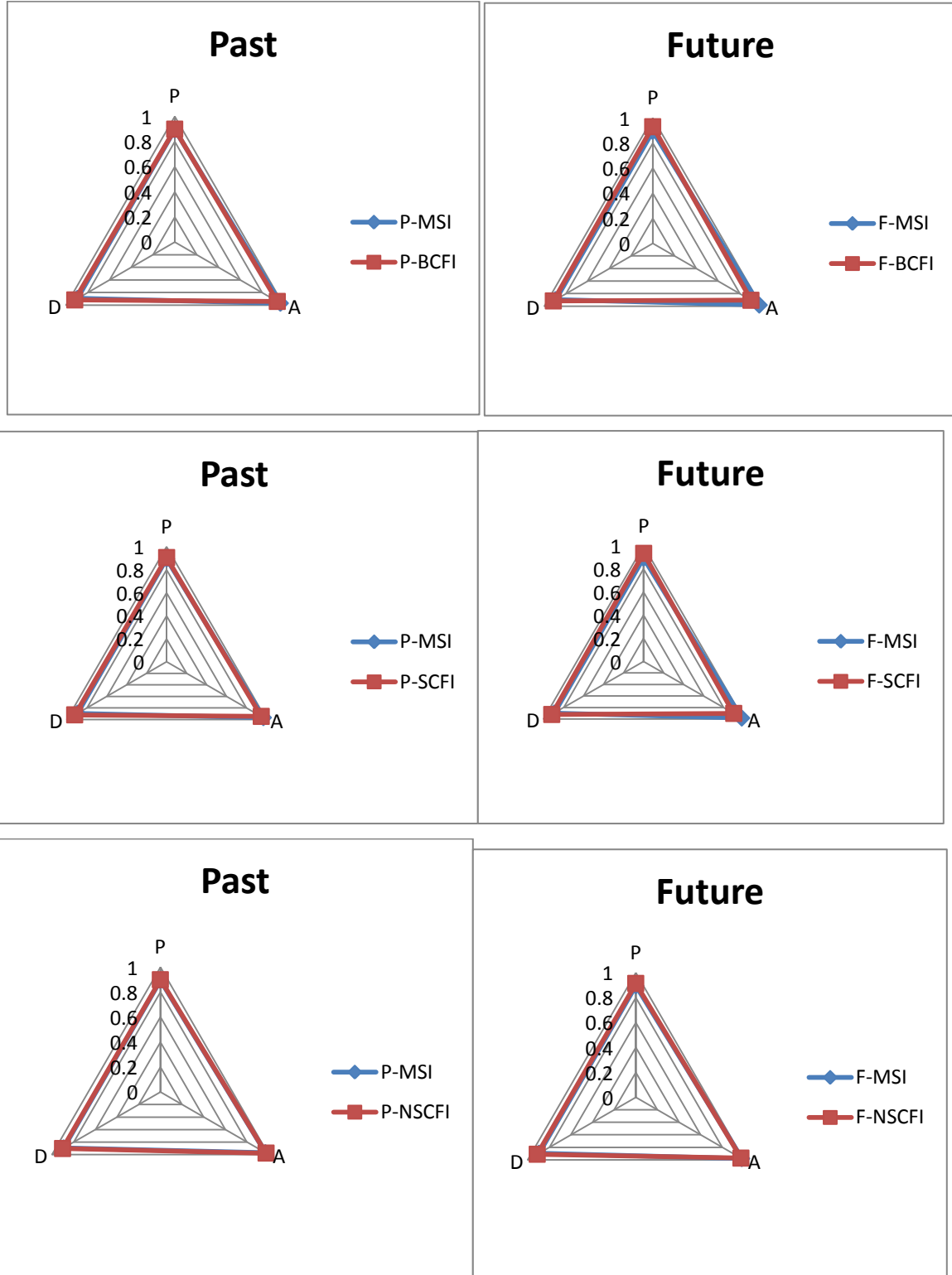
	Q	C	T	F	SUM
P-MSI	0.18988	0.18988	0.31012	0.31012	1
F-MSI	0.22473	0.22473	0.18351	0.36703	1

The above table shows the integrated values of MSI results obtained from NIG16 solar company. As explained earlier, both past and future manufacturing strategy index values for Q, C, D and F equals 1. From the above table, great emphasis has been laid on flexibility. The issue of focusing on flexibility rather than quality is questionable. Many solar experts argued that quality is much more essential than the other attributes.

**Table 16.** Sum check and P, A, D results

	Q	C	T	F	Check	P	A	D
P-MSI	0.18988	0.18988	0.31012	0.31012	TRUE	0.894028	0.970446	0.894028
F-MSI	0.22473	0.22473	0.18351	0.36703	TRUE	0.894893	0.981204	0.894893
P-BCFI	0.174215	0.331038	0.272726	0.222021	TRUE	0.899556	0.942025	0.917974
F-BCFI	0.322817	0.1476	0.414391	0.115192	TRUE	0.931717	0.904777	0.915019
P-SCFI	0.188331	0.350066	0.268753	0.19285	TRUE	0.905184	0.94902	0.922308
F-SCFI	0.344335	0.15401	0.402928	0.098727	TRUE	0.935866	0.900739	0.919333
P-NSCFI	0.19032	0.22127	0.33827	0.25014	TRUE	0.899161	0.976848	0.903479
F-NSCFI	0.23874	0.22475	0.36036	0.17615	TRUE	0.913259	0.973648	0.911703

Calculations based on the S&R questionnaire regarding the orientation gave a high analyzer values for both past and future NSCFI like in the first case company (NIG10). Also, both P-MSI and F-MSI have high analyzer values. Therefore, there is a high tendency of analyzer strategy for P-MSI, F-MSI, P-NSCFI and F-NSCFI. The figures below clearly illustrate the relationship between MSI and BCFI, SCFI and NSCFI.



**Figure 14.** Comparison of BCFI, MSI, SCFI and NSCFI

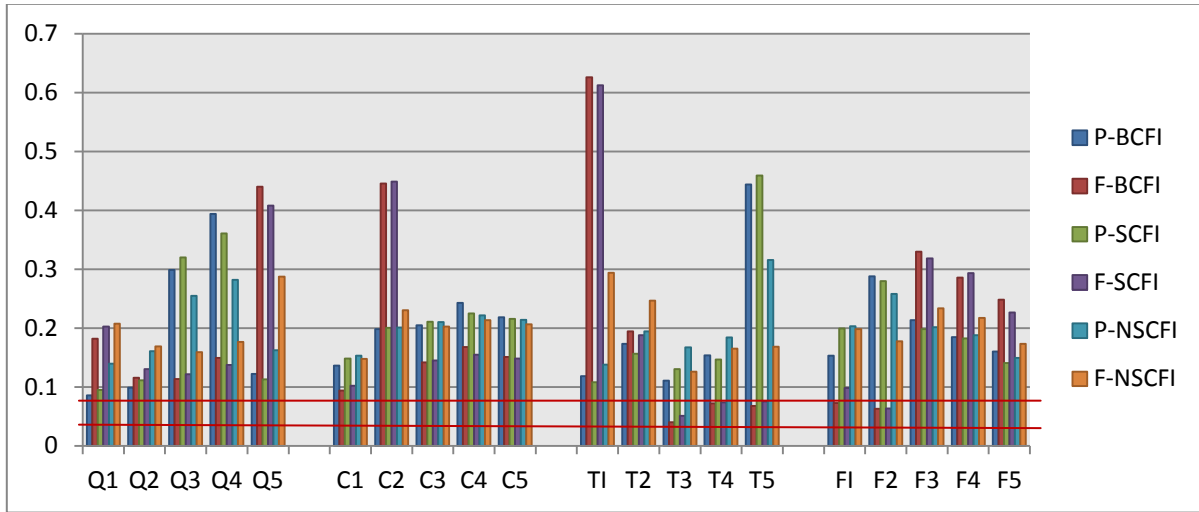
**Table 17.** Angle result and MAPE, RMSE and MAD values

A	B	$\Gamma$	$\alpha$ Degree	$\beta$ Degree	$\gamma$ Degree	Check	MAPE	RMSE	MAD
1.070857	0.999879	1.070857	61.36	57.28887	61.35556	TRUE			
1.073753	0.994087	1.073753	61.52	56.95701	61.5215	TRUE			
1.066362	1.026419	1.048812	61.1	58.80946	60.0925	TRUE	0.948674	0.966149	0.973457
1.033508	1.058916	1.049168	59.22	60.67143	60.11291	TRUE	0.874409	0.921375	0.934785
1.066256	1.025308	1.050029	61.09	58.74582	60.16222	TRUE	0.950823	0.967697	0.974568
1.03101	1.064138	1.046444	59.07	60.97062	59.95685	TRUE	0.864293	0.915165	0.929533
1.072484	1.00077	1.068339	61.45	57.33989	61.21131	TRUE	0.995239	0.997062	0.997649
1.065181	1.009755	1.066657	61.03	57.85469	61.11494	TRUE	0.969648	0.981137	0.984239

As explained earlier, the SCA-method is capable of providing stability, flexibility as well as sustainability for the company and improves its performance and competitiveness. The result of this research can provide the case companies with the insight relevant to forecast their future strategy and business performance.



### BCFI Vs SCFI Vs NSCFI (Case company NIG8)



**Figure 15.** Results of BCFI Vs SCFI Vs NSCFI (Case company NIG 8)

The collected sense and respond data from NIG8 is shown in the above figure. The figure also illustrates the trend of how critical factors change and their corresponding development directions. It shows the calculated S&R results of past and future values using models like BCFI, SCFI and NSCFI. The range of the attributes are of three categories namely; resourced, balanced and under resourced. A red line has been marked to show the resource level in the above figure.

**Table 18.** Comparison of Past and Future BCFI, SCFI and NSCFI

Attribute	P-BCFI	F-BCFI	Trend	P-SCFI	F-SCFI	Trend	P-NSCFI	F-NSCFI	Trend§
1	Over	over	Better	Over	over	better	Over	over	Better
2	Over	over	Better	Over	over	better	Over	over	Better
3	Over	over	Better	Over	over	better	Over	over	Better
4	Over	over	Better	Over	over	better	Over	over	Better
5	Over	over	Better	Over	over	better	Over	over	Better
6	Over	over	Better	Over	over	better	Over	over	Better
7	Over	over	Better	Over	over	better	Over	over	Better
8	Over	over	Better	Over	over	better	Over	over	Better
9	Over	over	Better	Over	over	better	Over	over	Better
10	Over	over	Better	Over	over	better	Over	over	Better
11	Over	over	Better	Over	over	better	Over	over	Better
12	Over	over	Better	Over	over	better	Over	over	Better
13	Over	good	Better	Over	good	better	Over	over	Better
14	Over	good	Better	Over	good	better	Over	over	Better
15	Over	good	Better	Over	good	better	Over	over	Better
16	Over	good	Better	Over	over	better	Over	over	Better
17	Over	good	Better	Over	good	better	Over	over	Better
18	Over	over	Better	Over	over	better	Over	over	Better
19	Over	over	Better	Over	over	better	Over	over	Better
20	Over	over	Better	Over	over	better	Over	over	Better

Table 18 above shows a comparison of past and future values of BCFI, SCFI and NSCFI. All the attributes have been analyzed one by one. A closer comparison of the results shows that all the values are valid. The trend is similar to that of the first case company (NIG10). The trends of BCFI, SCFI and NSCFI are marked with “better”. Therefore the trend in turbulent environments depicts a good result. There are no cases of zero index values also.

**Table 19.** Integrated values of MSI

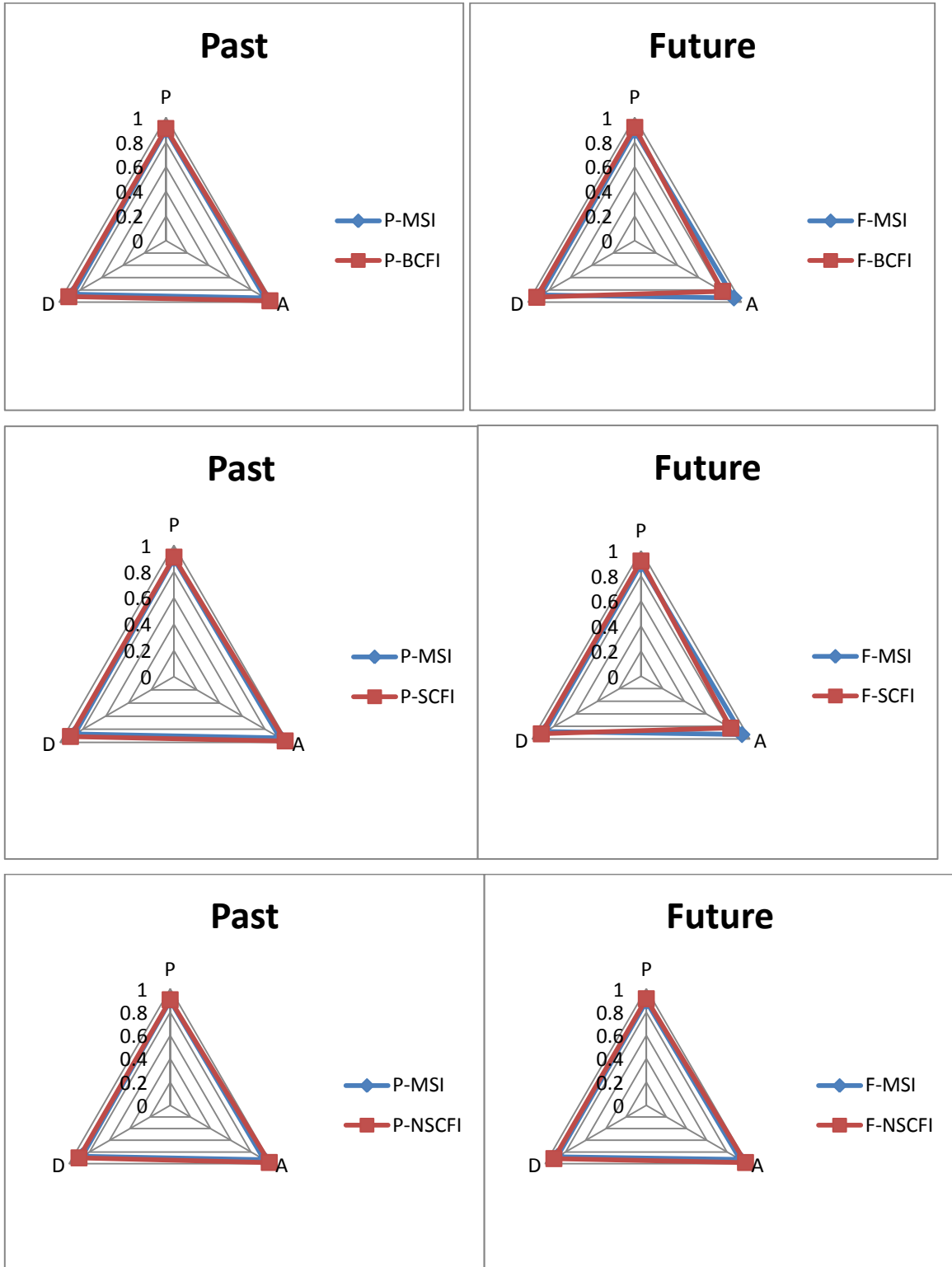
	Q	C	T	F	TOTAL
P-MSI	0.169	0.062419	0.384126	0.384126	1
F-MSI	0.159	0.1175	0.36156	0.36156	1

The above table shows the integrated values of MSI results obtained from NIG8 solar energy company. Both past and future manufacturing strategy index values for Q, C, D and F equals 1. From the above table, great emphasis has been laid on flexibility and time. The issue of focusing on flexibility rather than quality is also questionable since many solar experts rank quality higher than the other attributes

**Table 20.** Sum check and P, A, D results

	Q	C	T	F	Check	P	A	D
P-MSI	0.169328	0.062419	0.384126	0.38413	TRUE	0.8986	0.931405	0.871913
F-MSI	0.15938	0.1175	0.36156	0.36156	TRUE	0.8921	0.92973	0.883226
P-BCFI	0.272628	0.259968	0.251278	0.21613	TRUE	0.9111	0.976583	0.90971
F-BCFI	0.11951	0.11396	0.60583	0.1607	TRUE	0.9201	0.823116	0.919287
P-SCFI	0.269359	0.263846	0.245714	0.22108	TRUE	0.9103	0.977685	0.90966
F-SCFI	0.11925	0.11681	0.598303	0.16564	TRUE	0.9188	0.826528	0.918414
P-NSCFI	0.26036	0.24524	0.2261	0.2683	TRUE	0.9053	0.981891	0.903352
F-NSCFI	0.27535	0.2935	0.23911	0.19204	TRUE	0.9141	0.983208	0.915933

The calculations of solar energy company NIG8 based on the S&R questionnaire regarding the orientation gave a high analyzer values for both past and future NSCFI like in the first and second case companies. The figures below illustrates the relationship between MSI, BCFI, SCFI and NSCFI



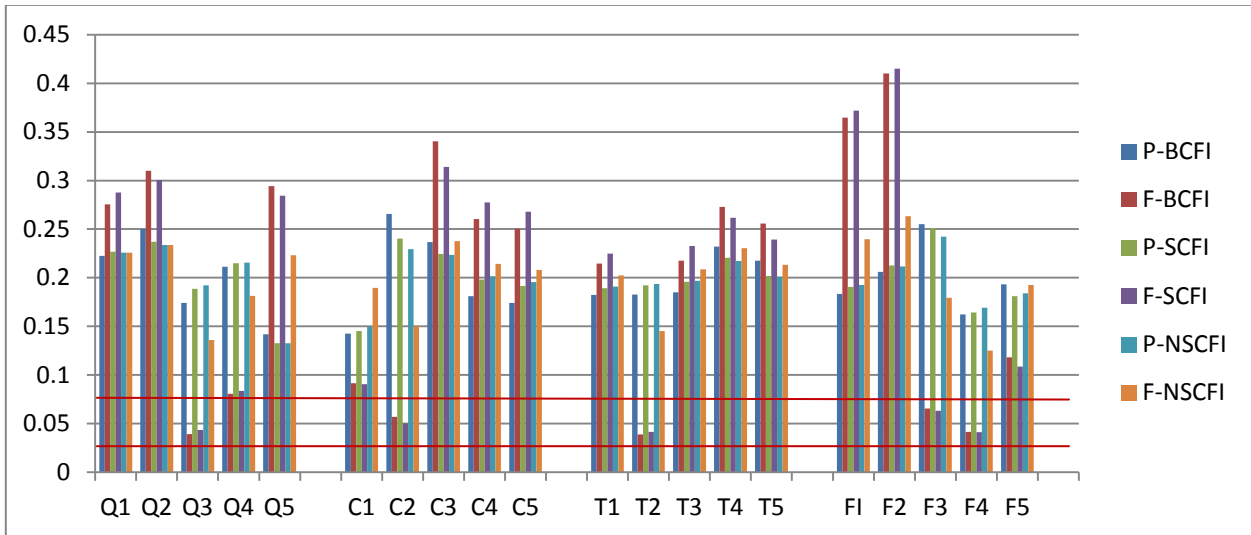
**Figure 16.** Comparison of BCFI, MSI, SCFI and NSCFI (NIG8)

**Table 21.** Angle result and MAPE, RMSE and MAD values

A	B	$\gamma$	$\alpha$ Degree	$\beta$ Degree	$\gamma$ Degree	Check	MAPE	RMSE	MAD
1.048815	1.018	1.074959	60.09269	58.3167	61.5906	TRUE			
1.056258	1.02	1.064881	60.51914	58.4677	61.0132	TRUE			
1.066774	1.007	1.068107	61.12167	57.6803	61.198	TRUE	0.96559	0.978718	0.98288
1.014827	1.111	1.0156	58.14529	63.6651	58.1896	TRUE	0.825603	0.892378	0.91111
1.067613	1.006	1.068199	61.16974	57.627	61.2033	TRUE	0.963961	0.977624	0.98208
1.016576	1.108	1.016919	58.24551	63.4893	58.2652	TRUE	0.831505	0.895997	0.91411
1.07003	1	1.071853	61.30822	57.2791	61.4127	TRUE	0.959091	0.972906	0.97977
1.068799	1.006	1.06707	61.23768	57.6237	61.1386	TRUE	0.971636	0.981197	0.98557

The angle result and MAPE, RMSE and MAD values obtained from NIG8 case company is shown in the table above. The above table does not show any risk probability.

### BCFI Vs SCFI Vs NSCFI (Case company NIG6)



**Figure 17.** Results of BCFI Vs SCFI Vs NSCFI (Case company NIG 6)

The collected sense and respond data from solar energy company NIG6 is illustrated in the above figure. The figure shows the trend of how critical factors change and their development directions like in the other cases. The figure also shows the calculated S&R results of past and future values using similar models like BCFI, SCFI and NSCFI. The range of the attributes are of three categories namely; resourced, balanced and under resourced. A red line has been marked to show the resource level in the above figure.

**Table 22.** Comparison of Past and Future BCFI, SCFI and NSCFI (NIG6)

Attribute	P-BCFI	F-BCFI	Trend	P-SCFI	F-SCFI	Trend	P-NSCFI	F-NSCFI	Trend
1	Over	over	Good	Over	Over	Good	over	Over	Good
2	Over	over	Good	Over	Over	Good	over	Over	Good
3	Over	good	Good	Over	Good	Good	over	Over	Good
4	Over	over	Good	Over	Over	Good	over	Over	Good
5	Over	over	Good	Over	Over	Good	over	Over	Good
6	Over	over	Good	Over	Over	Good	over	Over	Good
7	Over	good	Good	Over	Good	Good	over	Over	Good
8	Over	over	Good	Over	Over	Good	over	Over	Good
9	Over	over	Good	Over	Over	Good	over	Over	Good
10	Over	over	Good	Over	Over	Good	over	Over	Good
11	Over	over	Good	Over	Over	Good	over	Over	Good
12	Over	good	Good	Over	Good	Good	over	Over	Good
13	Over	over	Good	Over	Over	Good	over	Over	Good
14	Over	over	Good	Over	Over	Good	over	Over	Good
15	Over	over	Good	Over	Over	Good	over	Over	Good
16	Over	over	Good	Over	Over	Good	over	Over	Good
17	Over	over	Good	Over	Over	Good	over	Over	Good
18	Over	good	Good	Over	Good	Good	over	Over	Good
19	Over	good	Good	Over	Good	Good	over	Over	Good
20	Over	over	Good	Over	Over	Good	over	Over	Good

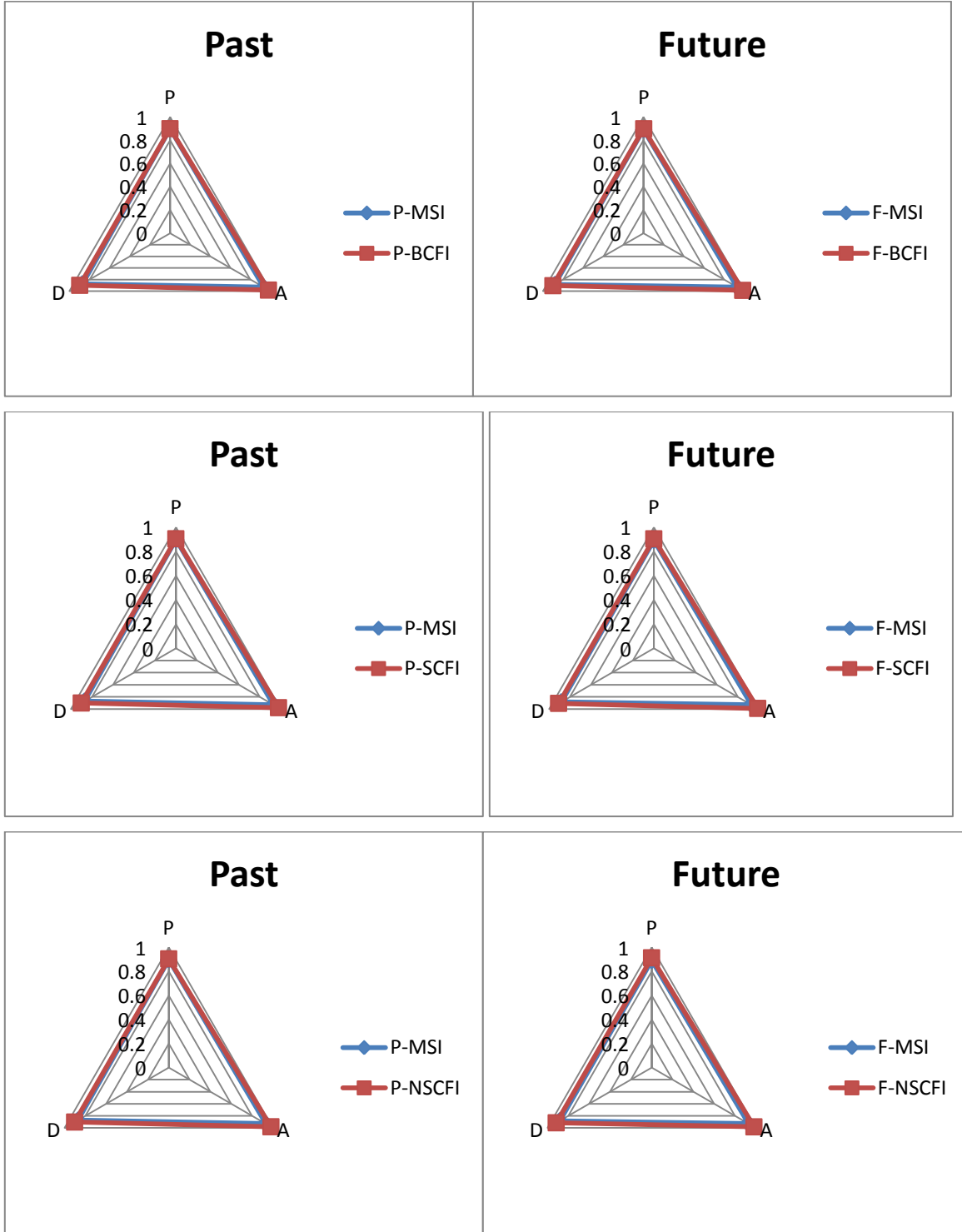
Table 22 above shows the comparison of past and future BCFI, SCFI and NSCFI. All the attributes have been analyzed one by one. A closer comparison of the results shows that all the values are valid. The trend is similar to that of the first and third case companies. The trends of BCFI, SCFI and NSCFI are marked with “better”. Therefore the trend in turbulent environments shows a good result. There are no cases of zero index values also.

**Table 23.** Sum check and P, A, D results

	Q	C	T	F	Check	P	A	D
P-MSI	0.169328	0.062419	0.384126	0.38413	TRUE	0.898646	0.93141	0.871913
F-MSI	0.15938	0.1175	0.36156	0.36156	TRUE	0.892066	0.92973	0.883226
P-BCFI	0.245517	0.222691	0.228986	0.3028	TRUE	0.900968	0.9797	0.897761
F-BCFI	0.233803	0.259781	0.21806	0.28836	TRUE	0.900413	0.98456	0.903852
P-SCFI	0.260926	0.235741	0.236679	0.26665	TRUE	0.905423	0.97904	0.902217
F-SCFI	0.247839	0.274216	0.22474	0.2532	TRUE	0.904981	0.99104	0.90815
P-NSCFI	0.26036	0.24524	0.2261	0.2683	TRUE	0.905257	0.98189	0.903352
F-NSCFI	0.27535	0.2935	0.23911	0.19204	TRUE	0.914105	0.98321	0.915933

The calculations of the fourth case company based on the S&R questionnaire regarding the orientation gave a high analyzer values for both past and future NSCFI like in the first, second and third case companies (NIG10, NIG16 and NIG8). Also, BCFI and SCFI gave a high analyzer values for both past and future directions. Therefore, there is a high tendency of analyzer strategy for P-NSCFI, F-NSCF, P-BCFI, F-BCFI, P-SCFI and F-SCFII. The figure below shows the relationship between MSI and BCFI, SCFI and NSCFI.





**Figure 18.** Comparison of BCFI, MSI, SCFI and NSCFI (NIG6)

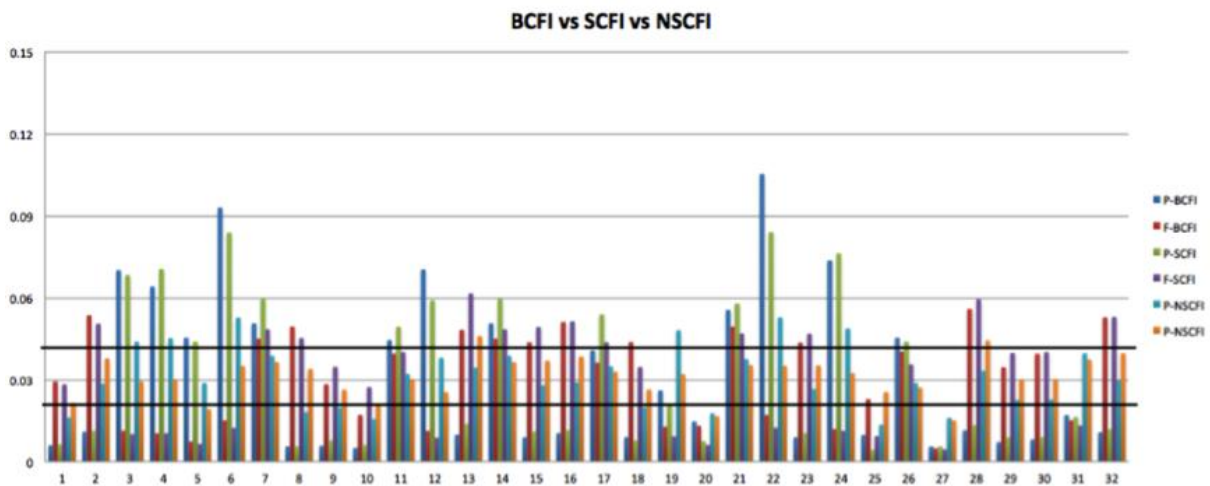
**Table 24.** Angle result and MAPE, RMSE and MAD values (NIG6)

A	B	$\gamma$	$\alpha$ Degree	$\beta$ Degree	$\gamma$ Degree	Check	MAPE	RMSE	MAD
1.04882	1.017818	1.074959	60.09269	58.31668	61.59	TRUE			
1.05626	1.020454	1.064881	60.51914	58.46769	61.01	TRUE			
1.07033	0.99784	1.073419	61.32561	57.17199	61.5	TRUE	0.958422	0.97157	0.979483
1.07407	0.99676	1.070767	61.53942	57.11014	61.35	TRUE	0.954395	0.970779	0.976781
1.06872	1.001074	1.071794	61.23341	57.35733	61.41	TRUE	0.961622	0.974709	0.981017
1.07441	0.995803	1.071383	61.55898	57.05531	61.39	TRUE	0.952555	0.969734	0.975843
1.07003	0.999709	1.071853	61.30822	57.2791	61.41	TRUE	0.959091	0.972906	0.979772
1.0688	1.005724	1.06707	61.23768	57.62372	61.14	TRUE	0.971636	0.981197	0.985565

The angle result and MAPE, RMSE and MAD values obtained from the fourth case company (NIG6) is shown in the table above. There are no cases of risk probability.

### Finnish manufacturing companies

The results obtained here were based on previous research where the sense and respond questionnaire used included 32 attributes. The attributes were not equal, they were divided as follows: Q: ten, C: eight, T: eight and F: seven. During the analysis, no attribute was left out of the calculation. Hence, it may affect the results (Veli et al. 2012). In this research, 2 informants were interviewed. The company's operations strategy before and after the 2009 economic crisis in Finland were taken into account. The company is denoted by FIN3.



**Figure 19.** Results of BCFI, SCFI and NSCFI (Veli et at.2012) FIN3

The collected sense and respond data from the case company is shown in the above figure. The trend of how critical factors change and development directions are illustrated. The Figure depicts the calculated S&R results of past and future values using BCFI, SCFI and NSCFI models. The range of the attributes are divided into three different categories namely; over resourced, balanced and under resourced. If an attribute falls between the range of  $\frac{1}{3}$  and  $\frac{2}{3}$  of the average resource level, it is considered balanced. Any attribute that is lower than  $\frac{1}{3}$ , is considered under resourced. In this case, average level is  $100\%/32=3,125\%$ , which means that the judging values are 2,083% and 4,167%, any attribute higher than 4,16% is over resourced (Veli et. al 2012).The resourced levels are marked with black lines in Figure 19.

**Table 25.** Comparison of Past and Future BCFI, SCFI and NSCFI (FIN3)

Attribute	P-BCFI	F-BCFI	Trend	P-SCFI	F-SCFI	Trend	P-NSCFI	F-NSCFI	Trend
1	Under	Good	Better	Under	Good	Better	Under	Good	Better
2	Under	Over	Worse	Under	Over	Worse	Good	Good	-
3	Over	Under	Worse	Over	Under	Worse	Over	Good	Better
4	Over	Under	Worse	Over	Under	Worse	Over	Good	Better
5	Over	Under	Worse	Over	Under	Worse	Good	Under	Worse
6	Over	Under	Worse	Over	Under	Worse	Over	Good	Better
7	Over	Over	Better	Over	Over	Better	Good	Good	-
8	Under	Over	Better	Under	Over	Better	Under	Good	Better
9	Under	Good	Better	Under	Good	Better	Under	Good	Better
10	Under	Under	Better	Under	Good	Better	Under	Under	Better
11	Over	Good	Better	Over	Good	Better	Good	Good	-
12	Over	Under	Worse	Over	Under	Worse	Good	Good	-
13	Under	Over	Better	Under	Over	Better	Good	Over	Worse
14	Over	Over	Better	Over	Over	Better	Good	Good	-
15	Under	Over	Better	Under	Over	Better	Good	Good	-
16	Under	Over	Better	Under	Over	Better	Good	Good	-
17	Good	Good	-	Over	Over	Better	Good	Good	-
18	Under	Over	Better	Under	Good	Better	Under	Good	Better
19	Good	Under	Worse	Under	Under	Worse	Over	Good	Better
20	Under	Under	Worse	Under	Under	Worse	Under	Under	Worse
21	Over	Over	Better	Over	Over	Better	Good	Good	-
22	Over	Under	Worse	Over	Under	Worse	Over	Good	Better
23	Under	Over	Better	Under	Over	Better	Good	Good	-
24	Over	Under	Worse	Over	Under	Worse	Over	Good	Better
25	Under	Good	Better	Under	Under	Better	Under	Good	Better
26	Over	Good	Better	Over	Good	Better	Good	Good	-
27	Under	Under	Worse	Under	Under	Worse	Under	Under	Worse
28	Under	Over	Better	Under	Over	Better	Good	Over	Worse
29	Under	Good	Better	Under	Good	Better	Good	Good	-
30	Under	Good	Better	Under	Good	Better	Good	Good	-
31	Under	Under	Worse	Under	Under	Worse	Good	Good	-
32	Under	Over	Better	Under	Over	Better	Good	Good	-

(Veli et al. 2012)

Table 25 shows how the attributes change prior to the economic crisis and during the crisis. There is a comparison of results of both past and future values using three different S&R models (NSCFI, BCFI and SCFI) which are based on the analysis of 32 attributes. These attributes have been analyzed one by one. The trend clearly illustrate how any specific attribute change from past to future. When comparing the results, a deduction can be made that all the values are valid. Most of the trends of BCFI and SCFI are marked “Better” while NSCFI have almost the same amount of attributes marked with “Better” and “Same”. The trend for before and during NSCFI depicts good results. There are also some cases of 0 zero index values due to zero standard deviation in the collected data (Veli et. al 2012). This phenomenon is not uncommon.

**Table 26.** Integrated values of MSI (FIN3)

	Q	C	D	F
P-MSI	0,529	0,068	0,254	0,150
F-MSI	0,550	0,068	0,247	0,136

Figure 26 shows the integrated values of the MSI results. The MSI- results of the company before the economic crisis and during the crisis shows that the company has been focusing on quality as their main strategy type.

**Table 27.** Sum check and P, A, D results (FIN3)

	Q	C	T	F	Check	P	A	D
P-MSI	0,484	0,071	0,283	0,162	TRUE	0,941	0,896	0,898
F-MSI	0,550	0,068	0,247	0,136	TRUE	0,950	0,916	0,906
P-BCFI	0,275	0,275	0,055	0,394	TRUE	0,908	0,902	0,908
F-BCFI	0,298	0,298	0,326	0,078	TRUE	0,935	0,973	0,935
P-SCFI	0,314	0,297	0,067	0,322	TRUE	0,914	0,893	0,912
F-SCFI	0,303	0,286	0,354	0,056	TRUE	0,942	0,984	0,941
P-NSCFI	0,264	0,250	0,217	0,268	TRUE	0,906	0,986	0,904
F-NSCFI	0,261	0,247	0,304	0,188	TRUE	0,913	0,985	0,912

SCA calculations derived from the MSI questionnaire (shown with green background colour) gave a medium high values for the Prospector strategy and low values for the rest groups, both for past- and future-orientation. The tendency in the MSI-based SCA values towards the Prospector group is supported by the MSI priority weights, which have a high emphasis on quality (Veli et al. 2012).

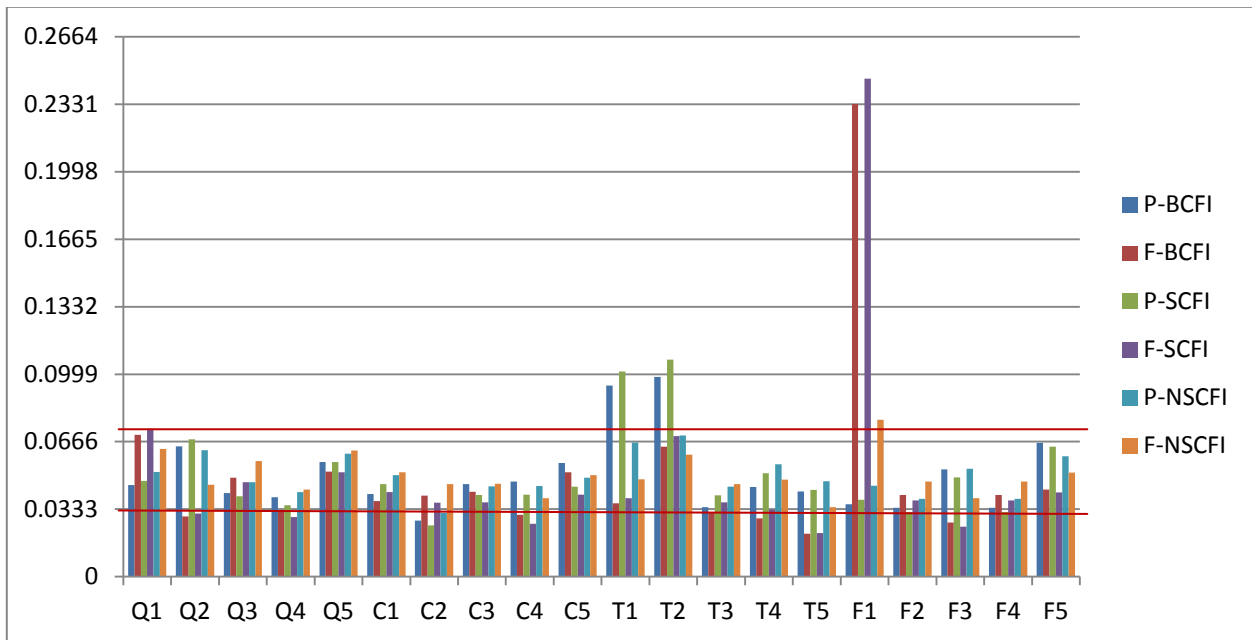
Calculations based on the S&R questionnaire regarding the past orientation resulted in low values for all strategy types, except P-NSCFI for Analyzer. Concerning the future orientation, Veli et al. found high values for Analyzer and medium high to low values for the Analyzer and Defender groups. Veli et al. states that the results would indicate that their case company has turned from a former strategy that was not clearly defined towards a highly Analyzer characterized business strategy.

**Table 28.** Angle results and MAPE, RMSE and MAD values (FIN3)

$\alpha$	$\beta$	$\gamma$	$\alpha$ Degree	$\beta$ Degree	$\gamma$ Degree	Check	MAPE	RMSE	MAD
1,037	1,025	1,079	59,444	58,714	61,842	TRUE			
1,023	1,055	1,064	58,615	60,430	60,955	TRUE			
1,045	1,051	1,045	59,881	60,240	59,879	TRUE	0,935	0,958	0,968
1,059	1,024	1,059	60,657	58,687	60,656	TRUE	0,931	0,955	0,965
1,040	1,060	1,042	59,577	60,737	59,686	TRUE	0,928	0,951	0,965
1,060	1,021	1,061	60,712	58,521	60,767	TRUE	0,930	0,952	0,964
1,071	0,998	1,073	61,369	57,165	61,466	TRUE	0,935	0,958	0,968
1,069	1,003	1,070	61,226	57,465	61,309	TRUE	0,901	0,933	0,951

The way of business strategy implementation is correctly reflected by the angles. The calculations may have outcome prompting the company to change its operations strategy.

Graph of BCFI Vs SCFI Vs NSCFI (FIN2)



**Figure 20.** Results of BCFI, SCFI and NSCFI (Oba et al. 2012) FIN2

The collected sense and respond data from FIN2 manufacturing company is shown in the above figure. The figure illustrates the trend of how critical factors change and their development directions. The calculated S&R results of past and future values using BCFI, SCFI and NSCFI models are also shown in the figure.

The range of the attributes are of three categories namely; resourced, balanced and under resourced. Attributes that falls within the range of  $1/3$  and  $2/3$  of the average resource level are considered to be balanced while the attributes that are below  $1/3$  are considered under resourced. All the attributes that are higher than  $2/3$  are over resourced. In this research, the average level is  $100\%/20=5\%$ , this implies that the judging values are  $3.333\%$  and  $6.667\%$ . Therefore, any attribute that is lower than  $3.333\%$  is under resourced and any attribute that is higher than  $6.667\%$  is over resourced. Table 29 below shows a comparison of past and future BCFI, SCFI and NSCFI. All the attributes have been analyzed one by

one. Table 29 also shows a comparison of the results of past and future values using different models of S&R (CFI, BCFI and SCFI).

**Table 29.** Comparison of BCFI, SCFI and NSCFI

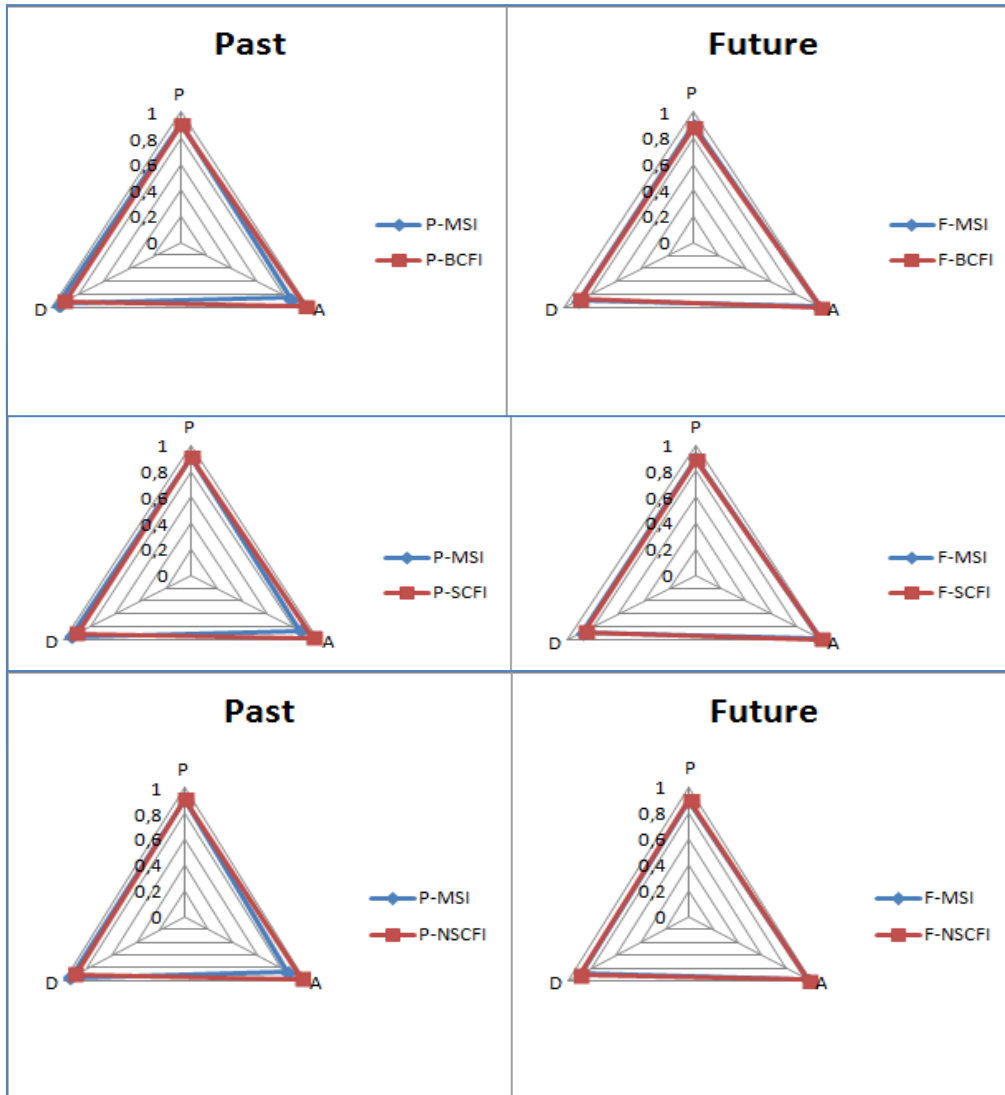
	P-BCFI	F-BCFI	Trend	P-SCFI	F-SCFI	Trend	P-NSCFI	F-NSCFI	Trend
<b>Q1</b>	Good	above	worse	Good	above	worse	good	good	-
<b>Q2</b>	Good	below	worse	Above	below		good	good	-
<b>Q3</b>	Good	good	-	Good	good	-	good	good	-
<b>Q4</b>	Good	below	worse	Good	below	worse	good	good	-
<b>Q5</b>	Good	good	-	Good	good	-	good	good	-
<b>C1</b>	Good	good	-	Good	good	-	good	good	-
<b>C2</b>	below	good	better	Below	good	better	below	good	Better
<b>C3</b>	Good	good	-	Good	good	-	good	good	-
<b>C4</b>	Good	below	worse	Good	below	worse	good	good	-
<b>C5</b>	Good	good	-	Good	good	-	good	good	-
<b>T1</b>	above	good	better	Above	good	better	above	good	Better
<b>T2</b>	above	good	better	Above	above	better	above	good	Better
<b>T3</b>	Good	below	worse	Good	good	-	good	good	-
<b>T4</b>	Good	below	worse	Good	good	-	good	good	-
<b>T5</b>	Good	below	worse	Good	below	worse	good	good	-
<b>F1</b>	Good	above	worse	Good	above	worse	good	above	Worse
<b>F2</b>	Good	good	-	Below	good	better	good	good	-
<b>F3</b>	Good	below	worse	Good	below	worse	good	good	-
<b>F4</b>	Good	good	-	Below	good	better	good	good	-
<b>F5</b>	above	good	better	Good	good	-	good	good	-

(Felix et al. 2012)

Considering the three trends of CFI (P-BCFI, F-SCFI and F-NSCFI), it can be seen that fewer colors are found in the trends of F-SCFI. Trends with fewer colors are the best. Therefore, F-SCFI is considered to be the best.

During this research, the case company was contacted to verify the result. According to the manager, the result gotten from NSCFI is fine in his opinion.





**Figure 21.** Comparison of BCFI, MSI, SCFI and NSCFI (FIN2)

In general, the result obtained when the company's past and future operation strategy was evaluated and compared with MSI, BCFI, SCFI and NSCFI shows that the company's past strategy will change into Analyzer strategy in the future. (i.e. from Defender strategy to Analyzer strategy) as we can see the changes from the triangles above.

**Table 30.** SCA analysis (FIN2)

	P	A	D	MAPE	RMSE	MAD
P-MSI	0.910473	0.8568236	0.9475432			
F-MSI	0.8944057	0.9756035	0.8882209			
P-BCFI	0.9080662	0.9754894	0.9044525	0.8310176	0.8941484	0.9186089
F-BCFI	0.8826102	0.9906551	0.8766238	0.9682276	0.9802859	0.9835135
P-SCFI	0.9096103	0.9659873	0.9033327	0.8418979	0.9000345	0.9238892
F-SCFI	0.882942	0.9916837	0.873235	0.9651373	0.9782437	0.981905
P-NSCFI	0.908538	0.9752585	0.9032197	0.8307886	0.8937233	0.9185112
F-NSCFI	0.9038903	0.9822548	0.8988662	0.9950552	0.9968353	0.9974326

The data analysis and results were summarized as seen in the table above. The values were used to discover the most preferred strategy of the case company. The value of SCA is between Zero (0) to one (1). The values from the SCA were used to describe the risk possibility the analyzed company may have. All values below 0.7 shows that the company's strategy is in risk region and all values above 0.7 shows that the company's strategy is good i.e. the company strategy is safe from risk. That means values that are closer to 1 are the best SCA values and vice versa. The values obtained from MAD, MAPE and RMSE were greater than 0.7. The lowest future value is 0.965 from SCFI tool, which means the future strategy of the analyzed company (FIN2), is not in risk situation.

## **5.1. Decision making elements for outsourcing production in Finnish manufacturing companies**

Many decision-making elements are taken into account by Finnish manufacturing companies when outsourcing production. These elements are Versatility, Delivery time, stability of production plan, Flexibility (order to delivery). In this research, a Finnish manufacturing company in Vaasa was taken as a case company. The name of the company is denoted by FIN1. The data was collected via the case study outsourcing questionnaire, the combined micro level questionnaire and the combined macro level questionnaire. The results of the analysis are explained below.

**Versatility:** is one attribute taken into consideration by many Finnish manufacturing companies when outsourcing production, see figure 9. An interview with a top officer of the case company revealed that versatility is taken into account due to the fact that there is need for a comprehensive solution from their suppliers (i.e. from the design process to the final product and also maintenance). A versatile supplier is an added advantage. According to the interviewee, the key factor is to find optimum within the costs, final product and its maintenance. FIN1 subscribes the product for the needs they have and the design process is often times made by the company. The overall design process has been done several times by the case company. This way, the selection factors will be cost, quality which is required all the time despite the supplier.

**Stability of production plan:** Stability of production plan matters a lot for Finnish manufacturing companies; this is due to the fact that many components and products provided by their suppliers are permanent. There can be exceptions and changes on the basis of agreement and the co-operation. In FIN1, changes in cost and quality can bring about exceptions for co-operation. Quality is usually demanded and is always monitored. The outsourced products and parts of the production are almost the same. Some products manufactured by FIN1 have more than one supplier for the components that are used, but almost every time one component comes from the same supplier.

## **5.2. Evaluation elements for choosing subcontractor suppliers in Finnish manufacturing companies**

Many Finnish manufacturing companies' take into consideration supplier's ability to produce good quality products (Products and services), certainty (trust) and capability to deliver the whole process demanded with cost effectiveness. The factors that are taken into account when outsourcing production in Finnish manufacturing companies are: quality, Logistics, Flexibility, Management, Language and time. See figure 10.

**Logistics:** can be defined as the flow of materials or resources between a starting point and the point where they are consumed in order to fulfil some requirements (Hisham et al., 2014). Resources or materials managed by logistics include liquids, staff, information, particles and food. Proper Logistics is valued by many Finnish manufacturing companies. It is also an added advantage for a subcontracting firm that can manage their logistics effectively. The ERP-system is used by many Finnish manufacturing companies and their information is stored in PDM-System. Therefore, logistics is a crucial attribute taken into account when choosing subcontractor suppliers.

**Management:** in business and organization is defined as the act of coordinating the effort put in by people to achieve set goals and objectives with the aid of proper utilization of available resources. The opportunity to visit supplier's production and advice on how the production and development process should proceed is important factor taken into account by Finnish manufacturing companies when choosing their suppliers. In this research, management comprises of management system compatibility and management level compatibility.

**Language:** has a great role to play when choosing subcontractor supplier. Manufacturing companies in Finland requires all their suppliers to communicate in the language preferred by the company (preferably English language). When dealing with foreign

subcontractors, all the reports and information are written in English and the suppliers are expected to understand the language. (There can be misunderstanding as a result of poor language skills.)

**Time:** is a critical factor taken into account in Finland. Not only Finnish manufacturing companies take time into consideration, many other firms from different industries value timeliness. FIN1 sets acceptable production times/ limits within agreements with their suppliers, this is applicable to other manufacturing companies. The production time is usually stated clearly in the offers made for the suppliers (when dealing with a new supplier or starting a new production). The expected production time is made for every supplier as unique. Demands depend on the costs, supplier's production and the product produced.

**Flexibility (order to delivery):** FIN1 does not have much storage for spare parts except the parts that are difficult to get or parts that runs out easily. The production plans are made with the supplier that supplies the products /components. The most important thing in flexibility is confirmation from the supplier according to the product / component ordered. In addition, the informant stated that legislation is strictly taken into account when choosing suppliers. The suppliers are required to follow all legislations strictly in all business levels. Many Finnish manufacturing companies keep continuous evaluation of their suppliers and their actions in to order for them to follow the legislations and agreement made between them and the company. Also, Delivery time is another attribute taken into consideration as well as cost and quality. Transformability is one of the least attributes that is considered because most of the products are ordered for a specific purpose or with specific unique demand. On time delivery is an essential ingredient for both the case company and many Finnish manufacturing companies (Oba et al. 2013).

### **5.3. Decision making elements for outsourcing production in Nigerian Solar energy companies**

**Maturity of outsourcing service provider:** is one of the attributes of the decision-making elements for outsourcing production. See figure 9. It comprises of the number of outsourcing service providers in the market, the scale of outsourcing service providers and whether the state law allows such outsourcing. (Liu, 2013) Mr xxx of solar estate in Port Harcourt- Nigeria disclosed to the author that maturity of outsourcing is one attribute they take into consideration when making decision for outsourcing production. This is due to the fact that the government often impose certain standards on solar plant projects, making it difficult for solar plant companies to make their decisions concerning solar plant projects. Also, there are many suppliers of solar plant components in Nigeria thus there are many outsourcing service providers.

**Cost analysis:** is another attribute of the decision-making elements for outsourcing production. It has to do with whether this is the bottleneck of current production, whether this is in compliance with the enterprise development strategy, input and output analysis of own production and input and output analysis of outsourcing production (Liu, 2013). Cost analysis is considered as a critical attribute when making decision on production outsourcing, according to a solar expert in Port Harcourt Nigeria “Solar is difficult”. It means that to handle a solar project in Nigeria, proper understanding of the enterprise strategy is necessary as well as input and output analysis of outsourcing production.

#### **5.4. Evaluation elements for choosing subcontractor suppliers in Nigerian Solar companies**

**Time:** is one of the attributes of the evaluation elements for choosing subcontractor suppliers. Time consists of the length of time taken to manufacture a product and transportation turnaround (Liu, 2013). The concept of logistics is applied “getting the right product in the right way, the right product, in the right quantity and right quality, in the right place, at the right time, for the right customers and at the right cost” (Tekijät et al. 2013). Time is a critical attribute for solar companies in Nigeria. Most of the solar companies define the time required for them to complete a certain project. They also expect their suppliers to comply accordingly.

**Quality:** Many solar energy companies assess the quality of products supplied by the subcontractor suppliers, therefore quality is an essential ingredient for solar companies in Nigeria. The attributes of quality are quality standard, manufacturing quality, quality control of procurement, quality of material storage, quality of manufacturing plant and quality of process control. In time past, there were many failed solar projects in Nigeria as a result of corruption and poor quality. A solar expert in Nigeria states that “many people do not see solar energy as a reliable source of power as a result of numerous failed solar projects in the country”. Nowadays, quality has become an indispensable attribute to many solar energy companies in Nigeria. Solar energy is beginning to gain recognition in Nigeria since the implementation of high quality standard.

**Flexibility:** apart from cost and quality, many solar energy companies in Nigeria also take into account flexibility. A solar professional in Nigeria states that it is good to deal with “people without pressure”. It means dealing with those that can easily adapt to changes. He argues that it is difficult to deal with “rigid sub contractor suppliers”.

**Table 31.** Comparison of the decision making elements for outsourcing production in Finnish manufacturing companies and Nigerian solar companies

<b>Finnish manufacturing companies</b>	<b>Solar companies in Nigeria</b>
Versatility	Maturity of outsourcing service providers
Stability of production plan	Cost analysis

**Table 32.** Comparison of the evaluation elements for choosing subcontractor suppliers in Finish manufacturing companies and Nigerian Solar companies

<b>Finnish manufacturing companies</b>	<b>Solar companies in Nigeria</b>
Logistics	Time
Language	Quality
Management	Flexibility
Time	
Flexibility	
Delivery	



## 6. FINDINGS

As explained earlier, five different questionnaires were administered to informants from Finnish manufacturing companies and Nigerian solar energy companies. They are sense and respond, MSI questionnaire, case study outsourcing questionnaire, the combined micro level questionnaire and the combined macro level questionnaire. The sense and respond questionnaire included questions based on competitive priorities of manufacturing strategy such as cost, quality, time and flexibility. There are altogether 25 questions in the S&R questionnaire. The MSI questionnaire comprises of 6 top-level questions of both past and future MSI and 46 detailed questions. The combined micro level questionnaire consists of 40 questions covering management, innovation process, technologies, and resources. The combined macro level questionnaire comprises of 37 questions. The questions covered R&D, industry and public. The case study outsourcing questionnaire explains the decision-making elements of manufacturing outsourcing and evaluation of subcontractor suppliers. Detailed questionnaires are found in the appendices.

All the five questionnaires were sent to 45 solar energy companies in Nigeria, only 20 were filled. The main findings of the research are related to quality and cost. In order to survive in dynamic and turbulent business environments, these attributes should be managed properly. Table 33 below provides a summary of the research findings.

**Table 33.** Research summary

	<b>Finnish manufacturing companies</b>	<b>Solar energy companies in Nigeria</b>
Survival strategies in dynamic and turbulent business environments	<ul style="list-style-type: none"> <li>➤ Quality</li> <li>➤ Cost</li> <li>➤ Analyzer strategy</li> <li>➤ BCFI&amp;SCFI have solved the problem of zero index.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Quality</li> <li>➤ Cost</li> <li>➤ Flexibility</li> <li>➤ Analyzer strategy</li> <li>➤ BCFI&amp;SCFI have solved the problem of zero index</li> </ul>
How firms make decisions on manufacturing outsourcing	<ul style="list-style-type: none"> <li>➤ Versatility</li> <li>➤ Stability of production plan</li> </ul>	<ul style="list-style-type: none"> <li>➤ Maturity of outsourcing service providers</li> <li>➤ Cost analysis</li> </ul>
How to evaluate and select subcontractor suppliers	<ul style="list-style-type: none"> <li>➤ Logistics</li> <li>➤ Language</li> <li>➤ Management</li> <li>➤ Time</li> <li>➤ Flexibility</li> <li>➤ Delivery</li> </ul>	<ul style="list-style-type: none"> <li>➤ Time</li> <li>➤ Quality</li> <li>➤ Flexibility</li> </ul>

## 6.1. Discussion

This study examines a total of 20 solar energy companies in Nigeria and 3 manufacturing companies in Finland. Both companies were investigated to answer the following questions:

- 1) What are the survival strategies of companies in dynamic and turbulent business environments?
- 2) How do firms make decisions on manufacturing outsourcing?
- 3) How do firms evaluate and select subcontractor suppliers?

It can be seen from Table 10, that virtually all the solar energy companies are adopting the analyzer strategy. It means that the companies share characteristics with both defender and prospector companies; the entrepreneurial problem of how to sustain their shares in the current markets and how to search and exploit new markets and products opportunities. They aim at maintaining low costs, high quality and emphasize new product and service development to survive in dynamic and turbulent business environments (Miles et al. 1978). Analyzer strategy is in line with technology adaptation competency, continuous innovation improvement concentration, research and development. See chapter 2.7. It can also be seen that quality is a valued attribute for most of the companies. Only a few informants gave more weight to cost than quality, they argued that products should be made affordable for the customers. As explained in chapter 2.7, market acceptance quality is valued by Nigerian manufacturing companies; this attribute is in line with quality. In the case of the Finnish manufacturing companies, quality is highly valued and analyzer strategy remains the best strategy. The BCFI&SCFI have solved the problem of zero index in both cases (Solar energy and manufacturing companies). The results obtained from the SCA calculations does not indicate high risk probability, it implies that the Finnish manufacturing companies have managed well during crisis.

Secondly, when making decisions on manufacturing outsourcing, versatility and stability of production plan are highly valued by Finnish manufacturing companies, a versatile supplier

is a plus for both the company and the supplier. The attributes of production plan stability are stability of such product, stability of the productivity of such product as well as the coordination of the feasibility of the production plans for both sides; see figure 9. These attributes are essential for Finnish manufacturing companies. On the other hand, Logistics, management, time and language are critical attributes taken into consideration by Finnish manufacturing companies when evaluating and selecting subcontractor suppliers (Oba et.al 2013).

Maturity of outsourcing and cost analysis are the attributes valued by Nigerian solar energy companies when making decisions on manufacturing outsourcing. When dealing with their suppliers, they first consider whether the state law allows such outsourcing, the scale of outsourcing service providers and the number of outsourcing services providers available in the market. These are the attributes of maturity of outsourcing. Also, the bottle neck of current production is considered as well as the input and output analysis of outsourcing production (Liu, 2013). See figure 9.

When making decision on how to evaluate and select subcontractor suppliers, time, quality and flexibility are mostly considered by solar energy companies in Nigeria. In chapter 2.9, it is stated that quality and capability are valued attributes for Nigerian solar energy companies during outsourcing. The attributes of time are manufacturing time, transportation time and turnaround time. The attributes of quality are quality of process control, quality of material storage, quality of manufacturing plan and standard level. The attributes of flexibility are flexibility of planning, flexibility of manufacturing and flexibility of equipment (Liu, 2013). See figure 10.

Previous research has shown that Finland and Nigeria went through deep economic recession, survival strategies were needed to curb such situation. Finnish manufacturing companies received funding from Finnvera during the 2009 economic crisis chapter (2.2). A supplementary budget was approved by the government to save companies. In addition, the adaptation strategy was also applied by many manufacturing companies (chapter 2.2). Solar energy companies do not get funding from the government, they have to devise a

means of survival. The survival strategies of Nigerian solar energy companies are explained in chapter 2.7. These strategies are in line with the results obtained from the thesis.

## **6.2. Feedback from informants**

The results of the research cannot be valid until the informants are contacted. In order to ascertain the validity and reliability of the results some informants were contacted and here are their feedbacks.

Manager from NIG19 confirmed that models showing high values of quality are valid. He states that in the solar energy business, good quality attracts customers and vice versa. Another manager from NIG18 has also confirmed that quality and cost are valued attributes. He states that they do solar installations in the northern regions of Nigeria with high solar potential. They install quality solar plants in open places where people can see. When quality becomes visible to the general public, customers are attracted.

Manager from NIG16 is agreeable to the models with high values of quality and cost. He is of the opinion that quality and cost are two attributes that are useful. He states that “As I told you earlier, we don’t compromise with quality”. While the manager was interviewed to answer the questionnaires, he kept emphasizing on quality. He disclosed to the author that there are many solar companies that cannot guarantee quality services. Many customers believe solar does not work as a result of this. He said “We are out to change this impression”.

The manager from NIG2 has also confirmed that the models with high quality values are valid. He states that “quality is our priority”.

### 6.3. Validity and reliability criteria

A qualitative research takes into account modification in the basic criteria. These criteria include internal validity, external validity, reliability and objectivity. Internal validity in qualitative should be replaced by credibility in qualitative research while the criteria of external validity should be replaced by transferability and reliability by dependability (Takala et al. 2005). On the other hand, the criteria of objectivity can be replaced by conformability. The case companies were tested with this method to ascertain the validity and reliability of the results obtained. Concepts of internal validity and external validity are valid mainly in action research along with constructive research approach, it gives room for reconsideration.

**Internal validity:** otherwise known as credibility is a criterion which depends solemnly on the inconsistency ratio among the responses which exist in a particular group. The results with lower inconsistency ratio are the credible ones. This applies in cases where informants answer without any contradictions. The decision making process will be accepted in this case as well as the model used.

**External Validity:** Values for responses obtained from different groups of participants are expressed by external validity. External validity is referred to as transferability. Better transferability is obtained when groups of respondents are separated.

**Reliability:** is based on how qualified the members are. When there are high qualified respondents in a group, there is bound to be an increase in the group's dependency. It is also applicable in a small group of participants. Reliability is also known as dependability.

**Objectivity:** (Conformability) is a criterion which underlines the relevance in eliminating any dependency which is possible (i.e dependency between the answers from different number of respondents). Independent responses obtained from each and every participant

has an effect on conformability. This effect is usually positive and it can improve conformability (Golovko, 2012). The reliability and validity grades below were based on the feedback obtained from the participating informants.

**Credibility**-4.5 points. There has not been very high inconsistency value of MSI. There were a few cases where they did not match for example, in case company NIG8. The rest of the participants were clear and coherent and not controversial. It can be gathered that the respondents considered their answers so well and they were in line with the task.

**Transferability**-4,0 points. The obtained data were analyzed separately for each and every company. However, different departments of the case companies were interviewed. It may not necessarily mean interviewing employees from every department, but employees with different duties. There were cases of very close relationship which exist in case company NIG8.

**Dependability** -4,7 points. The qualification of the respondents accounted for the high quality of answers obtained from the case companies. Interviewees from top management of the case companies were interviewed. See table tables 5 and 6. There was a slight difference in the answers obtained from case company NIG16, the difference was as a result of personal opinion and experience acquired by the respondent.

**Conformability**-5,0 points. The answers obtained from all the respondents were based on personal experiences and opinions. The respondents were allowed to express their various opinions; they were informed that their answers won't be used to implicate anyone. The web tool software contains only the company's name and no other personal information was required.

#### **6.4. Research limitations**

One of the greatest limitations of the research lies on the number of questionnaires administered to informants. As stated earlier, a total of 5 different questionnaires were used for the research. In all, 154 questions were asked. These questionnaires were mailed to 20 solar energy companies in Nigeria; no filled questionnaire was received after two months. The author visited Nigeria and one on one interviews were conducted to get some of the questionnaires filled. Some of the interviewees were interviewed via phone calls. It was expensive to visit Nigeria; it was also expensive to call some of the interviewees residing in other cities other than the author's city in Nigeria.

If the questions were concise it would have been easier for the interviewees to fill. It takes approximately 5 hours to fill all the questionnaires. Time they say is money. It is very difficult to get these questionnaires filled by managers who are busy with different activities at their work places. The fact that the author is unknown to them makes it even more difficult to get them filled. Some informants did not want to continue with the phone interview when the questions became too much. Some asked the author to send the questionnaires by email. All the questionnaires sent by email were not filled. Earlier research conducted at the University of Vaasa where an interviewee was invited to fill questionnaires like case study outsourcing questionnaire, the combined micro level questionnaire and the combined macro level questionnaire, it took about 4 hours to fill all of them. The informant complained about the number of questions asked in the questionnaires.

This thesis comprises of two different case studies. The first case study is about how companies survive in dynamic and turbulent business environments and the second one is the evaluation elements for choosing subcontractor suppliers. The thesis should have focused on one of the case studies alone, not the two of them. Both the sense and respond questionnaire and the manufacturing strategy index questionnaire are used to analyze



companies with production activities. These methodologies are not useful for companies without production activities like hospitals, restaurants, shopping malls and so on. The methodologies should have been relevant to companies from all other industries other than companies with production activities. Future research should bridge the gap. The questionnaires should be concise and the methods should be applicable to other industries.

## 7. CONCLUSION

The results obtained from the research are used to study how manufacturing companies in Finland and Solar energy companies in Nigeria survive in hostile business environments. The results can also be used to study the evaluation criteria for choosing subcontractor suppliers in Nigerian solar energy companies as well as Finnish manufacturing companies. These results are useful in strategic planning in turbulent business environments. The research has shown a strong theoretical basis connecting different approaches such as manufacturing strategy index, sense and respond methodology and evaluation elements for choosing subcontractor suppliers. Four Nigerian solar energy companies and two Finnish manufacturing companies were used to validate the research method. The number of respondents from the companies was enough to make deductions concerning the research. At the end of the research, some practical deductions can be made. These include:

- MSI (manufacturing strategy index) and S&R (Sense and respond) have proven to be reliable methods used to understand adaptation strategies for companies in turbulent business environments.
- Finnish manufacturing companies and Nigerian solar energy companies often adopt the analyzer strategy in turbulent business environments.
- Cost and quality are essential attributes for both solar energy companies and manufacturing companies.
- BCFI and SCFI have solved the problem of zero index in each case (Solar energy and manufacturing company)
- SCA calculations have shown that risk probability is relatively low in both solar energy company and manufacturing company.
- Attributes such as versatility and stability of production plan are valued by Finnish manufacturing companies when making decision on outsourcing. Finnish manufacturing companies take into consideration logistics, management, time and language when evaluating subcontractor suppliers.

- Maturity of outsourcing and cost analysis are the attributes considered by Nigerian solar energy companies when making decision on manufacturing outsourcing. On the other hand, attributes such as time, time, quality and flexibility are usually considered when making decision on how to evaluate and select subcontractor suppliers.

Finally, the research did not rule out the fact that Finnish manufacturing companies survive using the adaptation strategy in chapter 2.3 which comprises of efficient strategies, product strategy, expense strategies, asset strategies and finance strategies. Similarly, the survival strategies of Nigerian solar energy in companies in chapter 2.6 are still valid. Another means through which Finnish manufacturing companies survive during economic crisis is by getting support from the government and other financial organizations. Nigerian solar energy companies does not get funding from banks or financial organizations.

## LIST OF REFERENCES

- Ahmet .U. Mustafa .B, Tülay .U. (2011). *Prevailing during the periods of economical crisis and recession through business model innovation.*
- Arto M. (2009).*European monitoring centre on change (EMCC).*
- Benjamin .O. (2012).*Global Recession: Its Implications on Nigeria Economy And The Way Forward'*
- Bradley S. & R. Nolan (1998). *Sense and Respond. Capturing Value in the Network Era.* Boston: Harvard Business School Press.
- Domberger. S. (1999). *The Contracting Organization: A Strategic Guide to Outsourcing.* Oxford University Press, Oxford.
- DiRomualdo, A., & Gurbaxani, V. (1998). *Strategic intent for IT outsourcing. Sloan Management Review*, 39(4), 67–80.
- Erkki K. Laitinen (2000).*Long-term Success of Adaptation Strategies: Evidence from Finnish Companies.*
- EMCC *European monitoring centre on change* (2009)
- Freytag, P. V. (1999). *Why do companies in business markets resist the outsourcing of market communication.* *Advances in Business Marketing and Purchasing*, 8, 81–93.
- Felix J, Olli R, Oba O, Jose A. Johannese H(2012). *Operations strategy research based on developed sense and respond methodology: ABB motors case study.*
- FINNFACTS (2014). Facts about Finland.  
<http://www.finnfacts.fi/eng/facts-about-finland/>

- Golovko, I. (2012). *Directions of a Company's Preferable Strategy Type by Sense & Respond Methodology*. Vaasa: University of Vaasa.
- Gulati, R., Nohria, N. & Wohlgezogen, (2010) *Roaring out of Recession*. Harvard Business Review, 2010; 88(3):62-9.
- Hauwa L. A. (2013). *Survival Strategies of Micro Enterprises in Nigeria and the Global Market*.
- Hisham, Khaled .E. (2014).*Automated multi-objective construction logistics optimization System*.
- Ian M., Angela A. (2003).*The impact of outsourcing on the transaction costs and boundaries of manufacturing*.
- Idris, I., Yinus, A (2013) *Nigerian Executive focus 'Solar Power can give Nigeria 20 percent of its energy Need'*
- John .M, Chandra I, and Tim B.(2013). *Global logistics and supply Chain management*.
- Lussier, R. N. (1996). *Reasons why small businesses fail: an how to avoid failure*. The Entrepreneur Executive, 1(2): 10-17
- Liu, Y., Wu, Q., Zhao, S. & Takala, J., 2011. *Operations Strategy Optimization Based on Developed Sense and Respond Methodology*. Kitakyushu, Japan, Proceedings of the 8th International Conference on Innovation & Management.

- Mohammed Y, Mustafa N, Bashir A & Mokintar S. (2013) Renewable energy sources for distributed power generation in Nigeria: A review of the potential
- Oba O. Usman K, Ayodeji I & Hanna H (2013) *Anticipated diffusion of technological innovation: Wartsila case study.*
- OCRA (2014). Unrivalled knowledge and resources  
<http://www.ocra.com/solutions/finland-overview.asp>
- Onyenekenwa C, (2010). *Survival Strategies for Entrepreneurs in Dwindling Nigerian Economy.* Asian Journal of Industrial Engineering, 2: 52-62
- O. Shy, R. Stenbacka (2003). *Strategic outsourcing: Journal of Economic Behaviour and Organization*, 50 (2003), pp. 203–224.
- Porter, M.E.Sala-i-Martin.X.Schwab,K & Lopez-carlos. A. (2004). *The World Economic Forum's Global Competitiveness Report 2004-2005.* Palgrave, New York, N.Y.
- Ranta J. M. & Takala J. *A Holistic Method for Finding out Critical Feature of Industry Maintenance Services.* International Journal of Services and Standards, 2007, 3(3): 312-325
- Raymond E, Miles & Charles C. *Snow 1978 book Organization Strategy, Structure, and Process.*
- Ryszard, LLM,(2005). *Implementing Miles and Snow's strategies.*
- Saaty, T. L. (1980). *The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation.* New York: McGraw-Hill.

- Strang, L.(1998).*The turnaround process: conditions and strategies for a successful turnaround of firms, Doctoral dissertation, Publications of the Helsinki University of Technology, Helsinki for a review.*
- Takuo w. (2009). *Comparative study on Asian Approaches to Africa: An introductory reflection.*
- Takala, J., Liu, Y., Feng, B. & Yang, W.S., 2013. *Analytical Evaluation of Sustainable Competitive Advantage.* Moscow, Russia, IFAC Conference on Manufacturing Modelling, Management and Control.
- Takala, J., (2005). Validity and reliability in qualitative case studies. Research with constructive research approach.
- Timo, K, Yrjo .K. & Tuomas T. (2007). *Phoenix rising: Legal reforms and change in valuations in Finland during the economic crisis.*
- Veli-Pekka, V. (2013) *Validating performance based critical actions in high tech start-up*





Resource Inputs In	Optimizing	Flexibility	Competence
F1. Design adjustments			
F2. Volume changes			
F3. Mix changes			
F4. Lifecycle changes			
F5. Board product line			

## APPENDIX 2. MSI questionnaire

### Pilot Case Studies for Research on Global Manufacturing Strategies

Dr. Yang Liu & Prof. Josu Takala, University of Vaasa

NAME \_\_\_\_\_

ORGANISATION \_\_\_\_\_ COUNTRY \_\_\_\_\_

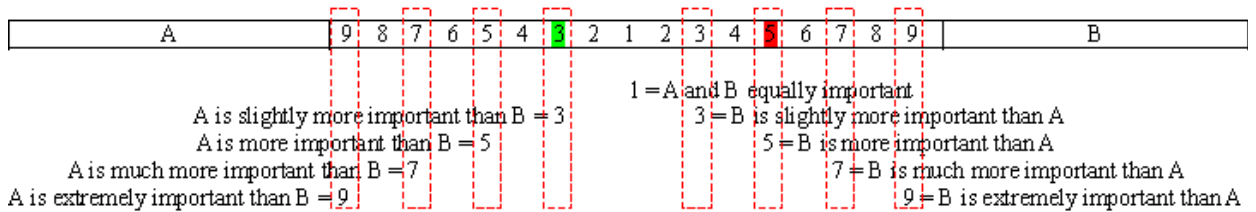
ANSWER IS ABOUT (corporation, business area etc.) \_\_\_\_\_

Please specify roughly the main operations strategy in your company by evaluating the priority weights of Q(Quality), C(Cost), T(Time/Delivery) and F(Flexibility). Note: Percentage of Quality, Cost, Delivery and Flexibility altogether is 100%, which means the sum of every row in below table should be 100%.

	Quality %	Cost %	Delivery %	Flexibility %
Past 3~5 years				
Future 3~5 years				

Then we use AHP methods to evaluate in details the main and sub-criteria in operations strategy. AHP method uses pairwise comparison among all the factors to support decision making process. All questions in this questionnaire are designed to follow AHP logic. It takes two steps to answer each question. For instance, you are given two different criteria which affect manufacturing decision making. Firstly you need to compare these two given

factors and select one factor which you considered as more important than the other (for example: A is more important than B or vice versa). Secondly you need to give a weight within scale of 1-9 to indicate in what extent you consider this selected factor is more important than the other one. If the factors are equally important, then select number 1. You can also use even numbers from the scale, if your answer is better suited between odd numbers.



In order to ensure the validity of answers, two incorrect examples with high inconsistency ratio (ICR) are illustrated below. By understanding the causes of ICR, informants are recommended to recheck the consistency after filling the answers.

Example 1:

1	A	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	B
2	A	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C
3	B	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C

This means  $A > B$  &  $B > C$  &  $C > A$  which is logically inconsistency, so it causes high ICR.

Example 2:

1	A	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	B
2	A	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C
3	B	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C

This means A is much bigger than B, and A is a little bigger than C, from these two conditions it can be concluded that C should be bigger than B, but last condition put B is bigger than C, which is contradictory and causes high ICR.

Please evaluate the following criteria in every pairwise comparisons what are more important in your opinion. Please circle (O) the evaluation values for past situation and mark (X) the evaluation values for future situation.

**Main Criteria**

Costs	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Quality
Costs	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Delivery
Costs	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	Delivery
Quality	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Flexibility
Delivery	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Flexibility

**Cost**

Low Cost	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Value Added
Low Cost	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Quality Costs
Low Cost	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Activity Based Measurement
Low Cost	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Continuous Improvement
Value Added	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Quality Costs
Value Added	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Activity Based Measurement
Value Added	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Continuous Improvement
Quality Costs	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Activity Based Measurement
Quality Costs	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Continuous Improvement
Activity Based Measurement	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Continuous Improvement

**Quality**

Low Defect Rate	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Product Performance
Low Defect Rate	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Reliability
Low Defect Rate	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Environmental Aspects
Low Defect Rate	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Certification
Product Performance	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Reliability
Product Performance	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Environmental Aspects
Product Performance	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Certification
Reliability	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Environmental Aspects
Reliability	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Certification
Environmental Aspects	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Certification

**Delivery**

Fast Delivery	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	On Agreed Time
Fast Delivery	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Right Amount
Fast Delivery	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Right Quality
Fast Delivery	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Dependable Promises
On Agreed Time	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Right Amount
On Agreed Time	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Right Quality
On Agreed Time	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Dependable Promises
Right Amount	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Right Quality
Right Amount	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Dependable Promises
Right Quality	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Dependable Promises

**7.1.1.1.1. Flexibility**

Design Adjustment	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Volume Change
Design Adjustment	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Mix Changes
Design Adjustment	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Broad Product Line
Volume Change	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Mix Changes
Volume Change	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Broad Product Line
Mix Changes	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	Broad Product Line

THANK YOU FOR YOUR ANSWER!

### **APPENDIX 3. Case study outsourcing questionnaire**

#### **Topics**

- (1) How firms make decisions on manufacturing outsourcing? The research objective is to find the decisive elements in decision-making of manufacturing outsourcing.
- (2) How to evaluate and select subcontractor suppliers? The research objective is to formulate the evaluation elements for subcontractor suppliers.

#### **Procedures**

Refer to the following sample questionnaire to carry out the case study. Find the decision-making elements of manufacturing outsourcing and evaluation of subcontractor suppliers, then explain by figures and make the analysis report.

#### **Tips**

- (1) The case company must be a manufacturing company. From each case company, 2~3 informants from different departments will be interviewed. Based on the sample approach, discuss with informants emphasizing on the case study topics.
- (2) Starting from main criteria of operations strategy (quality, cost, time, flexibility and also service), classify all related aspects to formulate the sub-criteria. Discuss with informants all the aspects as open questions and get answers from them.
- (3) Take proper notes/recording while interviewing the informants to summarize all the key points.

#### **Example design of questionnaire**

Case company	
Main products / production areas	
Some Examples including	

<p>manufacturing technology:</p> <ul style="list-style-type: none"> <li>- What parts are outsourced?</li> <li>- What parts are provided by subcontractor suppliers?</li> </ul>	
<p>Informants (Department/position)</p>	
<p>Period of case study</p>	<p>/ / - / /</p>

## APPENDIX 4. The combined micro level questionnaire

S3, the combined macro level questionnaire

Demographic information ( R&D, Industry, Public)

1. Organization Name
2. Contact
3. Organization Sector
4. Year of foundation
5. Total number of employees (total) (*Industry*)
6. Customers: (*Industry*)

- The number of the customers/customer groups:
- Name of customers:

7. Where your organization partners are located? Could you put the different areas in order of importance for your organization? (*R&D, Industry, Public*)

<b>How many partners do you have/kuinka monta kumppania teillä on...</b>	<b>Amount of partners /kumppanien lkm</b>	<b>Area of importance /alueet tärkeysjärj.</b>
in Ostrobothnian region (maakunta)?		
in Ostrobothnia (larger definition) Pohjanmaan maakunnissa?		
in other parts of Finland?/ muualla Suomessa		
outside Finland? /Suomen ulkopuolella		
in emerging markets? /nousevilla markkina-alueilla (definition of emerging markets)		
inside the EU? /Unionin sisällä		

8. In what product areas/industries are you cooperated in knowledge acquisition, creation and transfer: (*Industry*)

- ✓ Plastic plates, sheets, tubes and profiles
- ✓ Electric motors, generators and transformers
- ✓ Electricity distribution and control apparatus

- ✓ Electronic components
- ✓ Engines and turbines, except aircraft, vehicle and cycle engines
- ✓ Fluid power equipment
- ✓ Other pumps and compressors
- ✓ Other taps and valves
- ✓ Bearings, gears, gearing and driving elements
- ✓ Other farmed animals and animal products
- ✓ Pleasure and sporting boats
- ✓ Management consulting services
- ✓ Specialised design services
- ✓ Administrative services for more efficient operation of businesses
- ✓ Research and experimental development services in other natural sciences and engineering
- ✓ Research and experimental development services in nanotechnology
- ✓ Smart grids (no classification)
- ✓ LNC technology (no classification)
- ✓ Photonics
- ✓ electronic integrated circuits
- ✓ Joku muu, mikä:
- ✓ Others, what

9. Main products or product groups: (Industry)

- 1.
- 2.
- 3.
- 4.
- 5.

## **II. Partnership:**

10. Describe your three most important challenges in current partnerships? (R&D, Industry,

Public)

- 1.
- 2.
- 3.



11. Describe your three most important challenges in making partnerships? (*R&D, Industry, Public*)

- 1.
- 2.
- 3.

12. Please fill in the demanded weights of the different technology levels:

Product	Basic (%)	Core (%)	Spearhead (%)
Main			
Others			

Spearhead Technology: Technologies more orientated for the future

Core Technology: Company's core competitive technologies for today

Basic Technology: Technologies that are commonly used everywhere and can be bought from other companies or outsourced

13. What kind of risks do you share with your partners? (*Industry*)

14. Do you have the common vision and goal? (*Industry*)

15. Evaluate your organization according to the following criteria: (*industry, R&D*)

	Scale: 1=low, 10 = high	
	Expectations (1-10)	Experience (1-10)
5. Evaluate the benefits of cooperation with R&D sector for your company		
6. Evaluate the risks which you share with your partner		
7. Do your organization and your partner have common vision and goal		
8. Evaluate the resource providing to your partner		
9. Evaluate the resource providing from your partner to your organization		
10. Evaluate the treatment you share with your partner		
11. Evaluate your ability to to manage collaboration between national partners		

12. Evaluate your ability in information technology in combined sector		
13. Evaluate your ability to to manage collaboration between International partners		
14. Evaluate your competitiveness position to create and maintain critical mass of competence		
15. Evaluate your competitiveness position to enable the industry and academia to network		
<b><u>Partnership</u></b>		
1. Communication development		
2. Innovation development		
3. Service improvement		
4. Resources		
5. Evaluate your experience in the scope of the cooperation network		
6. Evaluate your ability to generate joint projects?		
7. Evaluate yourself to improve the ability to identify the various actors in areas of expertise		
8. evaluate yourself to improve the ability to identify the various actors in areas of joint project		
9. Evaluate yourself in integrating information with your partner?		
10. Evaluate yourself to find new forms of cooperation between the actors		
11. Evaluate your position in joint projects with other actors in the field		
12. Evaluate your ability to generate concrete joint projects		
13. Evaluate your ability to enable domestic partnerships?		
14.		
15. Evaluate the importance of emergence of new networks		
<b><u>Innovation</u></b>		
1. Evaluate your company willingness to apply the innovation project		

2. Evaluate your company performance in developing national project		
3. Evaluate your company performance in developing international project		
4. Evaluate yourself in understanding of new, customer-specified requirements current		
5. Evaluate yourself in understanding of new, customer-specified requirements in new sector		
6. Evaluate yourself in understanding of new, customer-specified requirements in requirement related to joint sector		
7. Evaluate yourself in understanding of new, customer-specified requirements		
8. Evaluate your ability to generate scientifically challenging research projects in R&D sector		
9. Evaluate your ability to generate scientifically challenging research projects in Industry sector		
10. Evaluate your ability to generate scientifically challenging research projects in public sector		
11. Evaluate your competitiveness advantage in R&D sector		
12. Evaluate your competitiveness advantage in industry sector		
13. Evaluate your competitiveness advantage in Public sector		
14. Evaluate your ability to generate new product or service innovations		
15. Evaluate your ability to produce a new international network		
<b><u>Providing knowledge for your partner</u></b>		
1. Information systems /informaatiojärjestelmiin		
2. Technical information /tekniseen tietoon		
3. Production information /tuoteinformaatioon		
4. Process information /tietoon prosesseista		
5. Organisational information /organisaationaaliseen tietoon		
6. Management (technology, HR, etc) /johtamiseen, tai hallinnointiin		
7. Marketing information		
<b><u>Providing knowledge for you from your partner</u></b>		
1. Information systems /informaatiojärjestelmiin		

2. Technical information /tekniseen tietoon		
3. Production information /tuoteinformaatioon		
4. Process information /tietoon prosesseista		
5. Organisational information /organisaationaaliseen tietoon		
6. Management (technology, HR, etc) /johtamiseen, tai hallintoiintiin		
7. Marketing information		
<b><u>Having knowledge concerning the following specific areas</u></b>		
1. Maritime technology		
2. Renewable energy		
3. Energy technology		
4. Fur farming		

37. How important are these technologies for future innovations in Ostrobothnia? (*Industry, R&D, Public sectors*)

Ala/branch/sector	Importance /Merkittävyys		Why? How to develop it more?
	Now Nyt	In future Tulevaisuudessa	
Plastic plates, sheets, tubes and profiles	esim. 1-10	esim. 1-10	
Electric motors, generators and transformers			
Electricity distribution and control apparatus			
Electronic components			
Engines and turbines, except aircraft, vehicle and cycle engines			
Fluid power equipment			
Other pumps and compressors			
Other taps and valves			
Bearings, gears, gearing and driving elements			
Other farmed animals and animal products			

<a href="#">Pleasure and sporting boats</a>			
Management consulting services			
Specialised design services			
Administrative services for more efficient operation of businesses			
Research and experimental development services in other natural sciences and engineering			
Research and experimental development services in nanotechnology			
Smart grids (no classification)			
LNC technology (no classification)			
Photonics			
electronic integrated circuits			
Joku muu, mikä: Others, what			

(Based on CPA 2008 classification)

## APPENDIX 5. The combined micro level questionnaire

<b>Attributes</b>	Expect. (1-10)	Exper. (1-10)	Direction of development expect. Future Worse better	Direction of development exper.(past) Worse same better	Compared with competitors Worse same better	Knowledge technology requirement Basic% core % Spearhead%
<b>Technologies</b>						
Compatibility of technologies						
Diffusion of technologies						
Confidentiality of technologies						
Availability of technologies						
Outsource-ability of technologies						
Does it support short-time and long time?						
<b>Supplementary technologies</b>						
Compatibility of technologies						
Diffusion of technologies						
Confidentiality of technologies						
Availability of technologies						
Outsource-ability of technologies						
<b>Resources</b>						
Guarantee of resources						
Availability of resources						
Management of resources						
<b>Management</b>						
Inter-functional integration						
Evaluation management						
Process co-ordination						
Process alignment						
Risk management						

Control and monitoring mechanism					
External processes					
Internal processes					
Learning and development curve					
<b>Product research direction</b>					
Compatibility with research goals?					
Balance of risk in project portfolio?					
Concurrency matrix					
Objectives					
Deadline of innovations					
Reactions to competition					
<b>Innovation product</b>	<b>progress</b>				
Product progress management					
Quality of productivity					
Vision and commitment					
Amount of productivity					
Team experience					
<b>Innovation processes</b>					
Strength of innovations					
Weaknesses of innovations					
Viability of innovations					
Complexity					
Product modularity					
Evaluation of Innovations					

## **APPENDIX 6. Cover letter to the respondents**

Dear sir/madam

We are a research team from the University of Vaasa, Finland. We are making a comparison study of how solar energy companies in Nigeria and Manufacturing companies in Finland survive during economic crisis. We have chosen your company to fill some web based questionnaires. We sincerely ask for your assistance in filling these questionnaires. We are sorry for all inconveniences this may cause. The questionnaires are three altogether (MST&TLI, Form 1 and Form 2). Click on this link <http://webapps.puv.fi/sca/> to begin. Start by filling the MST & TLI questionnaire and then click on form 1 to fill the second questionnaire and finally click on form 3 to fill the last one. When all the questionnaires are filled, click on "Submit Data and Start Over", a complete table will be generated, then click "Calculate Submitted Data". When filling the questionnaires, fill in all the blank spaces that can be filled. In form 2, assign values to P-MSI and F-MSI (F=future, P=Present) in such a way that the sum of the values will be equal to 100, these values are for Quality, cost, time and flexibility. It should be assigned on the basis of what you give priority to in your company. Finally click on 'calculate submitted data' followed by 'graph'. At this point, graphs will be generated. At the bottom of the page there will be an option to 'Export excel', export the excel file and send to us. Thank you for your participation.

Best regards

Oba Oriekwo

University of Vaasa,  
Department of Industrial management,  
Wolffintie 34, 65200 Vaasa,  
Finland  
+358443571432