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A MODEL TO SUPPORT STRATEGIC CONFIGURATION OF GLOBAL SUPPLY CHAIN

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Content

Abstract

Supply chain management has been studied in the past decades, because it is a powerful weapon in reducing the total supply chain costs, decreasing the operations risk, and enhancing the service level. However, there is not still a research focusing on the design of strategic supply chain configuration for the entire supply chain system (i.e. the strategic location alternatives of sourcing, manufacturing, and distribution on the global or local scale). Therefore, this research aims to develop a decision-making model in order to support users in selecting the appropriate strategic supply chain configuration or checking the coherence of an existing supply chain configuration based on the specific global supply chain problem represented by a combination of the significant drivers affecting supply chain costs and customer service level.

This research employed a methodology integrating both qualitative and quantitative approaches. Eight (8) strategic supply chain configurations and 27 affecting drivers have been identified on the basis of an in-depth literature research on 124 papers published since 1982 to 2013. Forty (40) best-in-class manufacturing companies have been investigated in order to collect the information about their adopted strategic supply chain configurations and the value of each identified driver. Five (5) contextual factors and 12 significant drivers have been found through a sequential quantitative analysis process based on correlation analysis, factor analysis, and regression analysis. As a result, three decision matrixes for each supply chain stage have been built used to make the decision on strategic supply chain configuration. Finally, the reliability of the developed decision-making model has been examined based on additional 5 firms. Therefore, the decision-making model has been proposed and validated. A firm could adopt the decision-making model, consisted of the 12 significant drivers, data transformation scales, and decision matrix for each supply chain stage, to design an optimal strategic supply chain configuration based on a predefined 4-step sequential process.

Keywords: Supply Chain Management, Supply Chain Configuration, Supply Chain Network Design, Location design, Decision Making

Abstract (Italian)

Supply chain management è stato studiato negli ultimi decenni, perché è una potente arma nella riduzione totale dei costi della supply chain, riducendo il rischio delle operazioni e migliorando il livello di servizio. Tuttavia, non vi è ancora una ricerca incentrata sulla progettazione di configurazioni strategiche della catena di fornitura per l'intero sistema della catena di approvvigionamento (cioè le alternative posizione strategica di approvvigionamento, produzione e distribuzione su scala globale o locale). Pertanto, questa ricerca intende sviluppare un modello decisionale per supportare gli utenti nella scelta della configurazione filiera strategica appropriata o di controllo della coerenza una configurazione filiera esistente basato sul problema specifico filiera globale rappresentato da una combinazione del significativo cause che minacciano i costi della supply chain e del livello di servizio al cliente.

Questa ricerca ha utilizzato un metodo che integra approcci qualitativi e quantitativi. Otto (8) configurazioni della catena di approvvigionamento strategiche e 27 cause che minacciano sono stati individuati sulla base di una ricerca della letteratura approfondita sui 124 lavori pubblicati dal 1982 al 2013. Quaranta (40) best-in-class aziende manifatturiere sono state studiate in modo per raccogliere le informazioni sulle loro configurazioni di supply chain strategico adottato e il valore di ogni driver identificato. Cinque (5) fattori contestuali e 12 piloti di rilievo sono stati trovati attraverso un progressivo processo di analisi quantitativa basata su analisi di correlazione, analisi fattoriale, e l'analisi di regressione. Come risultato, tre matrici di decisione per ogni fase della catena di approvvigionamento sono state costruite utilizzati per rendere la decisione sulla configurazione strategica della supply chain. Infine, l'affidabilità del modello decisionale sviluppato è stato esaminato basato su ulteriori 5 attività.

Pertanto, il modello decisionale è stato proposto e convalidato. Una società potrebbe adottare il modello decisionale, composto dai 12 piloti importanti, bilance di trasformazione dei dati, e matrice decisionale per ogni fase della catena di approvvigionamento, per la progettazione di una configurazione ottimale della catena di approvvigionamento strategico basato su un processo sequenziale a 4-step predefiniti.

Keywords: Supply Chain Management, Supply Chain Configuration, Supply Chain Network Design, Location design, Decision Making

Summary

1. Introduction

Supply chain network design is the heart of supply chain management, and involves many strategic decisions including network structure and management policy. In order to design an optimal supply chain network, a structured approach is required, which includes three phases: i) identification and understanding of product-market characteristics, sourcing context and planning horizon, ii) definition of the potential supply chain configuration alternatives and preliminary assessment, and iii) quantitative assessment of the alternative configurations and detailed design. The purpose of the first and second phases is to identify the possible strategic network configurations that answer three strategic location questions - where to source items, where to locate manufacturing facilities, and which markets to serve - through a preliminary qualitative assessment based on contextual factors. The last phase of the design approach shifts the focus to quantitative analysis in order to identify the optimal configuration based on the constraints, and fine-tune the configurations by simulation technique sometimes.

One of the critical strategic decisions a manufacturing firm has to consider is the design of strategic supply chain configuration, which indicates the strategic location decision of the entire supply chain system (i.e. the strategic location alternatives of sourcing, manufacturing, and distribution on the global or local scale). This strategic decision on the location perspective has a profound influence on the enterprises in the long-term horizon. The strategic supply chain configuration determines the detailed optimization of the network structure, such as number, location, type, and size of the facilities, and the decisions on management policy, such as inventory and transportation decisions no matter on strategic and operational levels. Therefore, any incorrectness on the strategic supply chain configuration might result in the huge loss both on efficiency and effectiveness due to the reconfiguration on location, inventory, and transportation issues. Furthermore, on the basis of the proposed three-step sequential approach, design of strategic supply chain configuration is a complex issue, because many contextual factors have to been considered. In the global business environment, this topic becomes more complicated, because it is driven by a number of external variables such as economic and legislation issues, trade barriers to international trade, and environment concern due to the increasing globalization. Taking into consideration the importance and difficulty of strategic supply chain configuration, it is imperative to provide a decision support model for the practitioners to design strategic supply chain configuration. However, there is not still a research focusing on the strategic selection of supply chain configurations in terms of the strategic location alternatives for the entire supply chain system. Therefore, it is necessary to develop a decision-making model used to design the strategic supply chain configuration on the global scale.

2. Objectives

This research aims to develop a decision-making model in order to support users in selecting the appropriate strategic supply chain configuration or checking the coherence of an existing supply chain configuration based on the specific global supply chain problem represented by a combination of the significant drivers affecting supply chain costs and customer service level.

In order to reach this main goal, the following sub-objectives should be achieved:

- Identifying the strategic supply chain configurations (i.e. the strategic location alternatives of sourcing, manufacturing, and distribution on global or local scale);
- Identifying the drivers (i.e. variables) affecting the strategic configuration of global supply chain network;
- Developing a theoretical framework in order to explore the contextual factors affecting strategic supply chain configuration, and remove the less important drivers;
- Identifying the relationships between the global supply chain configurations and the global supply chain problems in order to obtain the most significant drivers;
- Proposing and validating the decision-making model of strategic supply chain configuration design.

3. Methodology

In this research, an integrated methodology considering both qualitative and quantitative approaches (i.e. integration of multiple case study and quantitative analysis) was developed in order to identify the contextual factors and the drivers in each factor group, explore the relationships between global supply chain configurations and global supply chain problems, and finally, develop the decision-making support model.

More in detail, the research process is consisted of 7 main phases. The aim and output of each phase are described as follows:

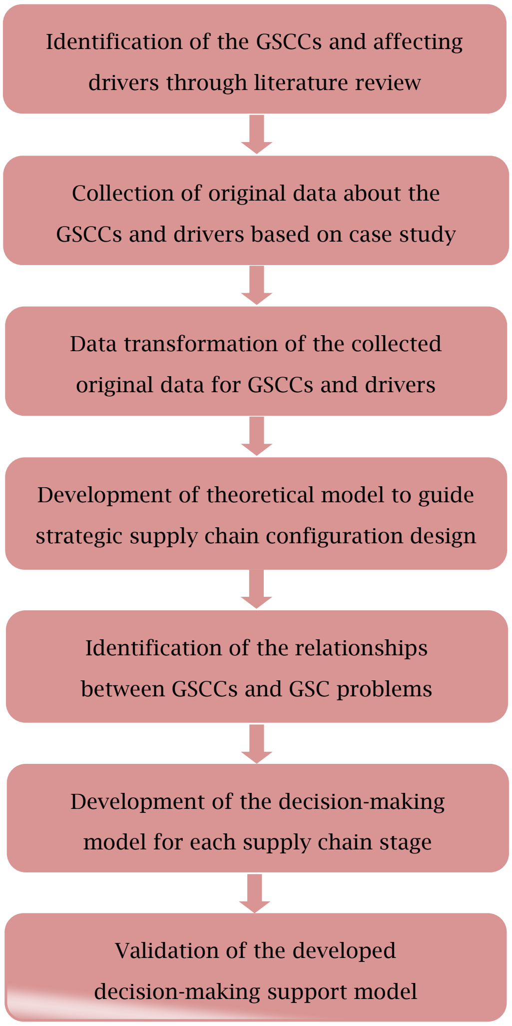


Figure 0.1 – Research process

1. Identification of both the strategic supply chain configurations in terms of the strategic location alternatives of sourcing, manufacturing, and distribution on the local or global level, and the drivers affecting strategic supply chain configuration.

On the basis of the literature research on the scientific articles, it is possible to summarize the types of strategic supply chain configuration, and identify the most frequently discussed drivers that influence supply chain configuration on the strategic level. What is more, the effect of each driver on the individual supply chain stage (i.e. sourcing, manufacturing, and distribution) can be recognized from the extant literature. It is noting that those effects are assumed as correct, no matter if they have been verified empirically. Therefore, a classification describing the strategic supply chain configurations and a framework representing the drivers and their main effects on the supply chain system can be proposed.

2. Collection of the original data about the strategic supply chain configurations and the identified drivers on the basis of company case study.

The aim of company case study is to investigate the adopted strategic supply chain configurations in the firms and collect the actual value of each identified driver. The examined companies should be the leading firms in the manufacturing industry, because another hypothesis of this study is that the top-class firms are more capable of designing and managing supply chain.

3. Evaluation of the investigated strategic supply chain configurations and drivers' original data.

In this phase, the original data of strategic global supply chain configurations and drivers are transformed into discrete number that can be utilized on the statistical model as preliminary evaluation for the further data analysis. More in detail, the entire supply chain configuration is divided into three stages in terms of the supply chain operational processes (i.e. sourcing, manufacturing, and distribution), and each stage is evaluated through a numerical scale of 1-5 discretely on the basis of the level of globalization (1= extremely local, 5 = extremely global). The original data of each driver is converted into 5 points discretely on the basis of the impact on total supply chain costs (1=low impact, 5=high impact).

4. Development of the theoretical model in which the important drivers are identified and categorized into several contextual factor groups.

On the basis of employment of the statistical models, the critical drivers can be found and categorized into several factor groups based on their common characteristics. Each factor group indicates an underlying contextual factor affecting strategic supply chain configuration. The proposed theoretical model is made up the identified contextual factors, the important drivers in each factor group, and the effects of those drivers on the supply chain system. Furthermore, the developed theoretical model can be used as a framework to guide the subsequent quantitative analysis. On the other side, some drivers are eliminated due to less importance and weak reliability.

5. Identification of the relationships between strategic supply chain configurations and supply chain problems for each supply chain stage.

The relationships between the strategic supply chain configurations and supply chain problems can be set up for each supply chain stage through regression model. The supply chain problem is represented by a series of the related critical drivers provided by the theoretical model based on the existence of the driver's effect on each supply chain stage. Therefore, the most significant drivers affecting strategic supply chain configuration on each supply chain stage can be identified based on the statistical indicators, whereas more drivers could be dropped due to the deficiency in statistical criteria.

6. Development of the final decision-making model based on the identified significant drivers and their value.

Three decision matrixes – as the main output of the decision-making model – for each supply chain stage can be proposed in this phase. The decision matrix is represented through illustration graph in which the value of supply chain problem for each investigated company is plotted based on the statistical parameter of those significant drivers.

7. Validation of the developed decision-making model on the basis of additional manufacturing company cases.

The proposed decision-making model should be validated in order to test the reliability. The decision-making model provides a set of toolset including the significant driver and their statistical parameters, the numerical data transformation scale (i.e. transformation from original data to discrete numerical scale), and three decision matrixes. Some additional company cases would be used in order to check if the proposed model could provide correct decision for the users to design strategic supply chain configuration.

4. Results

According to the research process, the first phase is to identify the strategic supply chain configurations and the affecting drivers. On the basis of an in-depth examination on 124 papers published since 1982 in literature, 8 strategic global supply chain configurations and 27 drivers were found.

Configuration	Sourcing	Manufacturing	Distribution
1	Global	Local	Global
2	Global	Global	Global
3	Global	Global	Local
4	Global	Local	Local
5	Local	Local	Local
6	Local	Global	Local
7	Local	Global	Global
8	Local	Local	Global

Table 0.1 – Classification of strategic supply chain configurations

In this classification, "Local" is explained as the material flow taken place within one country or one region. To the contrary, "Global" is interpreted as the material flow conducted across the regions. More in detail, local sourcing indicates the raw materials, components and sub-assemblies are transported from suppliers to plants within the borders of a country or a region. Instead, global sourcing is defined when purchased items are supplied across regions. Furthermore, local manufacturing represents the production facilities are set up in one country or one region. Oppositely, global manufacturing indicates the facilities are located in different regions worldwide. Finally, local distribution is defined when a market is served by its local plants, whereas global distribution indicates a market is fed by the plants located in different regions based on international delivery.

Table 0.2 presents the identified 27 drivers affecting strategic supply chain configuration, and the effects of each driver on the supply chain system. It should be noted that, on the one hand, those 27 drivers are the most popular variables that have a direct effect on the supply chain system on the strategic level. On the other hand, every identified driver might influence the strategic design of entire supply chain structure, whereas, the presented effects are the largest impact that a driver can act on the different supply chain stages. Therefore, it is found that the strategic location alternative of each supply chain stage is mainly influenced by various drivers, and some drivers determine more than one supply chain stage to the most degree. Additionally, despite not every identified effect has been verified based on quantitative approach, because most of those effects are proposed in the conceptual papers rather than the quantitative and empirical studies, it is still assumed that all the effects are correct and trustworthy.

Driver	**Effect on supply chain system**		
	Sourcing	**Manufacturing**	**Distribution**
Product variety	x		x
Product value density			x
Physical density			x
Risk of obsolescence			x
Profit margin	x		
Competition level	x	x	
Handling requirements			x
Technology level	x	x	
Cycle time		x	x
Completeness		x	x
Delivery reliability			x
Dimension of order			x
Demand predictability	x		x
Demand volatility	x		x
Dimension of market	x	x	
Strength of domestic demand		x	
Competition of domestic suppliers	x		
Availability of purchased items	x		
Quality of domestic sources	x		
Strength of domestic currency		x	
Import tariff	x	x	
Tax incentives and benefits		x	
Importance of labor’s quality		x	
Importatnce of labor’s cost		x	
Quality of infrastructure		x	
Political stability		x	
Enrionment concern and regulation		x	

Table 0.2 – Framework of the affecting drivers

On the basis of the identified strategic supply chain configurations and the drivers, company case study was carried out in order to discern what strategic supply chain configurations are adopted in the industry, and collect the original data of each identified driver. The studied companies were selected based on a serious criterion. On the one hand, the companies involve different sectors in the manufacturing industry, because each sector has distinctive constraints and challenges that influence the global supply chain design. On the other hand, the investigated companies should be the leading firms in their sectors, because it is assumed that the best-in-class companies are more able to be aware of the complex internal and external changes to design and manage supply chain on the global level. Finally, 45 companies - 25 firms in FMCG industry, 10 firms in Electronics industry, 6 firms in Luxury industry, and 4 firms in Automobile industry - were investigated based on both on-site interview and secondary document study. Moreover, the analysis of each company is three-pronged: 1) a brief description of the company with key outstanding figures, business area, products portfolio, and other related findings, 2) the adopted strategic supply chain configuration, and, 3) the supply chain operating process under the existing supply chain network.

In order to facilitate the quantitative analysis, the strategic supply chain configuration adopted by each company and every driver's original data have to be represented as discrete number that is easy to be fed into the statistical model. Therefore, the actual information of each strategic supply chain configuration and driver were linearly converted into the criticality value (i.e. 5-point discrete numerical scale) as the presented example in Figure 0.2. More specifically, the supply chain system is divided into three stages based on different operational processes, because the relationships between the strategic supply chain configuration and the supply chain problem would be identified for each individual supply chain stage, which is affected by various drivers as Table 0.2 presented.

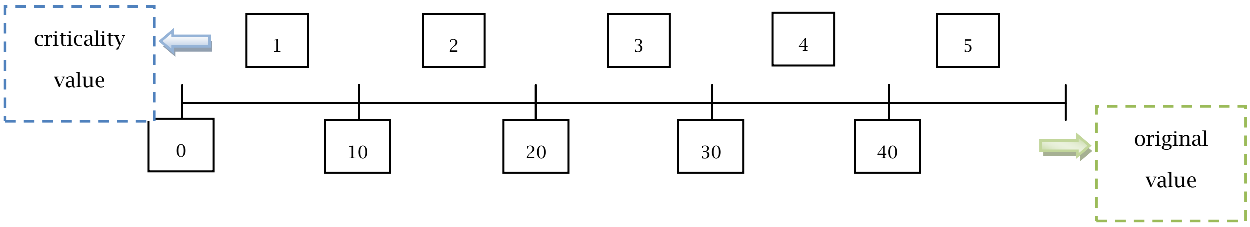


Figure 0.2 – Numerical measurement scale

Among the examined company sample, 40 company cases were random selected in order to develop the decision-making support model, whereas the remaining 5 cases were used to validate the developed model based on a comparison between the solutions proposed by the decision-making model and the current ones.

On the basis of the criticality value of both the strategic supply chain configurations and the 27 identified drivers for 40 company cases, the quantitative analysis was conducted based on four main phases that are shown below in Figure 0.3.

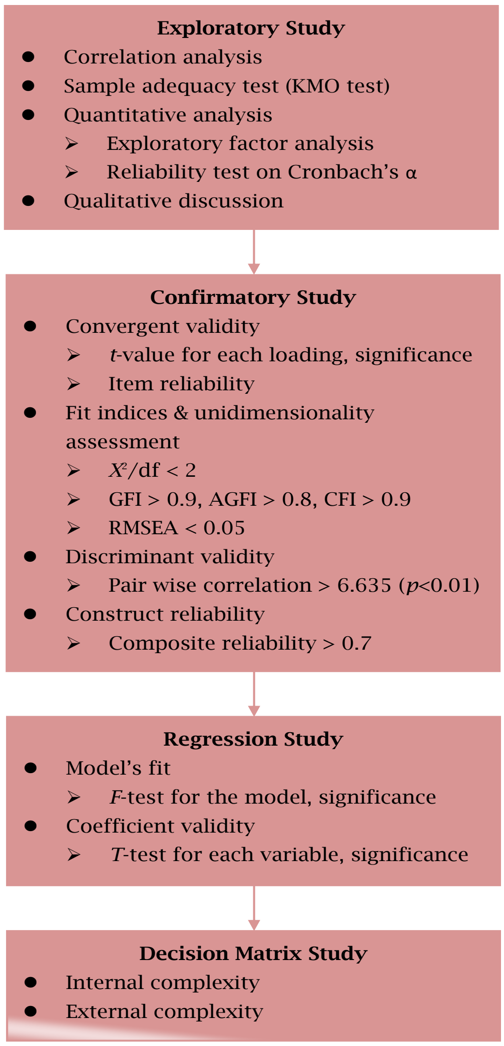


Figure 0.3 - Data analysis process

The aim of quantitative analysis is threefold. The first purpose is data reduction that diminishes the number of affecting drivers depending on a series of statistical models (i.e. correlation analysis, factor analysis, and regression analysis), in order to obtain the most significant drivers. Data classification is the second purpose that aims to identify the contextual factors affecting strategic supply chain configurations. In fact, these two issues are closely bonded, because during the journey of data reduction, the number of the measured drivers is reduced based on the importance and reliability through a sequential quantitative analysis process (i.e. exploratory study, confirmatory study, and regression study), while the latent contextual factors can be classified based on the drivers' common characteristics as the intermediate output of the entire data analysis procedure. Another purpose of quantitative analysis is model development in which the decision matrix can be built based on the most significant drivers.

The quantitative analysis process is divided into two main parts when the research sub-objectives are considered. The first part consists of exploratory study and confirmatory study aiming to propose a theoretical model in which the number of the drivers is preliminary reduced, and the retained drivers are categorized into different factor groups based on their common characteristics through the statistical techniques of correlation analysis and factor analysis. In the second part, the third phase of the data analysis process (i.e. regression study) aims to identify the relationships between strategic supply chain configurations and supply chain problems, therefore, the number of drivers is further reduced in order to obtain the most significant drivers, which are employed to develop the decision matrix in the last phase (i.e. decision matrix study).

Specifically, in the first phase of the quantitative analysis, the aim of correlation analysis is to avoid the multicollinearity among the 27 identified drivers. The driver has to be removed or combined when it is perfectly correlated to another one. It was found that the multicollinearity is absent between all the drivers. Afterwards, exploratory factor analysis (EFA) was conducted on 27 drivers using principle component analysis with varimax rotation to extract the factor. Three drivers were dropped because they destroy the construct reliability of the model by taking into account the cronbach's α that is usually higher than 0.7. Finally, 5 factors consisted of 24 drivers are labeled (see Table 0.3) and described below:

1) Factor 1 consists of nine drivers, namely, risk of obsolescence, cycle time, completeness, dimension of order, dimension of market, strength of domestic market, import tariff, tax incentives and benefits, and quality of infrastructure. These drivers are able to affect the decisions on transportation issue. Therefore, this factor is identified as a transportation factor.
2) Factor 2 consists of five drivers, namely, product value density, physical density, demand predictability, importance of labor's quality, and importance of labor's cost. These drivers indicates the product's physical property and production requirement, thus, this factor is identified as product physical and production factor.
3) Factor 3 comprises four drivers, namely, profit margin, competition level, handling characteristics, and technology level. These drivers are economy and technology related attributes, therefore, this factor is identified as product economic and technology factor.
4) Factor 4 consists of three drivers, namely, competition of domestic suppliers, availability of purchased items, and quality of domestic sources. They are related to procurement, thus, this factor is identified as a supply factor.
5) Factor 5 comprises three drivers, namely, strength of domestic currency, political stability, and environment concern and regulation. These drivers are related to the external environment and society, therefore, this factor is identified as external environment factor.

Factor	Driver	Factor loading	Cronbach's Alpha
Transportation requirements	Risk of obsolescence	0.509	0.825
	Cycle time	0.751	
	Completeness	0.433	
	Dimension of order	0.443	
	Dimension of market	0.572	
	Strength of domestic market	0.524	
	Import tariff	0.743	
	Tax incentives and benefits	0.869	
	Quality of infrastructure	0.902	
Product physical & production features	Product value density	0.820	0.871
	Physical density	0.480	
	Demand predictability	0.549	
	Importance of labor's quality	0.879	
	Importance of labor's cost	0.895	
Product economic & technology features	Profit margin	0.825	0.845
	Competition level	0.791	
	Handling characteristics	0.819	
	Technology level	0.783	
Supply characteristics	Competition of domestic suppliers	0.902	0.868
	Availability of purchased items	0.932	
	Quality of domestic sources	0.761	
External environment features	Strength of domestic currency	0.867	0.786
	Political stability	0.901	
	Environment concern and regulation	0.685	

Table 0.3 - Final result of EFA

As the second phase of the quantitative analysis process, confirmatory factor analysis (CFA) was carried out in order to estimate the hypothesized model of factor structure. The path diagram (see Figure 0.4) implies a measurement model where there are five latent factors made up of their corresponding multiple observed variables. The five latent factors are represented by circles and labeled with the Greek letters ξ. Those latent factors are inter-related, as indicated by the two-headed arrows. The Greek letter Φ_{ij} represents the correlation between them. In addition, the 24 observed variables are enclosed in squares. Nine observed variables (X1-X9) are loaded onto transportation requirements; five observed variables (X10-X14) are loaded onto product physical & production features; four observed variables (X15-X18) are loaded onto product economics & technology features; three observed variables (X19-X21) are loaded onto supply characteristics and the same number of observed variables (X22-X24) are loaded onto external environment features. At the left of the path diagram, the Greek letters δ are seen as errors in observed variables. A straight arrow pointing from a latent variable to an observed variable indicates the causal effect of the latent variable on the observed variable, and the Greek letter λ coefficients are the factor loadings of the observed indicators on the latent variables.

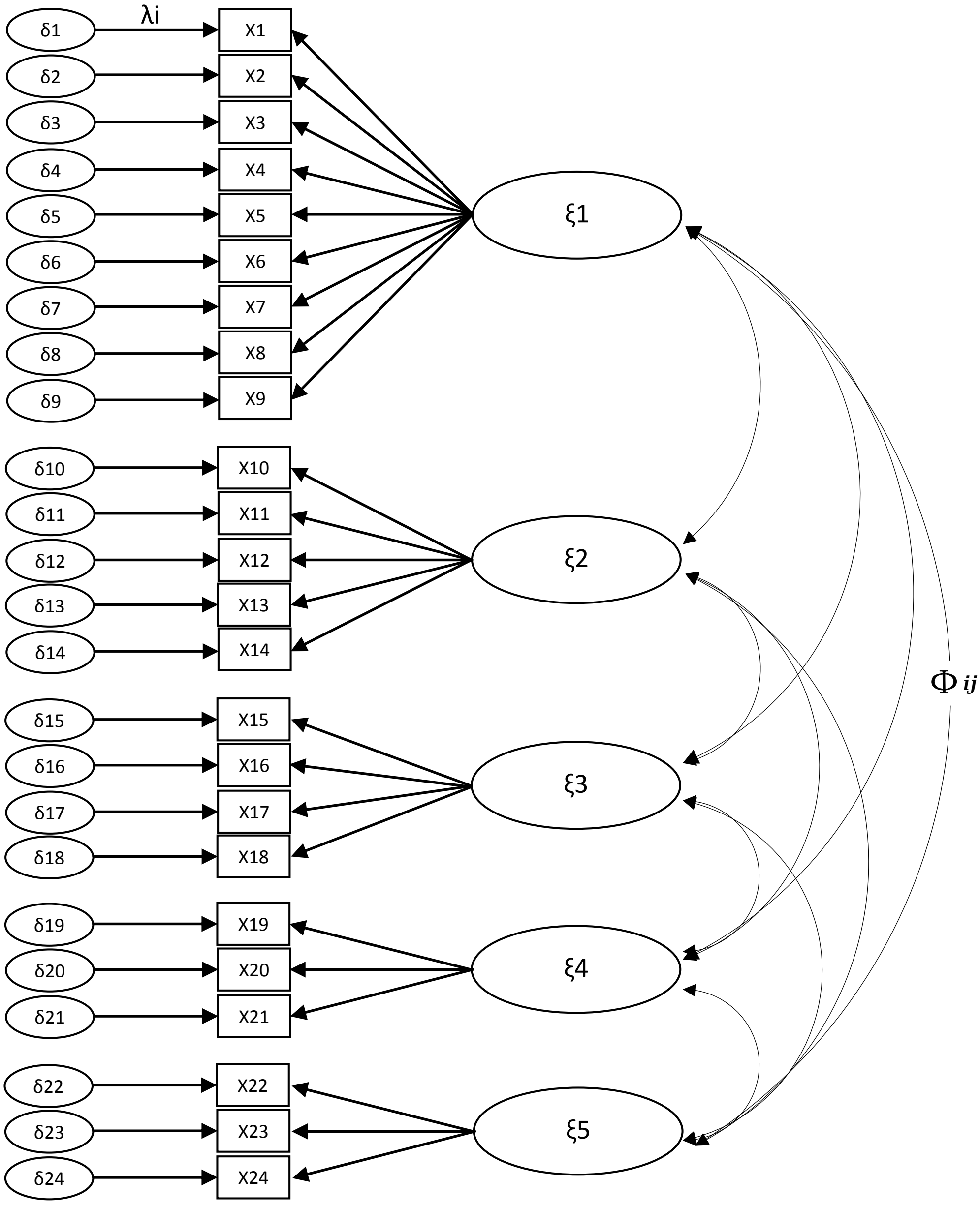


Figure 0.4 – Path diagram of CFA

The initial model's fit indices (e.g. X^2 (242) = 615.84, p = 0.000) of CFA suggested that improvement should be made. Examination of the factor loadings and modification indices suggested that four observed variables - X1, X3, X4, and X6 (i.e. risk of obsolescence, completeness, dimension of order, and strength of domestic market) - could be dropped from the model because of insignificant parameter estimates at $p < 0.01$. These drivers were considered less important to the model and thus were deleted. The modification indices also suggested observed variables are influenced each other between X13 (importance of labor's quality) and X14 (importance of labor's cost). This seems reasonable, because the quality and cost is the trade-off on the production in general. It was also found that X15 (profit margin) and X22 (strength of domestic currency) are correlated. This is not surprising, since the currency power is one of the factors to determine a firm's profit in the globalized business context. In addition, the observed item X16 (competition level) was suggested to establish the correlation link with X18 (technology level). It is reasonable to understand that the high-tech product is facing an increasing competition market. Finally, X22 (strength of domestic currency) was correlated with X24 (environment concern and regulation). The currency power indicates a country's economic advantage, which determines the other social-cultural facts, such as environment concern and regulation. The model was thus modified and the error covariance terms were added to link the appropriated sets of indicator variables.

Therefore, the final model, consisted of 20 drivers and presented in Table 0.4, provides an adequate model fit (X^2 (158) = 185.53, $p = 0.388 > 0.05$), indicating that the hypothesized model is acceptable.

Latent factor	**Driver**	**Standardized factor loading**	***T* – value**	***R*²**
ξ1	Cycle time	0.55	-	0.35
	Dimension of market	0.58	2.82	0.36
	Import tariff	0.74	3.30	0.62
	Tax incentives and benefits	0.74	3.29	0.63
	Quality of infrastructure	0.91	3.58	0.92
ξ2	Product value density	0.86	-	0.84
	Physical density	0.63	3.97	0.43
	Demand predictability	0.67	4.26	0.46
	Importance of labor's quality	0.78	5.09	0.70
	Importance of labor's cost	0.63	3.86	0.47
ξ3	Profit margin	0.57	-	0.30

	Competition level	0.60	3.14	0.32
	Handling characteristics	0.95	3.69	1.35
	Technology level	0.71	3.54	0.35
ξ4	Competition of domestic suppliers	0.80	-	0.76
	Availability of purchased items	0.94	5.19	0.94
	Quality of domestic sources	0.64	4.18	0.48
ξ5	Strength of domestic currency	0.84	-	0.67
	Political stability	0.57	2.89	0.81
	Environment concern and regulation	0.63	3.24	0.35
Goodness–of–fit statistics				
X^2 = 185.53 (p = 0.388); df = 158; X^2/df = 1.174; GFI = 0.90; AGFI = 0.80; CFI = 0.93; RMSEA = 0.027				

Table 0.4 – Parameter estimates, t – value, and R^2 for the proposed model

Furthermore, the validity, reliability, and unidimensionality of the proposed theoretical model were tested. Convergent validity can be tested by t – value that is all statistically significant on the factor loading. Table 0.4 shows that all items exceed the required t – value at the 0.05 level of significance (i.e. higher than 1.96 or smaller than -1.96). Therefore, all indicators in Table 0.4 are significantly related to their specific constructs. Item reliability refers to the R^2 value in the observed variable that are accounted for by the latent factor influencing them, so R^2 can be used to measure the reliability of a particular observed item. The R^2 value typically above 0.3 provides evidence of acceptable reliability. Table 0.4 also shows the R^2 value for all items are greater than 0.3. This reflects that the results are acceptable. Thus, the results of t – value and R^2 value provide sufficient evidence of convergent validity. In addition, Table 0.4 shows that the p value of the Chi-square (X^2 = 185.53, df = 158) of 0.388, above minimum level of 0.05, indicates statistical nonsignificance. Moreover, the goodness-of-fit index (GFI) and the adjusted goodness-of-fit (AGFI) are 0.90 and 0.80, respectively, reaching the recommended level perfectly. The Comparative Fit Index (CFI) is 0.93, which exceeds the recommended level of 0.90, further supporting acceptance of the model. The root-mean-square error of approximation (RMSEA) is 0.027. The normed Chi-square (X^2/df) obtains a value of 1.174, which falls well within the recommended range for conditional support to be given for model parsimony.

In order to assess discriminant validity, every possible pair of latent constructs was built as a constrained CFA model in which the correlation between the paired constructs is fixed 1.0. This result is compared to the result of the unconstrained model, in which the correlations among constructs are freely estimated. It provides reasonable evidence of discriminant validity if the difference between the chi-squares obtained from the original and the second CFA is greater than the chi-square value at the degree of freedom of 1 and significance level of $p < 0.01$ (i.e. 6.635). Table 0.5 reports the results for ten pair wise discriminant validity tests between the five latent constructs. The ΔX^2 values for all the tests confirm discriminant validity is satisfied.

Latent factors	**ξ1**	**ξ2**	**ξ3**	**ξ4**	**ξ5**
ξ1	-				
ξ2	6.94	-			
ξ3	9.62	9.61	-		
ξ4	35.19	31.43	7.07	-	
ξ5	12.48	10.28	21.87	27.94	-

Table 0.5 – Discriminant validity

Composite reliability (CR) provides a measure of the internal consistency and homogeneity of items comprising a scale. As presented in Table 0.6, which indicates that the reliability of the constructs of transportation requirements, product physical & production features, product economics & technology features, supply characteristics, and external environment features are 0.84, 0.84, 0.81, 0.85, and 0.76. All constructs exceed the recommended level. A complementary measure to composite reliability is the average variance extracted (AVE). Table 0.6 also presents that among the AVEs of the measures, all constructs reach the recommended level except for external environment (AVE = 0.48) closing to the minimum required value of 0.50. Thus, marginal acceptance can be given to this measure.

Measures	**CR**[a]	**AVE**[b]
ξ1	0.84	0.51
ξ2	0.84	0.51
ξ3	0.81	0.52
ξ4	0.85	0.76
ξ5	0.76	0.48

Table 0.6 – Assessment of construct reliability

[a] Composite reliability (CR) = (sum of standardized loadings)^2/[(sum of standardized

loadings)[2]+(sum of indicator measurement error)].

[b] Average variance extracted (AVE) = (sum of squared standardized loadings)/[(sum of squared standardized loadings)+(sum of indicator measurement error)].

To summarize, it is found that the overall results of the goodness-of-fit of the model and the assessment of the model's validity and reliability substantial confirm the proposed theoretical model. The 20 critical drives and their effects on the supply chain system, and the 5 grouped contextual factors affecting strategic supply chain configuration are presented as Table 0.7.

Factor	**Driver**	**Effect on supply chain system**		
		Sourcing	**Manufacturing**	**Distribution**
Transportation requirements	Cycle time		x	x
	Dimension of market	x	x	
	Import tariff	x	x	
	Tax incentives and benefits		x	
	Quality of infrastructure		x	
Product physical & production features	Product value density			x
	Physical density			x
	Demand predictability	x		x
	Importance of labor's quality		x	
	Importance of labor's cost		x	
Product economic & technology features	Profit margin	x		
	Competition level	x	x	
	Handling characteristics			x
	Technology level	x	x	
Supply characteristics	Competition of domestic suppliers	x		
	Availability of purchased items	x		
	Quality of domestic sources	x		
External environment features	Strength of domestic currency		x	
	Political stability		x	
	Environment concern and regulation		x	

Table 0.7 – Theoretical model

On the basis of the theoretical model, the relationships between the strategic supply chain configurations and the supply chain problems were examined through regression analysis for each supply chain stage, because a supply chain problem can be described by those confirmed critical drivers.

First, according to the theoretical model, it is reported that 9 critical drives affect the strategic location alternative on sourcing stage. Therefore, the fitted regression with strategic configuration of sourcing process as dependent variable (i.e. local sourcing or global sourcing) and those critical drivers as independent variables is presented as follows:

Y_s = β_0 +β_1(Profit Margin) +β_2(Competition Level) + β_3(Technology Level) + β_4(Demand Predictability) + β_5(Dimension of Market) + β_6(Competition of Domestic Suppliers) + β_7(Availability of Purchased Items) + β_8(Quality of Domestic Sources) + β_9(Import Tariff)

Where:

Y_s denotes the strategic supply chain configuration on sourcing stage (i.e. local sourcing or global sourcing)

β_i denotes the coefficients of the constant and independent variables.

The result of regression model on sourcing stage shows the significant *F* –test value is 3.15, which is higher than 2.21 under the freedom of 9 and 30 (*p*–value is 0.0085). It is presented that 5 drivers significantly influence the dependent variable. The reported coefficient of 0.509 on technology level is positive in the analysis and the reported *p*–value of 0.022 is significant at α level 0.05. Demand predictability shows the strong positive relation to the dependent variable with the coefficient of 0.685 and the *p*-value of 0.034, which is lower than 0.05. Another significant independent variable is competition of domestic suppliers whose value of coefficient is -0.309 and the reported *p*–value at required significance level is 0.022. The forth reported significant driver is availability of purchased items, which represents the significant coefficient of 0.638. In addition, quality of domestic sources reports the coefficient of -0.273 under the significant *p*–value of 0.003. Therefore, those 5 drivers have the significant influence on the strategic supply chain configuration on sourcing stage.

Dependent variable: strategic supply chain configuration on sourcing stage				
F value				3.15
Significance of *F*- test				.009
R square				.4862
Variable	**Coefficient**	**Standardized Beta**	***T*–test**	**Significance of *P*–test**
Technology level	.509	.559	2.42	.022
Demand predictability	.685	.419	2.23	.034
Competition of domestic suppliers	-.309	-.347	-2.40	.022
Availability of purchased items	.638	.657	2.10	.045

Quality of domestic sources	-.273	-.206	-2.83	.003

Table 0.8 – Result of regression analysis on sourcing stage

Second, the number of the critical drivers affecting strategic supply chain configuration on manufacturing stage is 12 given by the theoretical model. Therefore, the regression model is constructed as following with the same rationale as the sourcing stage:

Y_m = β_0 +β_1(Competition Level) + β_2(Technology Level) + β_3(Cycle Time) + β_4(Dimension of Market) + β_5(Strength of Domestic Currency) + β_6(Import Tariff) + β_7(Tax Incentives and benefits) + β_8(Importance of Labor's Quality) +β_9(Importance of Labor's Cost) + β_{10}(Quality of Infrastructure) + β_{11}(Political Stability) + β_{12}(Environment Concern and Regulation)

Where:

Y_m denotes the strategic supply chain configuration on manufacturing stage (i.e. local manufacturing or global manufacturing).

β_i denotes the coefficients of the constant and independent variables.

The result presents the *F*–test value is 4.35 under the freedom of 12 and 27, the *p*-value is 0.000, indicating the significant value. There are 5 variables show the significant relation with the dependent variable. The coefficient of competition level is -0.613, and the *p*-value is 0.009. The technology level also shows a strong relation with strategic supply chain configuration, and the reported coefficient of 0.476 is significant due to the *p*-value of 0.023. What is more, the strength of domestic currency determines the dependent variable obviously, its coefficient is -0.734 under the 0.05 significance level. Another significant variable is tax incentives and benefits whose coefficient is negative, shown -0.499, and reported *p*-value is 0.018. Lastly, the coefficient of 0.585 is obtained by importance of labor's cost, which is significant due to the *p*-value of 0.008.

Dependent variable: strategic supply chain configuration on manufacturing process				
F value				4.35
Significance of *F*- test				.000
R square				.6592
Variable	**Coefficient**	**Standardized**	***T*–test**	**Significance**

		Beta		of *P*–test
Competition level	-.613	-.567	-2.83	.009
Technology level	.476	.524	2.41	.023
Strength of domestic currency	-.734	-.473	-2.51	.018
Tax incentives and benefits	-.499	-.596	-2.51	.018
Importance of labor's cost	.585	.665	2.85	.008

Table 0.9 – Result of regression analysis on manufacturing stage

Lastly, the theoretical model presents that 5 critical drivers affect strategic distribution network configuration. Therefore, the regression function is formulated as follow based on the defined model's principle:

Y_d = β_0+β_1(Product Value Density) + β_2(Physical Density) + β_3(Handling Characteristics) + β_4(Cycle Time) + β_5(Demand Predictability)

Where:

Y_d denotes the strategic supply chain configuration on distribution stage (i.e. local distribution or global distribution).

β_i denotes the coefficients of the constant and independent variables.

The value of *F*-test of the model is 4.14 under the *p*-value of 0.0048, which reports the significant result. It is found 3 independent variables present the significant relation with the dependent variable. First, the product value density positive influences the strategic distribution network configuration, because the reported coefficient of 0.279 is significant due to the *p*-value of 0.007. Second, the value of coefficient of physical density is 0.334, which presents the strong significant relation under the *p*-value of 0.003. Lastly, cycle time is the third significant driver evidenced the coefficient of -0.098 and *p*-value of 0.049.

Dependent variable: strategic supply chain configuration on distribution stage				
F value				4.14
Significance of *F*- test				.005
R square				.378
Variable	**Coefficient**	**Standardized Beta**	***T*–test**	**Significance of *P*–test**
Product value density	.279	.357	2.06	.007
Physical density	.334	.346	2.85	.003
Cycle time	-.098	-.112	-2.70	.049

Table 0.10 – Result of regression analysis on distribution stage

In summary, the number of the drivers affecting strategic supply chain configuration was reduced from 27 initially, through 20 on the basis of correlation analysis and factor analysis as intermediate stage, to 12 depending on the regression analysis finally by taking into consideration both the importance and reliability of each driver. Table 0.11 presents the identified 12 significant drivers and their statistical parameters.

Driver	**Coefficient**	**Standardized Beta**	***T*–test**	***P*–test**
Cycle time	-.098	-.112	-2.70	.049
Tax incentives and benefits	-.499	-.596	-2.51	.018
Product value density	.279	.357	2.06	.007
Physical density	.334	.346	2.85	.003
Demand predictability	.685	.419	2.23	.034
Importance of labor's cost	.585	.665	2.85	.008
Competition level	-.613	-.567	-2.83	.009
Technology level	.476	.524	2.41	.023
Competition of domestic suppliers	-.309	-.347	-2.40	.022
Availability of purchased items	.638	.657	2.10	.045
Quality of domestic sources	-.273	-.206	-2.83	.003
Strength of domestic currency	-.734	-.473	-2.51	.018

Table 0.11 – Significant drivers

In order to describe the identified relationships for each supply chain stage, a decision matrix was developed and presented as graphic illustration. The decision matrix is consisted of two dimensions that imply differently. On the one hand, as the horizon dimension, the internal complexity implies the aggregated value assessed by the significant drivers that mainly lies on the firm and product. On the other hand, those significant drivers controlled by the market and customer can determine the external complexity. Therefore, a supply chain problem is plotted on the decision matrix based on the value of two complexities, and represented as different symbols in order to understand the actual strategic supply chain configuration, more detailed, the green triangle indicates global strategy, and red square represents local strategy. In addition, a curve is drawn on the matrix in order to approximately distinguish the two divisions (i.e. global strategy and local strategy). Despite this curve cannot be considered as a proxy of the border between the divisions, it could indicate the existence of the two areas visually.

According to the 5 significant drivers (i.e. technology level, demand predictability, competition of domestic suppliers, availability of purchased items, and quality of domestic sources) affecting strategic configuration on sourcing stage, the value of internal complexity is determined by technology level and demand predictability, because they are the properties of product. Whereas, the other three drivers (i.e. competition of domestic suppliers, availability of purchased item, and quality of domestic sources) were assigned to one factor group – supply characteristics – that are determined by the external entities. Therefore, the internal complexity and external complexity on sourcing stage can be obtained through the equations:

Internal Complexity = Criticality value of technology level * 0.559 + Criticality value of demand predictability * 0.419

External Complexity = Criticality value of competition of domestic suppliers * -0.347 + Criticality value of Availability of purchased item * 0.657 + Criticality value of quality of domestic sources * -0.206

It is noting that value of each complexity depends on the criticality value of the corresponding significant drivers and their standardized beta because of two reasons. First, the two dimensions of the decision matrix are scaled with 5 discrete points due to a linear shift in order to normalize the matrix for three supply chain stages. Thus, the value of each driver should be discrete number (i.e. criticality value, rather than the original value) when it is fed into the formulation. Second, the weight of each driver is defined as standardized beta rather than the regression coefficient, because the consideration of the constant element is not necessary.

The decision matrix of sourcing process is presented as Figure 0.5, in which a curve (i.e. blue line) separates the supply chain problems based on the strategic location strategy, even though a few of exceptions are found in the two divisions.

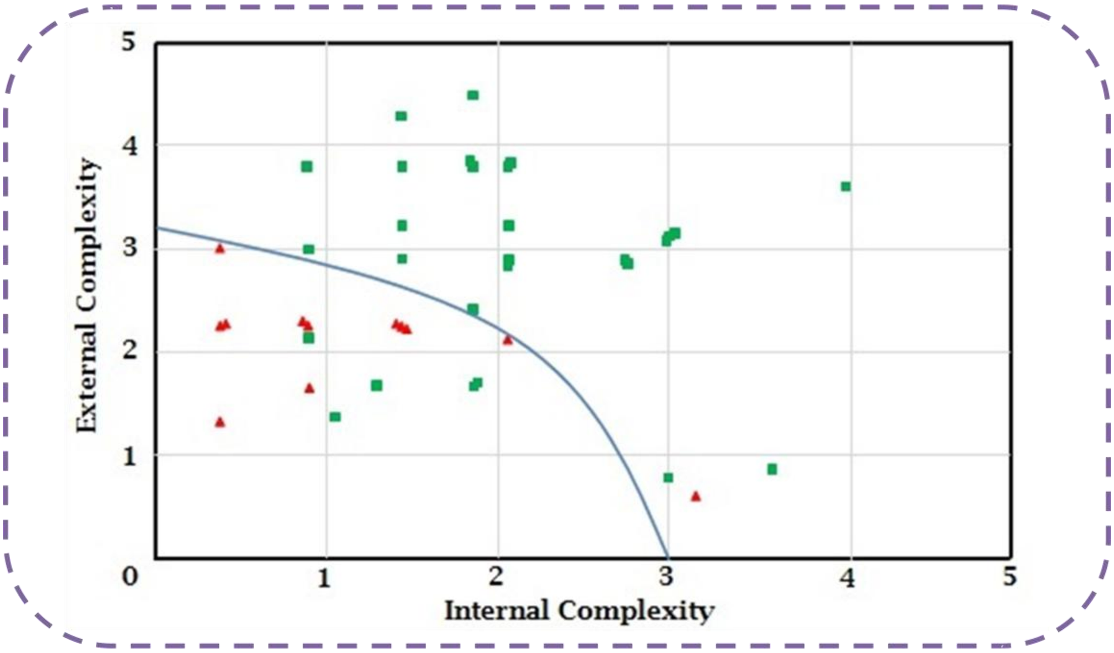


Figure 0.5 – Decision matrix on sourcing stage

The decision matrix of strategic supply chain configuration on sourcing stage highlights the following results:

1. Local sourcing (i.e. the division at left-down of the curve) is the preferred solution used for those supply chain problems in which the value of both two complexities are low (i.e. less than 3 generally) because the products are less innovation and the sourcing resources are abundant.

2. Global sourcing (i.e. the division at right-up of the curve) is the solution used for those supply chain problems when the external complexity is comparatively higher (i.e. approximate to or higher than 3) due to larger impact of the supply characteristics. It is also preferred when the internal complexity is obviously more complex, because the products are more innovative and more difficult to be predicted.

In conclusion, the strategic location alternative on sourcing stage greater relies on three drivers - competition of domestic suppliers, availability of purchased item, and quality of domestic sources – that reveals the contextual factor of supply characteristics, because despite some supply chain problems present similar internal complexities, most of the supply chain problems employing global strategy present more complex on the external dimension.

On the manufacturing stage, the strategic configuration lies on 5 significant drivers (i.e. competition level, technology level, strength of domestic currency, tax incentives and benefits, and importance of labor's cost). Competition level, technology level, and importance of labor's cost determine the internal complexity, whereas the external complexity depends on the remaining 2 significant drivers. Therefore, the value of internal complexity and external complexity can be obtained through the following equations:

Internal Complexity = Criticality value of competition level * -0.567 + Criticality value of technology level * 0.524 + Criticality value of importance of labor's cost * 0.665

External Complexity = Criticality value of strength of domestic currency * -0.473 + Criticality value of tax incentives and benefits * -0.596

Figure 0.6 presents the decision matrix of manufacturing process, it is shown the supply chain problems are divided into two separate areas by a curve (i.e. blue line), and only two supply chain problems are plotted in the opposite division.

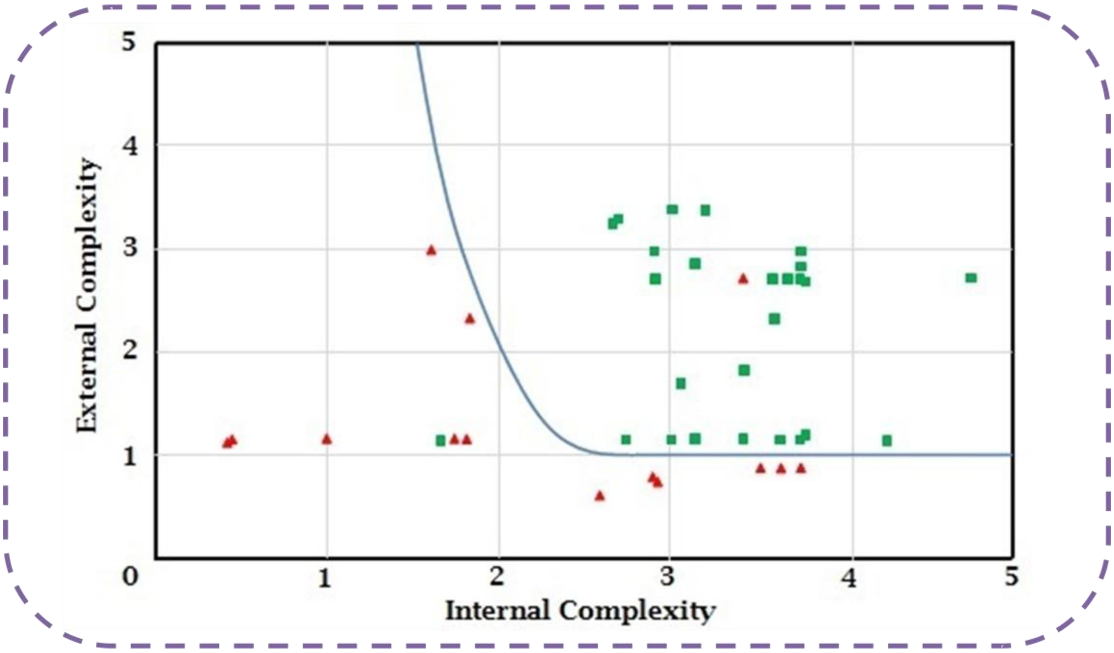


Figure 0.6 - Decision matrix on manufacturing stage

The plotted supply chain problems on manufacturing stage on the matrix demonstrate the following message:

1. Local manufacturing (i.e. the division under the curve) is the solution that is most frequently adopted by those supply chain problems in which the value of external

complexity is obviously small (i.e. approximate to 1) due to the less impact on the currency power and commercial tax. It is also a popular solution for the supply chain problems whose internal complexity is small (i.e. less than 2) no matter how large the external complexity.

2. Global manufacturing (i.e. the division above the curve) is the preferred solution when the internal complexity is comparatively high (i.e. higher than 2), and the external complexity is more complex than local strategy (i.e. higher than 1), because this strategy is greater affected by the synthesized impact of internal and external complexities.

According to the presented characteristics of the decision matrix on manufacturing stage, the strategic location alternative is not determined by single criterion, but rather a comprehensive evaluation of the 5 significant drivers. More in detail, it is inclined to produce globally when the synthesized effect of competition level, technology level, and importance of labor's cost (i.e. internal complexity) is increasing, while the strength of domestic currency and tax incentives and benefits (i.e. external complexity) are bonded to jointly impel the global strategy implementation.

Taking into account there are only 3 significant drivers obtained through regression analysis, it is certain that product value density and physical density determine the internal complexity because they imply the product properties, whereas the external complexity lies on cycle time that indicates the customer requirement. Therefore, the value of internal complexity and external complexity is obtained through the following equations:

Internal Complexity = Criticality value of product value density * 0.357 + Criticality value of physical density * 0.346

External Complexity = Criticality value of cycle time * -0.112

Figure 0.7 shows that the decision matrix on distribution stage has a very similar shape as that described for sourcing stage, but with two main differences. On the one hand, the number of exceptions is quite small, because it is found only one supply chain problem is plotted in the conflicting division. On the other hand, the two divisions are mainly discriminated by the internal complexity.

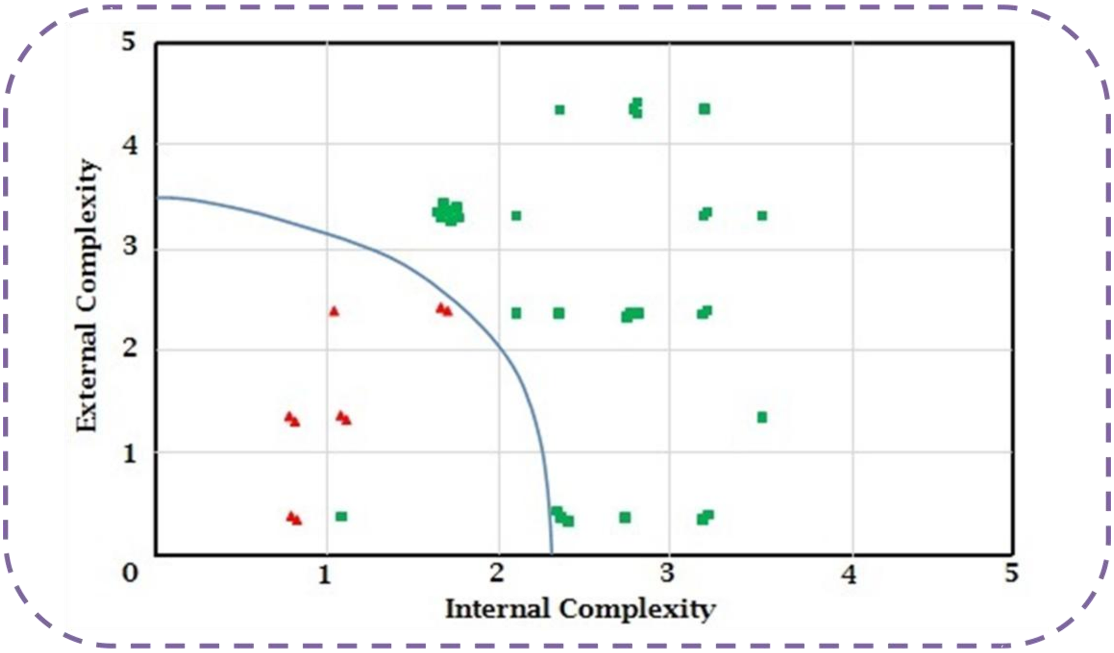


Figure 0.7 – Decision matrix on distribution stage

More in detail, according to the characteristics of the plotted supply chain problems, the decision matrix of distribution process is described as follow:

1. Local distribution (i.e. the division at left-down of the curve) is a favored solution for those supply chain problems in which the value of internal complexity is low (i.e. no more than 2) due to less product value density and physical density, and the external complexity is simple due to the rigid requirement on cycle time.

2. Global distribution (i.e. the division at right-up of the curve) is the preferred solution when the internal complexity is comparatively higher (i.e. approximate to or higher than 2), due to the larger impact on the physical property. At the same time, this solution is also suitable for the supply chain problems that are more complex on the external dimension due to the longer cycle time (i.e. at least one week in general) regardless of the internal complexity.

General speaking, the strategic supply chain configuration on distribution stage relies on two aspects. First, the internal complexity directly affects the implementation of global strategy due to the effects of product value density and physical density. Second, despite the internal complexity is weak (i.e. less than 2), the strong external complexity also permits the firms employ global distribution due to the extensive response to cycle time.

5. Validation and conclusion

The developed decision-making support model was applied to the remaining 5 investigated company cases in order to examine the reliability. The validation procedure is structured based on this process: 1) original data investigation for the 12 significant drivers, 2) data transformation through the numerical scales, 3) identification of internal complexity and external complexity, 4) representation of the complexities on the decision matrix, 5) decision making.

First of all, as shown in Table 0.12, the original value of the proposed 12 significant drivers was collected. The data was investigated as with the method applied on those previous 40 company cases in order to maintain the coherence.

Driver	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5
Cycle time (days)	<3	<14	7-15	<5	2-3
Tax incentives and benefits	68%	50%	47%	47%	40%
Product value density (€/kg)	l-m	>20	medium	0.8-2	<5
Physical density	50-100	>50	>50	>300	>200
Demand predictability	m-h	m-h	high	high	medium
Importance of labor's cost	high	high	high	high	high
Competition level	l-m	l-m	l-m	l-m	medium
Technology level	m-h	low	medium	low	low
Competition of domestic suppliers	m-h	m-h	m-h	m-h	high
Availability of purchased items	m-h	high	high	high	high
Quality of domestic sources	high	m-h	high	high	high
Strength of domestic currency	0.82	0.89	1	1	0.82

Table 0.12 – Original data of drivers

On the second step, the actual value of each driver was transformed into criticality value (i.e. discrete number) on the basis of the developed 5-point numerical scales, and the result of data transformation is reported in Table 0.13.

Driver	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5
Cycle time (days)	5	1	1	4	5
Tax incentives and benefits	5	3	3	3	2
Product value density (€/kg)	2	3	3	1	1
Physical density	4	4	4	1	1
Demand predictability	2	2	1	1	3
Importance of labor's cost	5	5	5	5	5
Competition level	2	2	2	2	3
Technology level	3	1	3	1	1
Competition of domestic suppliers	2	2	2	2	1

Availability of purchased items	2	1	1	1	1
Quality of domestic sources	1	2	1	1	1
Strength of domestic currency	2	2	1	1	2

Table 0.13 – Criticality value of drivers

Third, the converted criticality value was fed into the developed formulations in order to assess the internal complexity and external complexity of each supply chain problem based on the needed significant drivers. Table 0.14 presents the complexities of the 5 supply chain problems for each firm.

Stage	Complexity	Company				
		Firm 1	Firm 2	Firm 3	Firm 4	Firm 5
Sourcing	Internal Complexity	2.5	1.4	2.1	1	1.8
	External Complexity	3	1	1.5	1.5	2.25
Manufacturing	Internal Complexity	3.8	2.7	3.8	2.7	2.1
	External Complexity	1.1	2.3	2.7	2.7	2.9
Distribution	Internal Complexity	2.1	2.5	2.5	0.7	0.7
	External Complexity	0.36	4.5	4.5	1.8	0.36

Table 0.14 – Complexities of supply chain problems

The recommended strategic supply chain configuration on each stage is obtained when the two complexities of the supply chain problem are plotted on the decision matrix. Therefore, the validation of the developed decision-making support model can be confirmed in case the proposed solution is coherence with the actual structure, because it is assumed that those best-in-class firms employ an optimal strategic supply chain configuration.

As what Figure 0.8 shown, the plotted supply chain problems on the decision matrix 0f sourcing process suggest that the local sourcing should be a favored solution for four companies, because both their internal complexity and external complexity are weak (i.e. approximate to or less than 2), whereas global sourcing is an recommendation for one supply chain problem whose external complexity is more complex (i.e. approximate to 3). Therefore, it is found that all of the recommended strategic configurations on sourcing stage are coherence with the solutions those firms are using in practice.

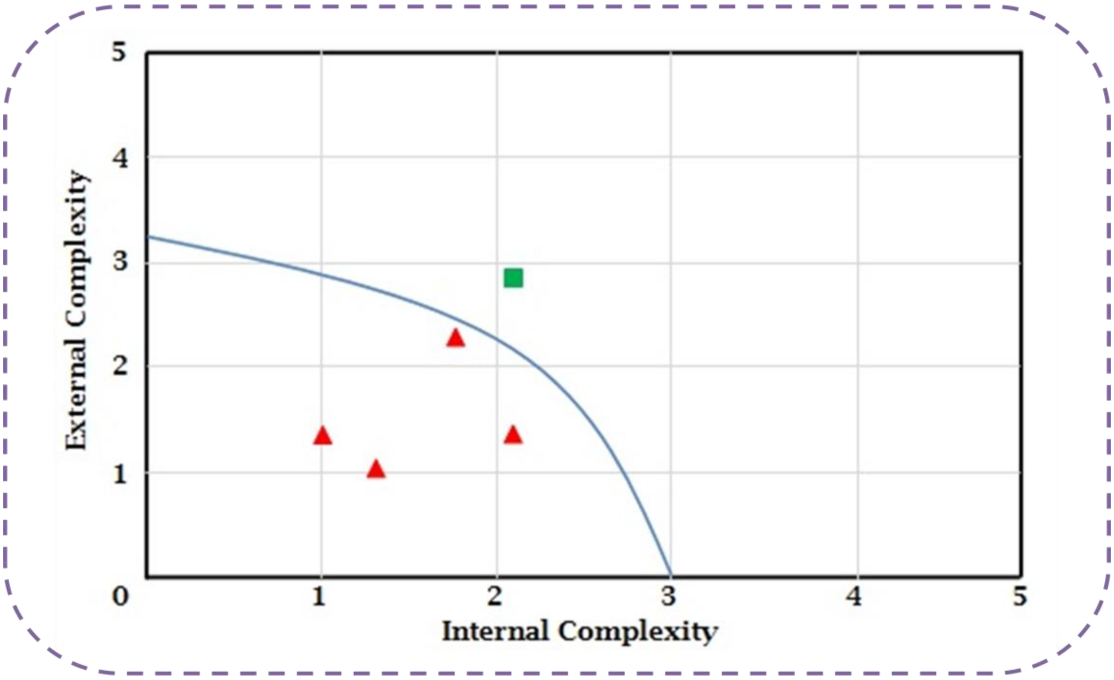


Figure 0.8 – Validation of decision matrix on sourcing stage

With regard to the validation of decision matrix on manufacturing stage, it is presented a satisfied result as shown in Figure 0.9, because the suggested strategic configurations are in line with the actual structure, when the supply chain problems of the 5 firms were plotted on the decision matrix based on the obtained value of two complexities. It is found that the supply chain problems comfort to the characteristics of the implementation of global manufacturing, because they presented a strong synthesized effect on both internal and external complexities (i.e. higher than 2 on internal complexity, and higher than 1 on external complexity simultaneously). Therefore, the 5 supply chain problems provide adequate evidence to verify the reliability.

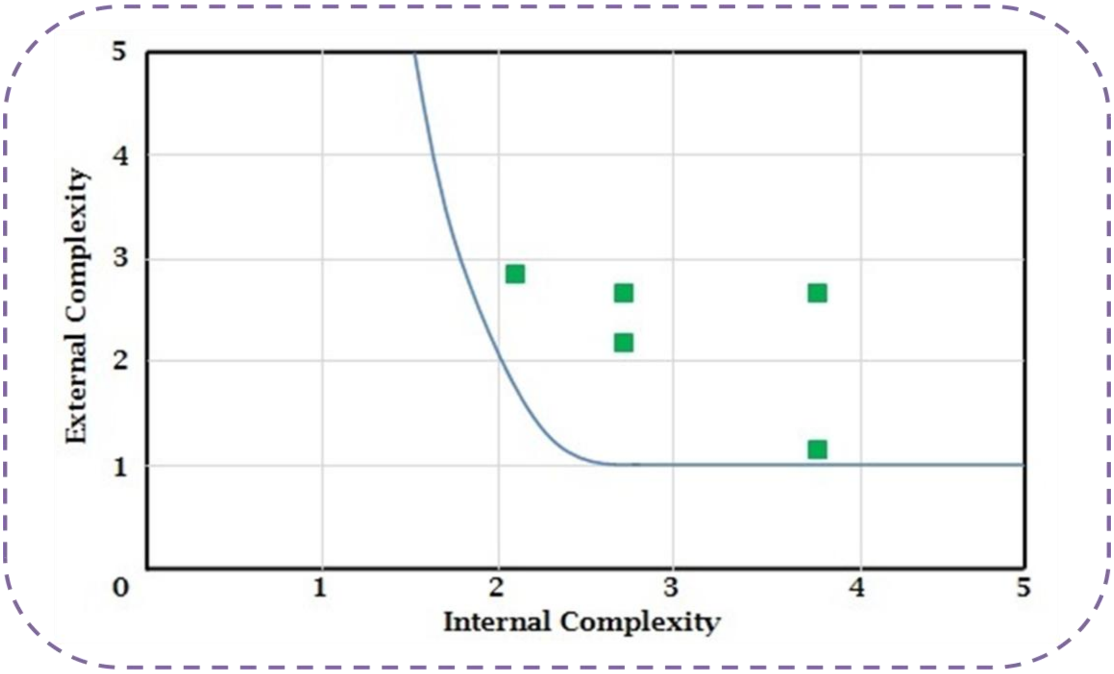


Figure 0.9 – Validation of decision matrix on manufacturing stage

Figure 0.10 presents the validation of the decision matrix on distribution stage for four firms are confirmed, because the proposed solution are coherence with the actual configuration, except one firm whose recommended structure is local distribution, whereas the global strategy is employed in practice. However, on the basis of an in-depth examination for this company, it is known that the manufacturing plants have been located in 13 countries in four main regions - 8 plants in Europe, 7 plants in Latin, 2 plants in NAFTA, and 3 plants in other regions (e.g. Asia-Pacific and MEAI). As the most important manufacturing site, the plants in Europe produce the completed product series and distribute them worldwide in order to fulfill overseas market, because the production capacity in other regions is limited, hence, those plants usually focus on specific product family. Therefore, Europe plants adopt global distribution strategy, whereas the plants in other regions only serve the local market. However, the investment for manufacturing plants in Asia and NAFTA is increasing in order to expand the production capacity to support the demand of the entire product series in their local market. In particular, the production capacity of in China would be increased more than double till 2014. It would mitigate the global distributed from European plants, because the distribution strategy is changing to be more local incrementally. Therefore, it is proved that the validation of distribution process is acceptable.

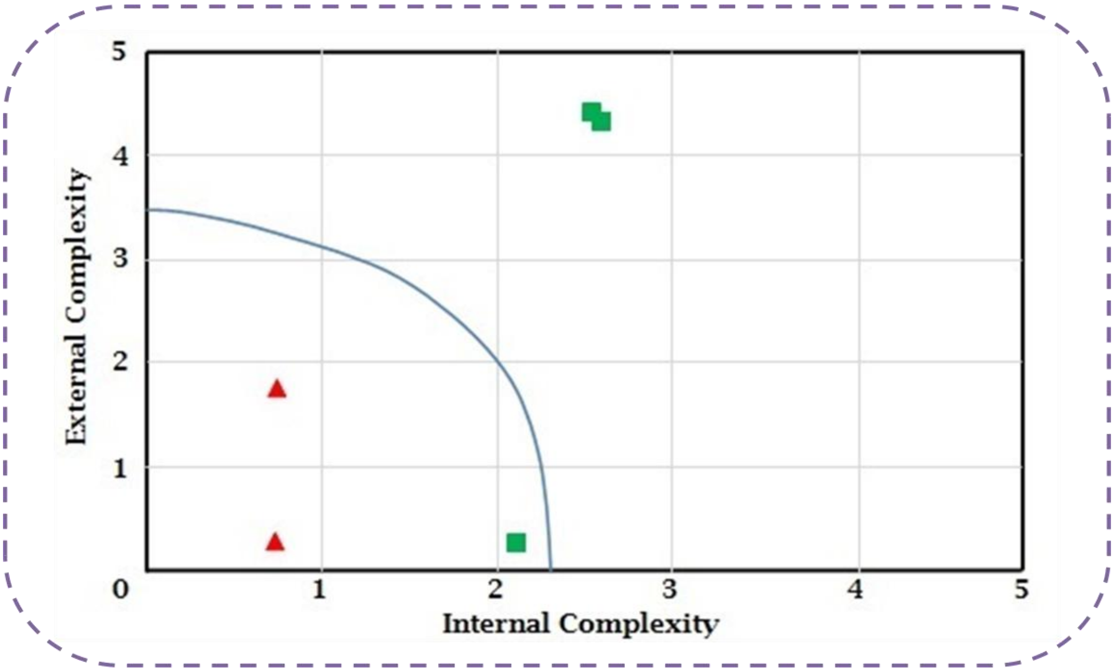


Figure 0.10 – Validation of decision matrix on distribution stage

In summary, the reliability of the proposed model consisted of 12 significant drivers, a series of data transformation scales, and three decision matrixes can be substantial accepted, because all of the recommended solutions of strategic supply chain configuration for each stage are reasonable. Therefore, the users could employ the proposed decision-making support model to design an optimal strategic supply chain configuration based on a 4-step sequential approach: 1) original data collection for the 12 significant drivers, 2) data transformation on the basis of the numerical scales, 3) evaluation of the complexities, and 4) mapping the supply chain problem on the decision matrix and identifying the solution.

6. Future research lines and implications

Despite the decision-making model in supporting users to select the appropriate strategic supply chain network configuration or check the coherence of an existing supply chain network configuration has been proposed and validated in this research, there are still some shortcomings that should be developed in greater detail.

1) The number of the investigated empirical cases is limited in this research.

In this study, 45 company case studies have been investigated in order to propose and validate the decision-making support model. Despite the quantitative analysis presented an accepted result based on the statistical indicators, it is encouraged to expand the samples in order to provide more evidences to support the reliability of the developed model. On the other hand, the leading manufacturing firms need to be studied in other industry sectors other than four sectors involved in this research, because the decision-making model should be applied in the manufacturing industry as a normative model.

2) The investigated information of company case study could be deeper.

The company case studies were conducted with the focus of strategic supply chain configuration. Therefore, the proposed decision-making model contributes to solve the strategic location alternative on the entire supply chain system. However, it was found that many firms prefer hybrid strategic supply chain configuration, rather than the pure global or local strategy. Therefore, it is possible to provide more detailed segmentations on the strategic solution for the location issue based on the flow of goods, for example, the identified divisions on the decision matrix could be pure local, local-based, global-based, and pure global strategy on the basis of the level of globalization. Furthermore, the global supply chain network design involves not only network structure issue, but also the management policy including inventory and transportation decisions. It is indicated other strategic decisions relevant to strategic global supply chain network. Taking an example, the transportation mode is also a strategic decision issue affected by several drivers, the appropriate selection on the means of transport plays huge impact on the total supply chain cost. Therefore, the information relevant to strategic management policy (e.g. transportation and inventory issues) could be investigated in order to extend the scope of the decision-making model.

3) the decision–making model is developed based on two hypothesizes.

There are two assumptions in this research: 1) the main effects of each identified driver on the supply chain system are correct, and 2) those investigated best-in-class firms employ optimal supply chain structure. However, it has not found adequate empirical evidence to support all the proposed effects for each driver in literature, because most of the relevant research is qualitative and conceptual based study. Similarly, the examination of the supply chain performance to the strategic supply chain configuration for each firm is necessary, in order to prove those companies' capability on the supply chain management.

In order to fill these gaps, some potential research lines should be considered. First of all, more empirical studies could be conducted by increasing the number of case studies, in order to provide adequate empirical evidence to support the reliability of the decision-making support model. The expanded sample size not only improves the statistical indicators, but also provides more supply chain problems on the decision matrix in order to describe the border between the divisions. At the same time, based on the empirical investigation, on the one hand, the study could be extended to other manufacturing based industry sectors, because this decision-making model is developed as normative toolset for the practitioners in the manufacturing industry. On the other hand, the identified divisions on the decision matrix could be further segmented, when the strategic supply chain configuration is classified taking into account the hybrid structure. Secondly, the strategic decisions about management policy on strategic global supply chain network design, such as inventory policy and transportation mode, can be studied on the basis of the proposed methodology in this research, in order to support the users to make relevant decisions. Thirdly, regarding to the assumptions mentioned in this study, the effects of each identified driver on the supply chain system can be examined in order to confirm the proposed influences. In addition, the relationships between strategic supply chain configurations and supply chain performance can be identified to examine if the actual solutions adopted by the firms are optimal. Lastly, a theoretical model has been explored and confirmed through the statistical analysis as the intermediate output of the data reduction process. There is a potential direction of empirical research is to identify the effect of each factor on the strategic supply chain configuration on the basis of structured equation modeling, which is a popular technique used to identify the relationships between the unmeasured latent factors and a observed factor based on a specific factor structure.

Furthermore, this research offers valuable insights for practitioners as well, which can be summarized as follows:

1) A thorough understanding of the classification of strategic supply chain configurations and their characteristics.

The strategic supply chain configurations have been classified and explained, in order to uncover the characteristics and benefits of each structure. Therefore, the users can obtain a clear picture about the features of each strategic supply chain configuration.

2) A comprehensive and systematic understanding of the main drivers and factors that affect the strategic supply chain configuration.

On the basis of quantitative analysis, a structured theoretical model including 20 drivers and 5 relevant factor groups has been proposed. The identified theoretical model provides a systematic framework in order to help decision makers understand the nature of the supply chain problem they have to deal with.

3) A set of toolset that can be used to support decision–making on strategic supply chain configuration design.

The developed model in this research can help the users to design strategic supply chain configuration or check the coherence of existing supply chain network. A firm could adopt the proposed decision-making model, consisted of the significant drivers, data transformation scales, and decision matrix for each supply chain stage, to design an optimal strategic supply chain configuration based on a predefined sequential process.

1. Introduction

Supply chain management has been studied since last decades. A supply chain can be defined as an integrated process in which various business entities work together in order to acquire raw materials, components, and sub-assemblies, transform them into specified final products, and deliver these final products to customers (Beamon, 1998). As a strategic issue, it is important for the companies because an optimal supply chain can achieve a high level of performance and allow the firm to compete successfully in the marketplace (Melnyk *et al.*, 2013).

Supply chain network design is still an evolving topic and lies at the heart of supply chain management, and involves many strategic decisions regarding the number, location, type and size of the facilities, the demand allocation to each facility, and supplier selection (Chopra and Meindl, 2004). In order to design an optimal supply chain network, a structured approach is required, which includes three phases (Rushton *et al.,* 1992; Mourits and Evers, 1996; Vila *et al*, 2006; Collin *et al*, 2009): i) identification and understanding of product-market characteristics, sourcing context and planning horizon, ii) definition of the potential supply chain configuration alternatives and preliminary assessment, and iii) quantitative assessment of the alternative configurations and detailed design. The purpose of the first and second phases is to identify the possible network configurations that answer three main strategic questions - where to source items, where to locate manufacturing facilities, and which markets to serve (Arntzen *et al.*, 1995; Vidal and Goetschalckx, 1997; Smith, 1999; Manzini and Bindi, 2009) - through a preliminary qualitative assessment based on contextual factors, such as product characteristics, supplier profiles, customer service requirements, and aspects of customer demand, etc. In the global business environment, the supply chain network design becomes more complicated, because it is driven by a number of variables such as economic and legislation issues, trade barriers to international trade, and environment concern due to the increasing globalization (Gunasekaran *et al.*, 2004) The last phase of the design approach shifts the focus to quantitative analysis in order to identify the optimal configuration based on the constraints, and fine-tune the configurations by simulation technique sometimes.

With regard to the manufacturing firms, one of the critical decisions is to design the strategic supply chain configuration indicating the strategic location decision of supply chain process (i.e. the strategic location alternatives of sourcing, manufacturing, and distribution on the global or local scale), since it has long-term impacts and direct effects on procurement, manufacturing, inventory, and transportation costs and determines economic success or failure (Weiler *et al.,* 2011). The strategic supply chain configuration determines the detailed optimization of the network structure, such as number, location, type, and size of the facilities, and the decisions on management policy, such as inventory and transportation decisions no matter on strategic and operational levels. Therefore, any incorrectness on the strategic supply chain configuration might result in the huge loss both on efficiency and effectiveness. However, there is not still a research focuses on the strategic selection of supply chain network configurations on the global level in terms of the strategic location alternative for the overall supply chain system, despite the numerous research efforts on the global supply chain design by far. Therefore, this research aims to develop a decision-making model in order to support users in selecting the appropriate strategic supply chain network configuration or checking the coherence of an existing supply chain network configuration based on the specific global supply chain problem represented by a combination of the drivers affecting total supply chain costs and customer service level.

2. Literature review

2.1. Strategic supply chain configuration

Supply chain network design determines the structure of the supply chain and the sequential links among components of the system with which supply chain can achieve high level of performance and satisfy customer demands (Truong and Azadivar, 2005). It involves many decision issues, such as the location of sourcing facilities, plants, distribution centers, stocking pints, and the inventory level, transportation modes and lanes, etc., and those revolve around the four major decision areas in supply chain management: 1) location, 2) manufacturing, 3) inventory, and 4) transportation (Tsiakis *et al.*, 2001). Location decisions have long-term impact and direct effect on manufacturing, inventory, and transportation plan, and issues is the focal problem on supply chain network design, and other decision areas are determined based to the location strategy (Ballou, 1977). Once the location decisions are determined, the possible paths through which the products flow to the customers can be established, and the supply chain structure is built as the result. Therefore, the ability of a firm to offer its products or services effectively is largely dependent on the location of the facilities (Jayaraman, 1998).

On the other hand, those four major decision areas include many decision issues on different level based on the scope, investment requirement, and the time horizon. Strategic decisions involve significant capital investment, requires approximate and aggregate data over a long period of time, normally more than one year. Tactical level is characterized by moderate capital investment, deals with the medium term decisions that have planning period of several months based on an appropriate amount of data. Operational decisions are concerned with low capital and day-to-day routine operations based on transaction data (Perl and Sirisoponsilp, 1993; Vidal and Goetschalckx, 1997; Bilgen and Ozkarahan, 2004; Nasiri *et al.*, 2010). The strategic decisions have a large impact on performance measures such as profitability, customer service, flexibility and reliability (Harrison, 2001), because they are not only closely bound up the corporate strategy, but also guide supply chain policies from a design perspective (Ganeshan and Harrison, 1995). In general, the strategic location issues of supply chain design refer following decisions: 1) where to buy, 2) where to locate facilities, and 3) which markets to serve by which warehouses (Longinidis *et al.*, 2011). Therefore, in this paper, the strategic supply chain configuration is defined as the strategic location alternatives for the entire supply chain system – sourcing, manufacturing, and distribution (Huan *et al.*, 2004; Narasimhan and Mahapatra, 2004; Nasiri *et al.*, 2010) – on the global or local level, in order to answer those three strategic questions based on the combinations between supply chain stages and geographic scales (i.e. global or local sourcing, global or local manufacturing, global or local distribution).

In the literature, despite lots of papers discussed the supply chain network design, only a small number of articles proposes and analyzes the type of supply chain configurations regarding the entire supply chain system on a global or local scale from a strategic perspective. In the limited literature resource, some articles considered the supply chain configurations based on sourcing and delivery stages, while the manufacturing is not involved. For example, Knudsen and Servais (2007) proposed 4 international supply chain configurations (i.e. local, global, international sources, and international sellers) based on an empirical study. Cagliano *et al.* (2008) also conducted empirical research to identify global supply chain configurations (i.e. local supply chain, global seller, global purchaser, and global supply chain) based on the data from a survey of manufacturing companies in more than 20 countries. In addition, Creazza *et al.* (2010) presented 5 configurations for international freight forwarding logistics (i.e. sourcing in the Far East, selling goods throughout Europe using regional warehouses) through company interviews. On the other hand, there are still some papers classified the supply chain configurations for the entire supply chain process. For example, Hong and Holweg (2002) proposed 6 global supply chain configurations (i.e. local manufacture, traditional export, international sourcing, global sourcing, offshoring, and global manufacturing) relying on the development of sourcing strategy (i.e. global sourcing, international sourcing, and offshoring) that results in the changes on manufacturing strategy. Garavelli (2003) provided a framework in which 9 supply chain configurations were identified based on the degree of manufacturing and distribution flexibility (i.e. no flexibility, limited flexibility and total flexibility). Finally, Caniato *et al.* (2013) identified 4 supply chain configurations (i.e. locals, shoppers, barons, and globals) based on an empirical study.

	Supply chain process			Scale	
	Sourcing	**Manufacturing**	**Distribution**	**Local**	**Global**
Hong and Holweg (2002)	x	x	x	x	x
Garavelli (2005)	x	x	x	x	x
Knudsen and Servais (2007)	x		x	x	x
Cagliano *et al.* (2008)	x		x	x	x
Creazza *et al.* (2010)	x		x		x
Caniato *et al.* (2013)	x	x	x	x	x

"x" denotes that consideration is included

Table 2.1 – Characteristics of the proposed supply chain configurations

2.2. Drivers affecting global supply chain design

Global supply chain design is a very complex issue due to the consideration of many drivers/variables, which affect different cost elements in supply chain system and can be categorized into several groups based on their common characteristics, such as product characteristics, customer service requirements, customers' demand patterns, supply characteristics, and external environmental issues (Christopher and Towill, 2002; Lovell *et al.*, 2005; Meixell and Gargeya, 2005; Turner and Williams, 2005; Quintens *et al.,* 2006; Gereffi and Lee, 2012; Mangiaracina *et al.*, 2012). The strategic decisions of supply chain network design for each stage (i.e. sourcing, manufacturing, and distribution) are influenced by different drivers, and determined in different level. Therefore, it is important to differentiate the drivers affecting each supply chain stage, and evaluate their effects when designing supply chain network.

First, with regard to sourcing stage, there is a increasing number of firms conduct the procurement activities globally, since it is an effective way to take advantage of the technology endowment of different countries to obtain raw materials for the high-tech and intensely competitive products, whereas a barrier impedes global procurement is the high import tariff that increases the purchasing cost and reduces the profit margin (Cho and Kang, 2001; Arntzen *et al.*, 1995). Smith (1999) highlighted the product variety, competition of domestic suppliers, availability of purchased items and quality of domestic sources determine the choice of global or local sourcing. In addition, the drivers associated with demand patterns also affect the selection of sourcing strategy. MacCarthy and Atthirawong (2003) stated the dimension of the market is a critical motivator for the global sourcing. On the other hand, when the final demand is hard to predict, a firm has to maintain high level of raw material stock in order to moderate the risk due to bullwhip effect, or to adopt local sourcing that shortens the transportation pipeline in order to speed up the replenishment cycle (Christopher and Towill, 2001; Harrison and van Hoek, 2008; Mangiaracina *et al.*, 2012).

Second, a firm also prefers to select global manufacturing as the main strategy in order to remain competitive advantages. For example, Canel and Khumawala (1996) asserted opening manufacturing facilities abroad is able to compete against the competitors in global market if a firm suffers intensive competition. Arntzen *et al.* (1995) described locating the plants in some countries that holds a technology advantage is critical to the innovative products manufacturers. From the view of service perspective, international operations (i.e. locating plants closer to abroad market) allows the manufacturer in responding the local demand variations and change production planning rapidly in order to reduce total cycle time and reach satisfied item fill rate (Lovell *et al.*, 2005; Harrison and van Hoek, 2008). What is more, global manufacturing is a preferred strategy concerning large market dimension and weak domestic demand. In this case, the overseas manufacturing facilities can proximate to foreign market and customers more efficiently (Prasad and Sounderpandian, 2003). Lastly, other drivers strongly affect strategic location selection of manufacturing process as the cost considerations - such as strength of domestic currency, import tariff, tax rate, labor's cost - and restriction issues - such as labor's quality, infrastructure, political stability, and environment concern and regulation (MacCarthy and Atthirawong, 2003).

Finally, in the distribution process, the wide range of product variety and large product value density promote local and fast distribution in order to reduce the stocks and inventory maintenance cost (Chopra, 2003; Lovell *et al.*, 2005). Risk of obsolescence and handling characteristics also have positive effect on local distribution, because local strategy results in less delivery lead time and product damage than global distribution that requires longer transportation time and more handling activities (Harrison and van Hoek, 2008; Rushton *et al.*, 2000). On the other hand, a large value of physical density usually shows a good utilization of transportation equipment, therefore, it is more suitable for the global transportation (Ballou, 1993). The drivers associated to service requirement have effect on the distribution stage, because they determine the service level. Local transportation reduces cycle time, and increases item fill rate and delivery reliability significantly compared to the global strategy due to shorter delivery distance, timely stock replenishment, and less uncertainties stemming from less logistics activities (i.e. handling, consolidating, and sorting) (Christopher and Towill, 2001; Huan *et al.*, 2004). Dimension of order determines the saturation of the shipment, and motivates the global distribution when it saturates the transport unit due to less delivery frequency and better economies of scale on transportation (Ashayeri and Rongen, 1997). In addition, an increase on both demand predictability and volatility requires short distance distribution, because a supply chain suffers the heavier loss stemming from the forecasting errors and the reduction of service level than the compressed distribution pipelines (Harrison and van Hoek, 2008; Mangiaracina *et al.*, 2012).

2.3. Global supply chain design models

In the literature, the supply chain design problem has been widely studied by using various methods, which usually fall into two categories based on the characteristics of main solutions: 1) quantitative models, and 2) non-quantitative methods (see Figure 2.1). The quantitative models indicate the supply chain is designed through mathematical models, whereas another category implies that the main solution of supply chain design problem is conducted based on theoretical or empirical study.

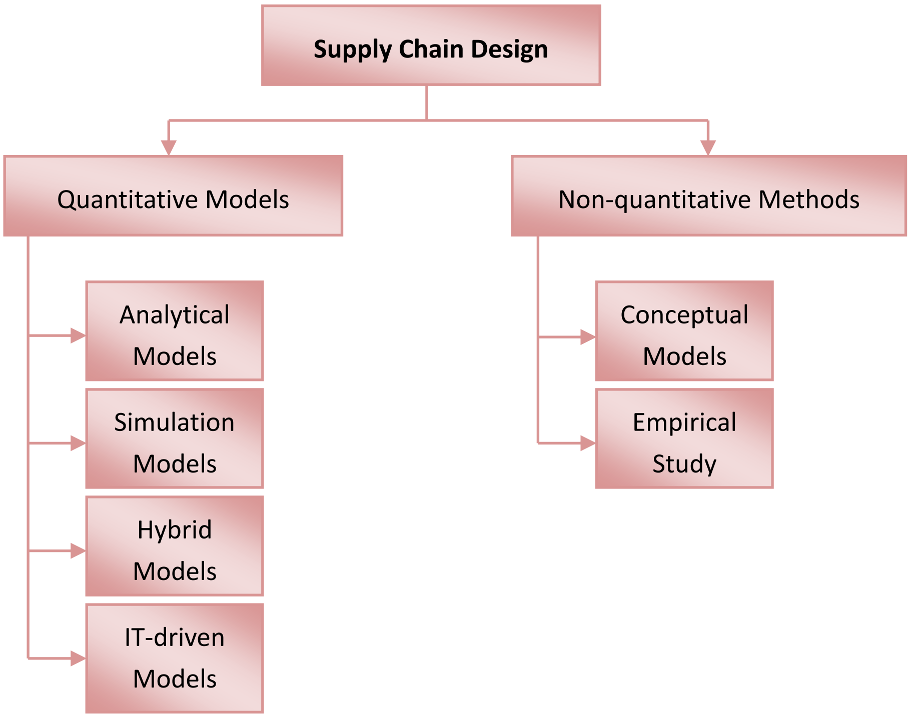


Figure 2.1 – Design models of global supply chain

2.3.1. Quantitative models

The analytical models are the one of the most preferred modeling approaches in supply chain network design, and classified into deterministic analytical models and stochastic analytical models. Deterministic models assume the variables are known and fixed with certainty, so that the modeling and computation can be implemented easily that results in many researchers studied supply chain design problem through this approach. For example, Cohen and Lee (1989) developed an optimization model in which the variables are deterministic in order to solve demand allocation problem based on economic order quantity theory. Another example is given by Tzafestas and Kapsiotis (1994), who presented deterministic mathematical model to optimize a supply chain with the objective of cost minimization. However, the supply chain is operated under an increasingly competitive environment in reality. Many parameters are random and changed over the time, such as customer demand, exchange rate, lead time, etc. Therefore, in order to solve the uncertainty of the supply chain operations environment, an effective approach is considered as stochastic models in which at least one of the variables is not fixed and assumed follow a probability distribution (Beamon, 1998). Taking the examples, Cohen and Lee (1988) developed a stochastic mathematical model to determine the best inventory policy based on minimum cost objective under the respond time constraint. Lee and Billington (1993) proposed a heuristic stochastic model in order to manage the material flow in the decentralized supply chain with the objective of either determining stock level under a defined item fill rate or achieving service level subject to given stock levels. Nevertheless, both the deterministic and stochastic modeling approaches can be realized base on various optimization-based solution methods. As the most popular technique for supply chain network design, mixed integer programming (MIP) can be broadly classified based on the pre-defined objectives (i.e. minimum cost, maximum service level, or others), capacity constraint (i.e. limited or unlimited capacity constraint), number of the stages of a supply chain system (i.e. single-stage or multi-stage supply chain network), number of the products managed in supply chain (i.e. single product or multi-product), and length of planning horizon (i.e. single period or multi-period). For examples, as early as 1974, Geoffrion and Graves developed a multi-commodity single period logistics network MIP model in order to optimize product flows from plants to final customers through distribution facilities with the objective of minimum cost. Hodder and Dincer (1986) developed a large-scale MIP model to solve the international facility location problem under the consideration of single-product and single-stage in order to achieve the maximum profit. Cole (1995) presented an inventory location and allocation system in which a multi- commodity, multi-stage and single period MIP model is proposed in order to optimize a production-distribution system. Liu and Papageorgiou (2012) proposed a mixed integer linear programming model in order to address production, distribution and capacity planning for a global supply chain with the aim of minimizing both total costs and total transport lead time. In addition to address the optimization of supply chain network problem with the formulation of MIP models, a large number of literature deals with supply chain problems based on other optimization approaches no matter the variables are deterministic or stochastic. In particular, taking into account the development of global business after 1990's, more uncertain parameters have to be considered, such as tax rate, import tariff, transfer price, etc. Therefore, the algorithm techniques have been expanded in order to tackle the supply chain problems. For examples, Min and Melachrinodis (1999) developed an analytic hierarchy process model to determine the facility relocation problem based on case study. Zhang *et al.* (2009) presented a coloured Petri nets model to help companies select an appropriate supply chain to provide the most added values to customer order fulfilment. Vidal and Goetschalckx (2010) proposed a non-convex optimization model to deal with location and allocation problem in order to obtain the maximum after-tax profits with the consideration of transfer price in a multinational corporation. Liu and Cruz (2012) developed a variational inequality equilibrium model to determine the optimal price, profits, and equity values of the firms in a specific supply chain subject to financial risks and economic uncertainty.

Simulation is another approach to tackle supply chain problems. Simulation models can be used to investigate quickly the effects of a complex system for different scenarios over a defined time horizon. For example, Zhao *et al.* (2001) presented a simulation model to evaluate the value of information sharing in a three-stage supply chain. Another example is given by Lim and Shiode (2011) who studied, through discrete event simulation, how changes in customer demand could affect both the cost and reliability of a distribution network in order to identify the appropriate network.

The hybrid models use more than one solution method. In general, this approach integrates analytic model and simulation model in order to set a recycle optimization process. More in detailed, the potential decisions can be obtained based on optimization of analytical model first. Second, they are fed into the simulation model as input parameters to investigate the performances of the entire system on the second step. Lastly, the supply chain system is fine tuned by the analytic model again based on the simulation outputs. An example is given by Lee and Kim (2002), who proposed an integrated method combining analytic and simulation models to deal with production-distribution problems with the aim of cost minimization. In addition, some studies on supply chain network design are conducted based on hybrid models through two or more various decomposed mathematical models. For example, Jang *et al.* (2002) presented a supply chain management system consists of four modules, which are modeled based on several decomposed analytic mathematical models.

IT-driven models are a rising approach as the supply chain network is becoming global that results in the information sharing is a critical factor determining supply chain success. IT applications improve the quality of supply chain decisions, because those new technologies can collect real-time information, analyze the data rapidly, and share them to partners. Therefore, the aim of IT-driven models is to integrate and coordinate the supply chain processes based on various real-time transaction information stemming from IT applications in order to facilitate collaboration between partners in a supply chain (Min and Zhou, 2002; Vakharia, 2002) For examples, Camm *et al.* (1997) proposed an integrated model combining MIP model and Geographic Information System (GIS) to develop a Decision Support System (DSS) in order to tackle location and allocation problem. Talluri (2000) presented an optimization model used to select ERP system under the consideration of system acquisition and maintenance costs, flexibility, execution accuracy, and compatibility.

2.3.2. Non–quantitative models

Despite most of the supply chain network design models are quantitative-based in literature, quantitative model is not a perfect approach, because there are still drawbacks. First, taking into account the uncertainty of many parameters, the mathematical models are usually restricted by assumptions that influence the accuracy of the solution. Second, the quantitative models may be not enough to optimize the supply chain system due to the deficiency of variables. In particular, the qualitative variables (e.g. political stability, environment concern, labor's quality, etc.) are hard to be measured in a quantitative method, whereas those parameters generate much influence on supply chain network design. Last but not least, the nature of mathematical models is another drawback, because it is difficult to understand the rationale of the formulations so that the users are confused on the models. Therefore, other than the quantitative approach, the conceptual and empirical models are developed by many researchers to design supply chain network in order to overcome the drawbacks of the quantitative models.

The conceptual study aims to propose holistic conceptual model in which a guideline is provided for designing a supply chain network. For examples, Berry and Towill (1992) proposed a methodology to design an electronic products supply chain in terms of order flow, material flow, and business processes throughout the supply chain. Smith (1999) presented a framework for making decisions about vendor location (both abroad and locally) based on six criteria (i.e. product specification, product technology, quality and process technology, logistics and availability, demand volatility and item criticality, and costs). A third example is given by Kirytopoulos *et al.* (2008) that proposed a comprehensive approach considering both tangible and intangible criteria for evaluating and selecting suppliers. Furthermore, Collin *et al.* (2009) presented a four-step approach for designing the supply chain according to the alignment of customer demand and product characteristics.

Empirical study indicates the research is conducted when interview, case study, survey research are the primary approach, whereas the quantitative methods (e.g. statistical models) are the subsidiary tool. Those papers aim at proposing matrices or models to support supply chain design decisions. There is a brief sample of this literature. Randall and Ulrich (2001) examined the relationships between product variety, supply chain structure, and firm performance based on case studies in order to identify the supply chain structure that better matches the type of product variety. Stratton and Warburton (2006) proposed a model based on three case studies with the aim of investigating the trade-off between responsiveness and costs. Creazza *et al.* (2010) identified five main international freight logistics network structures based on interview, and presented a framework for selecting the most suitable logistics network configuration. Kumar *et al.* (2011), through company interview, presented a selection matrix to determine which supplier has the qualities to become a long-term and key partner based on interviews in the food industry.

The above description presents the various modeling approaches used in literature and their characteristics. However, there are two main limitations that should be addressed. On the one hand, the supply chain system studies in the most of the models are incompleted. The main focus of them is partial supply chain system (e.g. production-distribution stages) or individual phase of a supply chain (e.g. supply, or production, or distribution) rather than the entire supply chain system (i.e. from origin of sourcing to final market). On the other hand, despite the models tackle the problems of supply chain network design (e.g. location/allocation, location/routing, inventory/transportation, and supplier selection/inventory control, etc.), the location problem addressed are concentrated on detailed design based on the constraints in a specific region rather than illustrating the method of how to select strategic location strategy (i.e. the location strategy of supply chain processes on global or local scale).

3. Methodology

In order to reach the main goal (i.e. developing a decision-making model to support the design of strategic global supply chain configuration), the following sub-objectives should be achieved:

- Identifying the strategic supply chain configurations (i.e. the strategic location alternatives of sourcing, manufacturing, and distribution on global or local scale);
- Identifying the drivers (i.e. variables) affecting the strategic configuration of global supply chain network;
- Developing a theoretical framework in order to explore the contextual factors affecting strategic supply chain configuration, and remove the less important drivers;
- Identifying the relationships between the global supply chain configurations and the global supply chain problems in order to obtain the most significant drivers;
- Proposing and validating the decision-making model of strategic supply chain configuration design.

It is necessary to develop a method integrating qualitative and quantitative approaches (i.e. integration of multiple case study and statistical models), in order to identify the context factors and the drivers in each factor group, explore the relationships between global supply chain configurations and global supply chain problems, and finally, develop the decision-making support model. More in detail, the research process is consisted of 7 main phases. The aim and output of each phase are described as follows:

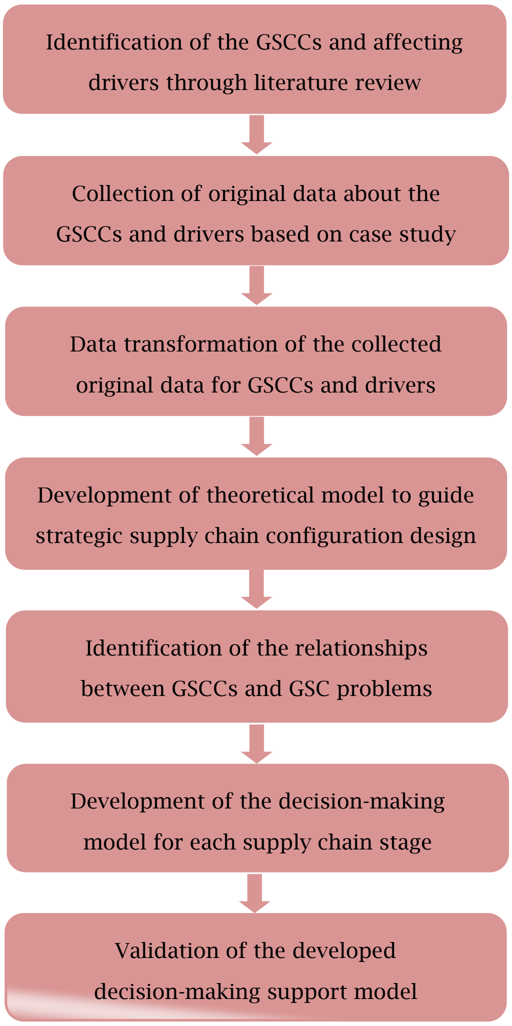


Figure 3.1 – Research process

1. Identification of both the strategic supply chain configurations in terms of the strategic location alternatives of sourcing, manufacturing, and distribution on the local or global level, and the drivers affecting strategic supply chain configuration.

On the basis of the literature research on the scientific articles, it is possible to summarize the types of strategic supply chain configuration, and identify the most frequently discussed drivers that influence supply chain configuration on the strategic level. What is more, the effect of each driver on the individual supply chain stage (i.e. sourcing, manufacturing, and distribution) can be recognized from the extant literature. It is noting that those effects are assumed as correct, no matter if they have been verified empirically. Therefore, a classification describing the strategic supply chain configurations and a framework representing the drivers and their main effects on the supply chain system can be proposed.

2. Collection of the original data about the strategic supply chain configurations and the identified drivers on the basis of company case study.

The aim of company case study is to investigate the adopted strategic supply chain configurations in the firms and collect the actual value of each identified driver. The examined companies should be the leading firms in the manufacturing industry, because another hypothesis of this study is that the top-class firms are more capable of designing and managing supply chain.

3. Evaluation of the investigated strategic supply chain configurations and drivers' original data.

In this phase, the original data of strategic global supply chain configurations and drivers are transformed into discrete number that can be utilized on the statistical model as preliminary evaluation for the further data analysis. More in detail, the entire supply chain configuration is divided into three stages in terms of the supply chain operational processes (i.e. sourcing, manufacturing, and distribution), and each stage is evaluated through a numerical scale of 1-5 discretely on the basis of the level of globalization (1= extremely local, 5 = extremely global). The original data of each driver is converted into 5 points discretely on the basis of the impact on total supply chain costs (1=low impact, 5=high impact).

4. Development of the theoretical model in which the important drivers are identified and categorized into several contextual factor groups.

On the basis of employment of the statistical models, the critical drivers can be found and categorized into several factor groups based on their common characteristics. Each factor group indicates an underlying contextual factor affecting strategic supply chain configuration. The proposed theoretical model is made up the identified contextual factors, the important drivers in each factor group, and the effects of those drivers on the supply chain system. Furthermore, the developed theoretical model can be used as a framework to guide the subsequent quantitative analysis. On the other side, some drivers are eliminated due to less importance and weak reliability.

5. Identification of the relationships between strategic supply chain configurations and supply chain problems for each supply chain stage.

The relationships between the strategic supply chain configurations and supply chain problems can be set up for each supply chain stage through regression model. The supply chain problem is represented by a series of the related critical drivers provided by the theoretical model based on the existence of the driver's effect on each supply chain stage. Therefore, the most significant drivers affecting strategic supply chain configuration on each supply chain stage can be identified based on the statistical indicators, whereas more drivers could be dropped due to the deficiency in statistical criteria.

6. Development of the final decision-making model based on the identified significant drivers and their value.

Three decision matrixes – as the main output of the decision-making model – for each supply chain stage can be proposed in this phase. The decision matrix is represented through illustration graph in which the value of supply chain problem for each investigated company is plotted based on the statistical parameter of those significant drivers.

7. Validation of the developed decision-making model on the basis of additional manufacturing company cases.

The proposed decision-making model should be validated in order to test the reliability. The decision-making model provides a set of toolset including the significant driver and their statistical parameters, the numerical data transformation scale (i.e. transformation from original data to discrete numerical scale), and three decision matrixes. Some additional company cases would be used in order to check if the proposed model could provide correct decision for the users to design strategic supply chain configuration.

4. Identification of the strategic supply chain configurations and drivers

4.1. Identification of strategic supply chain configurations

4.1.1. Classification of strategic supply chain configurations

On the basis of a systematic review method (Tranfield *et al.*, 2003), 124 papers published from 1982 to 2013 in international peer-reviewed journals in the Business, Management and Economics area were collected and examined. All of those studied articles was pre-defined as the scope is global supply chain network design i) from the suppliers to customers, and ii) affected only by flows from up to downstream, and reviewed based on their general characteristics (i.e. year of publication, journal title, region/country addressed), research methods (i.e. quantitative method, conceptual method, and empirical method) and core content, in order to identify and summarize the type of global supply chain configuration and the main affecting drivers.

As a result, 5 papers discussing supply chain configuration have been identified. These papers provide insights on the strategic global supply chain configurations. Whereas, there is not any contribution takes into account every possible combination based on two main areas: i) the operational processes of supply chain (i.e. sourcing, manufacturing, and distribution); ii) the scale of operational processes (i.e. global or local level). Therefore, according to the supply chain process and location scope, 8 strategic global supply chain configurations can be proposed (see Table III).

Configuration	**Sourcing**	**Manufacturing**	**Distribution**
1	Global	Local	Global
2	Global	Global	Global
3	Global	Global	Local
4	Global	Local	Local
5	Local	Local	Local
6	Local	Global	Local
7	Local	Global	Global
8	Local	Local	Global

Table 4.1 – Classification of strategic supply chain configurations

In the above classification, the "Local" scale is explained as the material flow taken place within one country or one region; the "Global" level is interpreted as the material flow conducted across the regions. More in detailed, local sourcing indicates the raw materials, components and sub-assemblies are transported from suppliers to plants within the borders of a country or a region. Instead, that is global sourcing when purchased items are sent across regions. With regard to manufacturing process, the local manufacturing represents the production facilities are established in a country or a region. Global manufacturing means the facilities are located in different regions worldwide. Local distribution describes a market is served by its local plants, whereas global distribution indicates a market is fed by the plants located in different regions through international transportation.

The proposed model as shown in the following figure (see Figure 4.1) takes the operational processes and location selection as the basis. This model presents the identified configurations as general scheme. Each pie of the model stands for a strategic supply chain configuration whose characteristics can be easily read from the corresponding location type and operational processes. The model can be applied to any company regardless of the industries and point of origins.

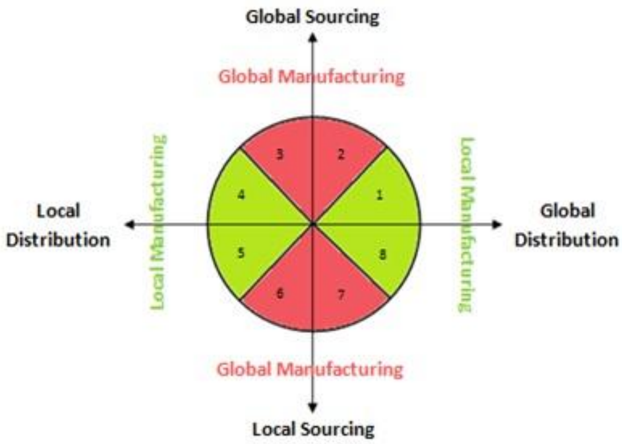


Figure 4.1 – Representation model of strategic supply chain configurations

4.1.2. Description of the strategic supply chain configurations

Configuration 1 (see Figure 4.2) is global sourcing, local manufacturing, and global distribution. After the sourcing materials globally, the raw materials are sent to manufacturing facilities, which are specifically designed to produce the full product range, whereas distribution takes place on a global scale in order to obtain pay back on the investment made.

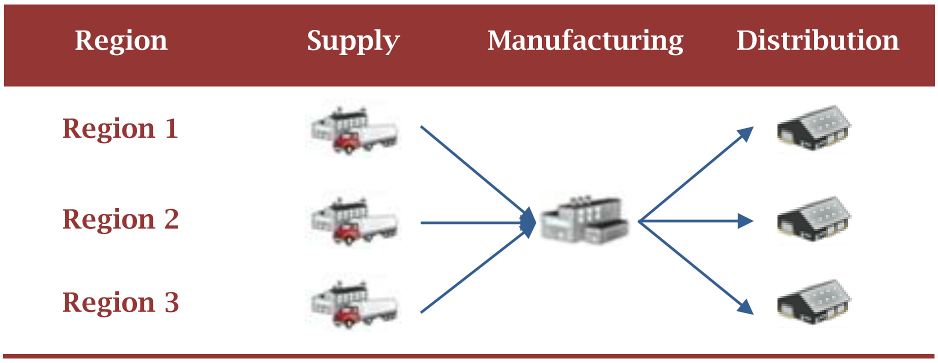


Figure 4.2 – Global sourcing, local manufacturing, global distribution

Configuration 2 (see Figure 4.3) is a truly global supply chain where sourcing takes place worldwide, plants are located in different regions, and distribution between regions takes place through a multi-echelon logistics network. This configuration also displays the highest level of complexity in terms of organization, management, planning and coordination.

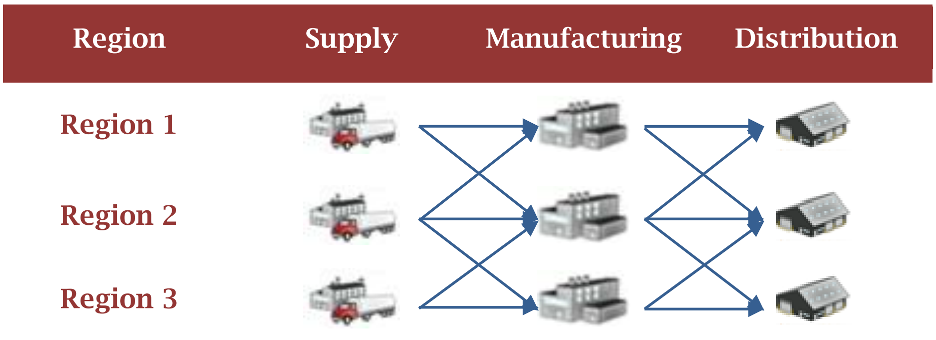


Figure 4.3 – Global sourcing, global manufacturing, global distribution

Configuration 3 (see Figure 4.4) is global sourcing, global manufacturing, and local distribution. This configuration is used by companies that conduct sourcing and manufacturing globally in order to serve the local market in the best possible way. In this case, sourcing "abroad" becomes an inevitable part of the procurement strategy that is aimed at developing optimal supplier capabilities and as a result the company achieves significant performance gains. On the other hand, the profitability of this configuration is a challenge since it requires a large local market in order to recoup the investments.

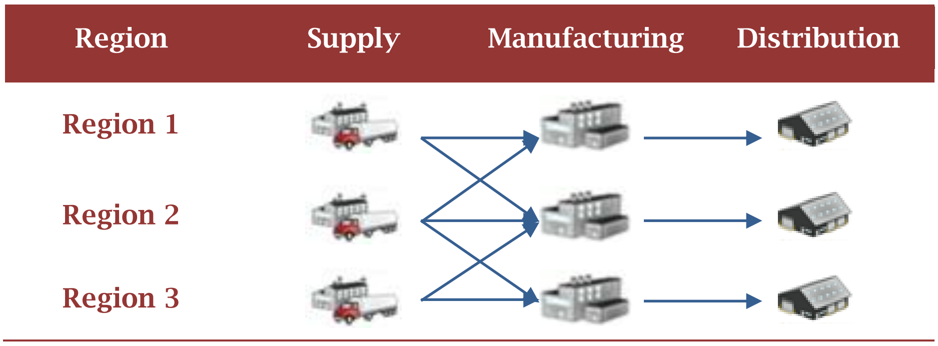


Figure 4.4 – Global sourcing, global manufacturing, local distribution

Configuration 4 (see Figure 4.5) is global sourcing, local manufacturing, and local distribution. It represents purely global sourcing. The companies adopt this configuration to implement their purchasing activities around the world, while the downstream operations (production and distribution) are performed on a local scale. The reason for this configuration is to benefit from cost, quality and availability advantages of using foreign sources in order to achieve superiority in a competitive business environment and to serve the local market in the best way.

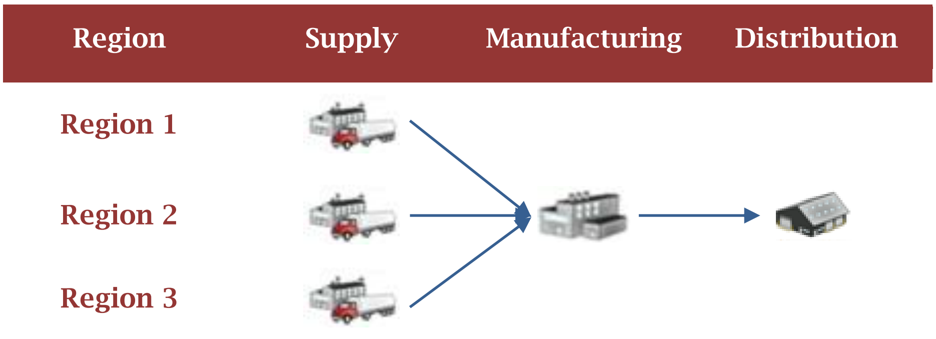


Figure 4.5 – Global sourcing, local manufacturing, local distribution

Configuration 5 (see Figure 4.6) is the truly local supply chain. The most important aspect of this configuration is that the company operates the business in only one region, and all operational processes are located within the border of that country or region. This configuration is generally adopted when a company has rigid manufacturing facilities, high inventory costs and high transportation costs which do not enable high-volume cross-border flows. The local market size should also be big enough for the company to be able to benefit from economies of scale.

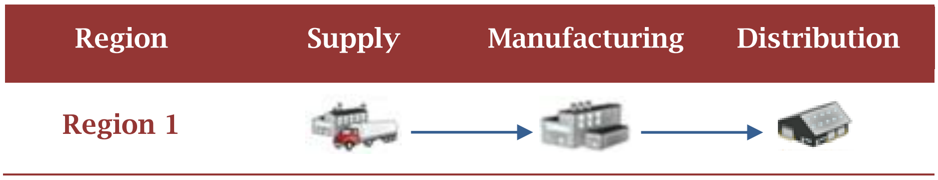


Figure 4.6 – Local sourcing, local manufacturing, local distribution

Configuration 6 (see Figure 4.7) is local sourcing, global manufacturing, and local distribution**.** It is a sort of replication of the truly local strategic supply chain configuration. Companies locate their production facilities worldwide in order to meet their own local demand. Production facilities purchase the raw materials and components from their local suppliers and each plant works almost independently from each other. Locating production plants worldwide provides the company with a comparative advantage in terms of labor costs, taxes, better environmental norms and regulations, etc.

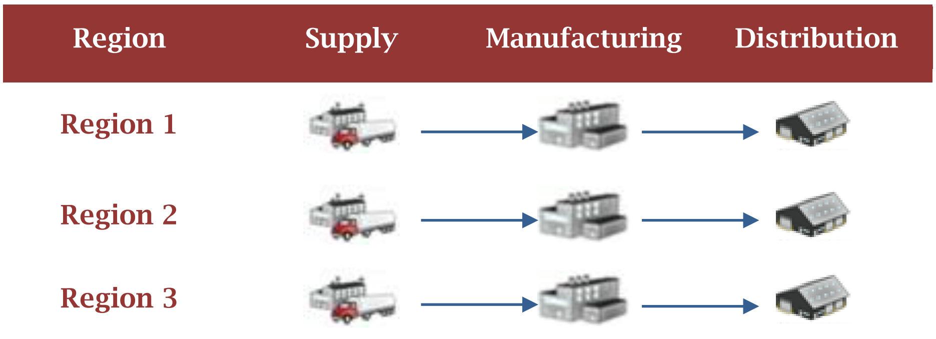


Figure 4.7 – Local sourcing, global manufacturing, local distribution

Configuration 7 (see Figure 4.8) is local sourcing, global manufacturing, and global distribution. Each plant has a limited or almost no dependency on the others. This configuration is adopted when the company needs a unique source of raw materials or parts, which can only be obtained from a single region and is accepted as value-added because of its uniqueness. It also includes global distribution to access foreign markets. This configuration is appropriate for companies that produce different families of products around the world with the capability to distribute worldwide in order to gain a competitive advantage.

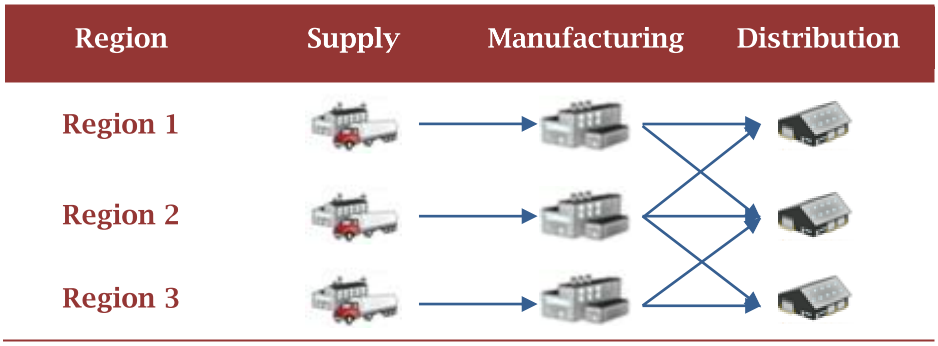


Figure 4.8 – Local sourcing, global manufacturing, global distribution

Configuration 8 (see Figure 4.9) is local sourcing, local manufacturing, and global distribution. This type of configuration is adopted by strong global brands that create value from their local roots. The aim of the company is to create a perception of uniqueness among their customers.

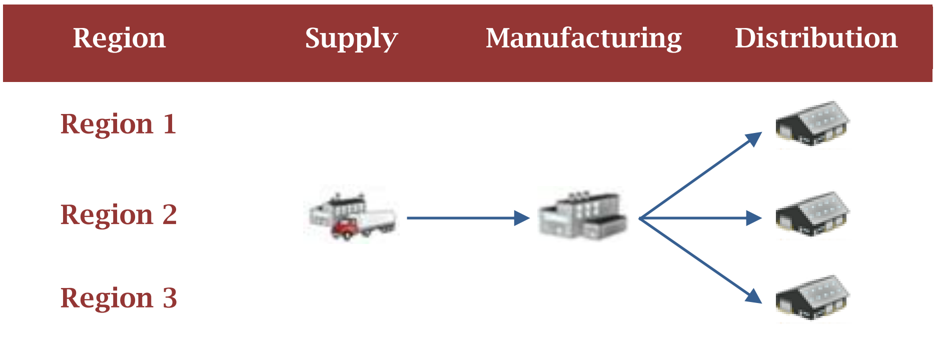


Figure 4.9 – Local sourcing, local manufacturing, global distribution

4.2. Identification of drivers affecting global supply chain design

4.2.1. Effect of each driver on supply chain system

On the basis of comprehensive literature analysis for 124 academic papers, 27 drivers affecting the strategic supply chain configuration have been collected. The effects of each driver on three supply chain operational processes (i.e. sourcing, manufacturing, and distribution) are presented in Table 4.2. It should be noted that, on the one hand, those 27 drivers are the most popular variables that have a direct effect on the supply chain system on the strategic level. On the other hand, every identified driver might influence the strategic design of entire supply chain structure, whereas, the presented effects are the largest impact that a driver can act on the different supply chain stages. Therefore, it was found that the strategic location alternative of each supply chain stage is mainly influenced by various drivers, and some drivers determine more than one supply chain stage to the most degree. Additionally, despite not every identified effect has been verified based on quantitative approach, because most of those effects are proposed in the conceptual papers rather than the quantitative and empirical studies, it is still assumed that all the effects are correct and trustworthy.

The detailed description of those drivers, including definition and measurement method, is followed in this section (also see Appendix Part A).

Driver	**Effect on supply chain system**		
	Sourcing	**Manufacturing**	**Distribution**
Product variety	x		x
Product value density			x
Physical density			x
Risk of obsolescence			x
Profit margin	x		
Competition level	x	x	
Handling requirements			x
Technology level	x	x	
Cycle time		x	x
Completeness		x	x
Delivery reliability			x
Dimension of order			x
Demand predictability	x		x
Demand volatility	x		x
Dimension of market	x	x	
Strength of domestic demand		x	
Competition of domestic suppliers	x		
Availability of purchased items	x		
Quality of domestic sources	x		
Strength of domestic currency		x	
Import tariff	x	x	
Tax incentives and benefits		x	
Importance of labor's quality		x	
Importatnce of labor's cost		x	
Quality of infrastructure		x	
Political stability		x	
Enrionment concern and regulation		x	

Table 4.2 – Effects of driver on operational processes

4.2.2. Definition of identified drivers

Product variety indicates the amount of product codes (SKU) that a company has. A company is more likely to purchase the items from other regions when the domestic suppliers are only able to provide part of them, because a large number of product codes may need more diversified raw materials, components and sub-assemblies (Smith, 1999). With regard to the distribution stage, the global transportation cost could be higher than local transportation, since a wide range of products implies a higher level of stocks and then a higher maintenance cost (Chopra, 2003).

Measurement: Number of product codes (SKU) in company portfolio.

Product value density measures the value of the product per kilogram. This is a very critical variable influencing the transportation cost, because the delivery service is charged as a function of both volume and weight (Lovell *et al.*, 2005). The product is likely to use more centralized inventory and faster transport options as its PVD increases, because of the reduction of stock level in transit, and the benefit from stock reductions due to risk pooling. Therefore, the local distribution is more suitable for the high value density products in order to reduce the total distribution cost.

Measurement: $\frac{\text{Product Value (€)}}{\text{Chargable Weight (kg)}}$

Physical density is defined as the product's weight per unit volume. The products that have a high weight-bulk ratio usually show a good utilization of transportation equipment and storage facilities, with the costs of both tending to be low. On the other hand, the products with low physical density tend to fully utilize the bulk capacity of transportation equipment before reaching the weight-carrying limit (Ballou, 1993). Therefore, in order to obtain the most efficient delivery performance, the high physical dense products are more suitable for the global transportation in the global business scenario.

Measurement: $\frac{\text{Mass (kg)}}{\text{Unit Volume (m}^3\text{)}}$

Risk of obsolescence represents a product's specific life cycle that can be measured in days, weeks, months, etc. The risk of obsolescence can be considered either as perishability, or as the period of time that a product can be offered to a market. The global transportation pipeline requires extended delivery lead time, which increases the product's obsolescence risk (Harrison and van Hoek, 2008). With regard to the products with high risk of obsolescence, the cycle time of the entire distribution stage should be short in order to launch the products to market as quickly as possible.

Measurement: Expected time duration for a product to be demanded in market (days)

Profit margin is a relation between the profit and the price of the product sold and is expressed in percentage. In general, one of the benefits of global sourcing is to obtain the cheaper purchased items from overseas suppliers, despite the transportation cost could be higher, but the lower procurement cost can cover the loss of transportation cost. Therefore, global sourcing is a way to reduce the total supply chain cost and to generate higher profit margin or to ensure the company to obtain the pre-defined profit target.

Measurement: $\frac{Price\ of\ the\ product\ - Cost\ of\ the\ product}{Price\ of\ the\ product}$

Competition level describes both the competitiveness of the industry sector that a company involves, and the competitive advantages a company has. The overall competition level in a specific industry sector is affected by multiple factors, such as the number of competitors, the innovation rate, and the customers demand level, and so on. On the other hand, a firm can provide more diversified products with better service, lower price and higher quality level for improving the competitive position. In order to reach this objective, a company could adopt global sourcing to reduce the purchasing cost, or locate the operations across the regional borders in order to reduce total operations cost and better access to the foreign markets (Cho and Kang, 2001).

Measurement: a subjective measure by considering both the competition level of the industry sector and the market position of a company.

Handling requirements indicates the special type of handling operation that can be used in supply chain (e.g. shockproof, waterproof, etc.). The differences in the level of handling security and safety requirement influence the selection of supply chain configuration (Lovell *et al.*, 2005; Rushton *et al.,* 2000). More in detailed, handling security or safety requirements is critical when the transportation distance is becoming longer or the purchased items derive from the countries or regions with poor transportation infrastructure.

Measurement:

Level	Criterion
Low	Traditional handling methods and no special requirement
Low-medium	Some special requirements with easy and widely-used solution packages
Medium	Moderate requirements
Medium-high	Difficult and highly costly to satisfy requirements
High	Many or special (difficult to provide) handling requirements

Table 4.3 – Measurement method of handling requirements

Technology level indicates the innovation level of the products that could be classified into functional and innovative goods (Fisher, 1997). The innovative products, in particular the digital equipment, can adopt global sourcing and global manufacturing in order to take advantage of the technology endowment of different countries to obtain the components and sub-assemblies (Arntzen *et al.*, 1995).

Measurement:

Level	Criterion
Low	Functional Product
Low-medium	Functional product with some basic additional services
Medium	Hybrid product
Medium-high	High level of innovation but still there is a gap for more
High	Innovative product

Table 4.4 – Measurement method of technology level

Cycle time is defined as a time bucket from the moment of arrival of customer order till the moment of receipt of the goods by the customer. With regard to the manufacturing, locating the plants closer to the market allows the manufacturer to respond the local variations and change the production planning immediately in order to reduce the total cycle time (Harrison and van Hoek, 2008). Moreover, taking into account the direct impact of cycle time on the distribution stage, local distribution can reduce the cycle time significantly compared to the global transportation due to the shorter distance from plants to market (Christopher and Towill, 2001).

Measurement: Time duration between receiving customer order and completing delivery (days)

Completeness or item fill rate indicates the probability of having a product in stock when a customer's order arrives. Completeness is a challenge in the industries where the customer demand is very volatile and unpredictable, and a very crucial variable affecting the selection of the most appropriate strategic supply chain configuration, because it determines the overall delivery reliability within the network (Lovell *et al.*, 2005). In order to maintain a satisfied item fill rate in the warehouse or to replenish the stock timely, the firm can locate the manufacturing facilities close to the market and adopt local distribution strategy.

Measurement: $\frac{number\ \ of\ orders\ -number\ \ of\ stock\ \ out}{number\ \ of\ order}$

Delivery reliability indicates the capacity of a firm to deliver orders in an accurate and punctuate way as they were placed by the customer. As an important element of the performance metrics of the supply chain operations reference model (SCOR) (Huan *et al.*, 2004), delivery reliability is determined by the length of the distribution network in a great sense, because the longer the distribution pipelines result in higher risky delivery. The long distribution pipeline brings more handling, consolidating, and sorting activities that create the uncertainties and mistakes. Therefore, the firm could face the high threat on the additional cost due to the low accuracy.

Measurement: $\frac{accepted\ \ quantity}{ordered\ \ quantity}$, accepted quantity indicates the delivery is completed without any mistake.

Dimension of order can be classified into different levels on the basis of the delivered products quantity, such as single product, packages, boxes, pallets, and truck/container load. This driver is strongly correlated with the saturation of the shipment, and can be used to optimize the location selection (Ashayeri and Rongen, 1997). More specifically, if the dimension of the order can saturate the transport unit, the long distance delivery could be adopted, since the delivery frequency can decrease, and the economies of scale on transportation could be achieved. Otherwise, the higher delivery frequency may be required and the transportation cost would be increased.

Measurement: percentage of the full truck load or full container load.

Demand predictability represents the average margin of accuracy in the demand forecast. The effect of demand predictability on supply chain design is widely discussed. With regard to the sourcing and distribution stages, the long supply chain suffers the heavier loss stemming from the forecasting errors than the compressed pipeline that moves the different facilities closer (Christopher and Towill, 2001).

Measurement: $1-\frac{predicted\ demand - actual\ demand}{number\ of\ forecasts}\%$

Demand volatility is a measure of overall demand variability. It gives a representation of how variable the demand pattern is in relation to the average demand. By taking into consideration the bullwhip effect on the entire supply chain, the slight demand change of finished products leads to the significant variability for the procurement. Therefore, the demand volatility does not only affect the sourcing process, but also influence distribution stage, since a great volatility shows significant reductions in service level and requires the shorter delivery cycle time (Harrison and van Hoek, 2008; Ballou, 1993).

Measurement: variance of the demand in unit time (year)

Dimension of market indicates level of products penetration around the world. In order to overcome the competitive pressure, many firms have developed both domestic and foreign markets. On the other hand, the companies often select the suppliers and set up the operations in some places where the firms sell the products, in order to reduce the total purchasing and operating costs. In this case, the global sourcing and global manufacturing are significant mutual related. Therefore, the dimension of the market is a critical motivator for the global sourcing and manufacturing (MacCarthy and Atthirawong, 2003).

Measurement: number of countries that sell the company's products

Strength of domestic demand describes the ratio between the demand level in domestic market and the overall demand worldwide in a firm. This variable determines the relative size of the domestic market (Prasad and Sounderpandian, 2003). A large value indicates that homeland is the dominant market. On the contrary, the overseas market is the critical target if the ratio is small. In fact, many multinational firms establish the overseas manufacturing facilities in order to have closer access to foreign market because of the large demand. Therefore, the firm inclines to select global manufacturing strategy when the overseas market overwhelms domestic market in order to provide better service due to closer to the customers.

Measurement: $\frac{domestic\ \ sales}{total\ \ sales\ \ worldwide}$, the value is seemed as 100% in case the supply chain configuration is pure locally.

Competition of domestic suppliers represents a proxy of the overall domestic purchasing costs, since the competition is closely related to the price. In fact, the low item price is a very frequently considered criterion affecting a firm to select global suppliers (Chan *et al.*, 2008; Smith, 1999), but the price is a factor hard to be measured (due to the wide range of purchased items in a firm), thus, the competition of domestic suppliers can replace it. The competition of domestic suppliers could affect the strategic sourcing decision when a company selects overseas suppliers due to the price advantage.

Measurement: this driver could be measured by the number of domestic suppliers. The competition is fierce if a large number of suppliers are available in domestic market, whereas the competition is weak.

Availability of purchased items indicates the availability of the required materials, components and sub-assemblies in the home country of the company. Sometimes, the needed items could be scarce in the homeland. Likewise, as a result of the technology advantage and/or nature resource advantage, some items may only be provided in the specific countries or regions. Therefore, a firm has to seek the overseas suppliers to obtain the specific items (Smith, 1999).

Measurement: the variable is measured by taken into account the endowment of purchased items in domestic market.

Quality of domestic sources is a critical variable affecting the sourcing decision, since the competitive pressure from the market forces the firms to improve the quality of their products and lower the cost (Cho and Kang, 2001). Acquiring high quality items by means of international purchasing can bring the competitive advantage to a firm, in particular in a mature market (Smith, 1999). A company is likely to pursue the foreign sources when the quality of the domestic resource is not able to reach the defined quality level.

Measurement: the satisfaction of the firm to the quality of raw materials provided by local suppliers.

Strength of domestic currency can be defined as exchange rate against US dollar. This variable has been widely discussed on the topics of global supply chain and international operations because its large effect on the total operating cost (Arntzen, *et al.*, 1995; MacCarthy and Atthirawong, 2003; Fisher, 1997). One of the aims of manufacturing is to reduce the total supply chain cost, which could be influenced by the exchange rate.

Measurement: $\frac{\text{maximum value of domestic currency against US dollar}}{\text{minimum value of domestic currency against US dollar}}$, which reflect the stability of the domestic currency depending on the value of this formulation.

Import tariff is the tax or duty that imposed on certain imported goods or services to the firm when a product is imported into a nation (Arntzen *et al.*, 1995). The import duty is used to increase government revenue and protect domestic industries from foreign competition. Whereas, regarding to the global sourcing, the charged import duty is a barrier because the purchasing cost is increased due to the tariff.

Measurement: the import tariff is launched by government, and can be checked on national customs website.

Tax incentives and benefits can be considered as the total domestic commercial tax rate that measures the percentage of a corporation's earning. Taking into consideration the tax rate has a direct effect on the after-tax profit (Fisher, 1997), the firm can pursue the higher net profit when setting up the global operations in the countries with lower total tax rate.

Measurement: total tax rate (% of commercial profit), which is provided by World Bank.

Importance of labor's quality indicates the skill level of labor. This is a major motivation for manufacturing outside national borders (MacCarthy and Atthirawong, 2003). Skilled labor is the specialized part of labor force with advanced education, and they can create significant economic value, particularly for the innovative products, through the work performed. Therefore, with regard to the firms providing non-commodity products, it is more important to pursue well-qualified workers. In this way, if the skilled labor is not available in the homeland, the firm has to establish the facility abroad in order to access the high quality labor force.

Measurement: a driver that can be measurement on the basis of the requirement of manufacturing process defined by the firm.

Importance of labor's cost indicates the effect of the labor's cost on a company. The importance is strongly related to the product characteristics and the company's strategy. This driver is one of the most motivators for the strategic manufacturing decision (MacCarthy and Atthirawong, 2003; Prasad and Sounderpandian, 2003). The large number of available work force could moderate the labor cost, and then reduce the cost of production. Otherwise, the higher labor cost has to be paid.

Measurement: this driver is measured on the basis of the company's strategy and the product feature.

Quality of infrastructure includes two parameters: 1) transportation infrastructure, transport modes availability and reliability (e.g. level of development of roads, interchanges and junctions, availability of loading ports and storage facilities, etc); 2) level of telecommunication development (MacCarthy and Atthirawong, 2003). If the infrastructure is poor, the firm has to invest more on that in order to support the operating activities, or move the operations to other countries with better infrastructure.

Measurement: both the Logistics Performance Index (LPI) and Internet users (per 100 people) determine the quality of infrastructure. The two indicators are given by World Bank.

Political stability is a typical factor while making an assessment of international operating opportunities (MacCarthy and W. Atthirawong, 2003; Prasad and Sounderpandian, 2003). Companies are searching for regions with favourable investment climate and stable economic conditions, which are strongly supported by regulative and normative elements. Moreover, this driver also includes security concerns and regulations that are ensured on the national level. Changes in the regulatory environment and political regime are highly undesirable and unacceptable in the long-term perspective. Therefore, the government and political issues affect the firm to make the decision about operating abroad or local.

Measurement: this variable is measured based on Political Instability Index (PII), which shows the level of threat posed to governments by social protest. The index scores are derived by combining measures of economic distress and underlying vulnerability to unrest.

Environment concern and regulation indicates the extent that how much the environment issue is considered. This driver affects the decision of global manufacturing (MacCarthy and Atthirawong, 2003). More specifically, different countries reshape both how supply chains are structured and how companies will seek efficient solutions in order to conform to emission quotas, sewage purification and wastes recycling requirements (e.g. energy efficient manufacturing and transportation solutions, waste treatment plants, etc). If the related legislation about the environmental issues and quality of life is severe in the homeland, the firm has to invest more in order to maintain the public relation or afford the potential fine, unless the firm moves the operations abroad.

Measurement: Environmental Performance Index (EPI) is used to measure this driver. EPI ranks countries on performance indicators tracked across policy categories that cover both environmental public health and ecosystem vitality

5. Case study

5.1. Summary of case study

Company case study was carried out in order to investigate what strategic supply chain configurations are adopted in the leading multinational firms, and collect the data of each identified driver that can be used to build the quantitative model through statistical models. The investigated companies were selected based on multi-criteria. First, the companies are selected from different sectors of manufacturing industries, since each sector has its own constraints and challenges that can affect the design of global supply chain configuration. The second criterion is the size of the company. It is necessary to select leading companies in their sectors because they are more able to be aware of the market situation in order to take the possible advantages that global environment serves.

On the basis of the selection criterion, 45 firms have been investigated based on the on-site interview and secondary document study including annual reports, sustainable reports, etc. It was found 25 firms in FMCG industry, 10 firms in Electronics industry, 6 firms in Luxury industry, and 4 firms in Automotive industry. More in detailed, the FMCG industry includes 9 companies in fast fashion sector, 11 companies in food and beverage sector, and 5 companies in other sub-sectors of FMCG industry, such as toy, personal clean & clear, etc. The Electronic industry consisted of 6 companies in consumer electronics sector, and 4 companies in household appliance sector. What in more, the luxury industry comprises fashion and cosmetics companies, and the automotive industry includes automakers and component suppliers. The distribution chart of the business sectors of the selected companied is shown in Figure 4.10.

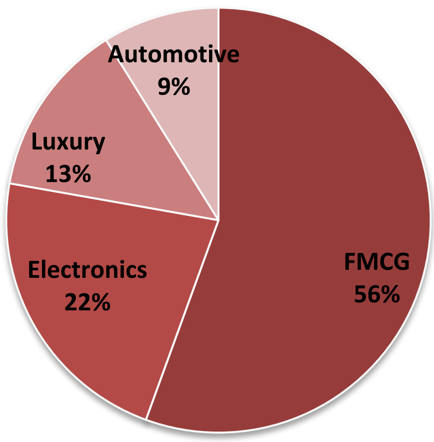


Figure 4.10 – Distribution of the business sectors

The analysis of the each case study has been done first with a brief description of the company with its key outstanding figures, business area that it operates in, products portfolio that it serves to the global market and findings related to the supply chain operations in global level. Afterwards, supply chain network scheme and the supply chain operating process have been presented in order to know what strategic supply chain configuration the firm is using and how the company manages the supply chain operating. The original value of each identified driver for every investigated company is presented in Appendix Part B.

5.2. Case study on FMCG industry

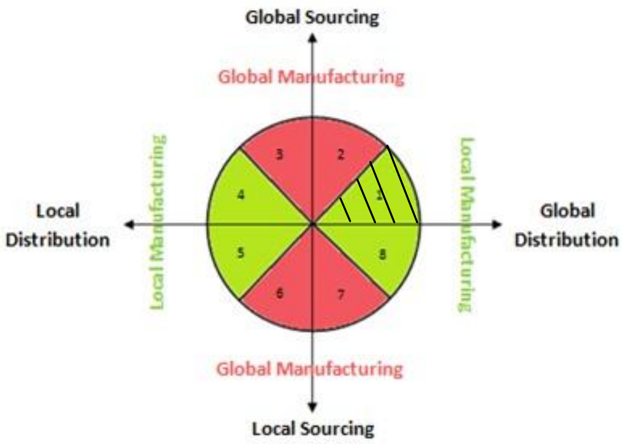
5.2.1. Parah Underwear & Beachwear

Company information

Parah was founded in the 1950s in Italy and became a huge success in the fashion industry in the 1970s. The Parah Group includes four companies that belong to the family Piazzalunga - Parah SpA, GTA Srl, GP Ltd and CRS Srl. Parah is the brand that has transformed the swimsuit into a product "fashion" and that today. It has wide range of swimsuit and underwear products for both men and women. There are 6 different brands belong to the company: Parah, Impronte Parah, Parah new generation, Parah Online, Parah Uomo and Sabbia. Every step of the production process, from style design to manufacturing with cutting-edge machinery, is done in Italy so Parah can guarantee its customers products that are 100% made in Italy.

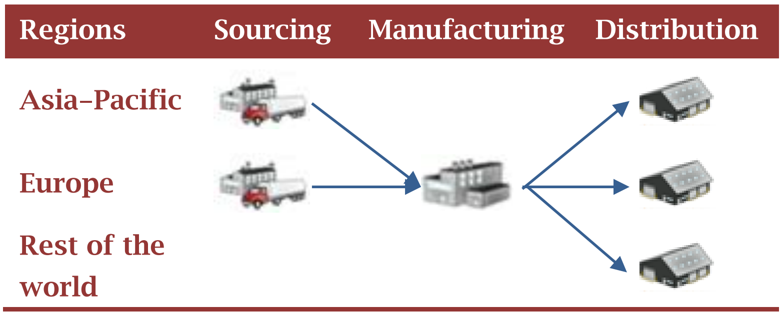
Strategic supply chain configuration in Parah

By analyzing supply chain of Parah, it is deduced that the company adds value to its product with the label written “Made in Italy”, benefiting from the fashion reputation of Italy. A few finished products are provided from Asia-Pacific countries due to cost advantage, but it is not against its main strategy of being an “Italian” brand by supplying and manufacturing totally within Europe, mostly in Italy. Therefore, the supply chain configuration of Parah is summarized as Global Sourcing – Local Manufacturing – Global Distribution.



Supply chain process in Parah

Parah supplies 15% of finished products from Asia and produce 85% of products at its plants in Europe. With regard to the raw materials for manufacturing in European plants, all the items are supplied from Europe. Moreover, the majority of the market that Parah serves is comprised of EU countries which results in proximity to main market to follow the changes, decrease lead time and increase delivery frequency. Being a fashion company, by locating its production facilities close to market enables them to follow the trend closely and be able to operate in a more flexible way.



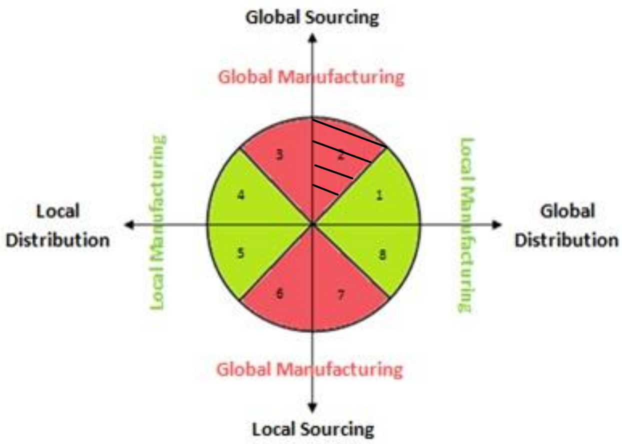
5.2.2. BasicNet Group

Company information

The BasicNet Group was founded in 1994 when the Football Sport Merchandise Srl Marco Boglione from the failure Maglificio Calzificio Torinese, taking a sample of the brand, the warehouse and the property. Maglificio Calzificio Torinese, founded in 1916 and survived during the Second World War with the provision of clothing to the armed forces. During the 60's, it converts from a company mainly produces underwear to one of the most active and modern clothing enterprises youth and sports. The Group's objective is to become a leading global operator in the casual and sport. The brands managed by the Group BasicNet are positioned in the casual segment, fast-growing market since the late 70s and believed to be intended to have a progressive development in light of the liberalization of the global costume. Nowadays, BasicNet has developed a network consisting of 8 group companies, 18 licensees, 6 sourcing centers, and 200 independent factories on which the BasicNet uses to produce the products.

Strategic supply chain configuration in BasicNet

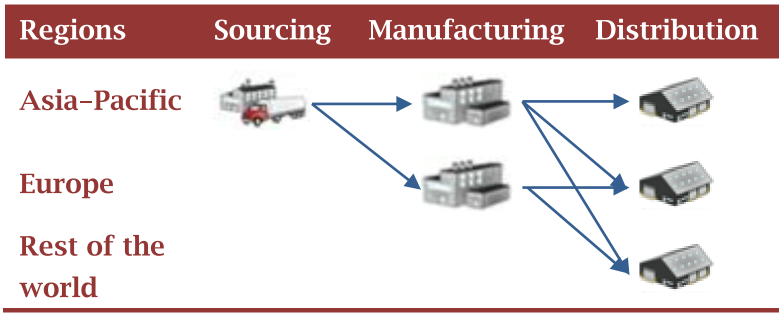
BasicNet Group is not engaged in manufacturing so that it outsources to third parties. Therefore, the main manufacturing activities are taken place in Far East where is closer to the raw material sources. The finished products are distributed globally, while the dominant market is Europe. In a conclusion, the strategic supply chain configuration of BasicNet Group is Global Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in BasicNet

BasicNet Group supervises and optimizes the manufacturing activities via dedicated Sourcing Centers, all manufacturing phases on behalf of the licensees, capturing significant economies of scale by seeking out the production sources more appropriate in terms of cost and standard of quality at the worldwide level. The outsourcing of the finished products is mostly in the Far East (i.e. 70% of the entire production), the remaining part is attributed to Europe, mainly in Italy, a market that is already consolidated the company's inception. The market served most weighted is

Europe, which obtains estimated the 66.53% of total sales, followed by the Asia and Oceania, reaching 17.76% of sales, and then America with 8, 25%.



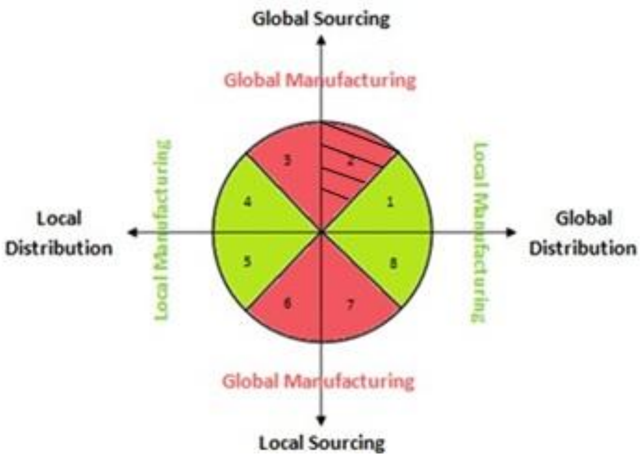
5.2.3. Zara

Company information

Zara is a Spanish clothing and accessories retailer founded in 1975 by Amancio Ortega and Rosalía Mera. It is the flagship chain store of the Inditex group. Inditex is one of the world's largest fashion retailers, welcoming shoppers at its eight store formats which are Zara, Pull & Bear, Massimo Dutti, Bershka, Stradivarius, Oysho, Zara Home and Uterqüe boasting 6.058 stores in 86 markets. Zara needs just two weeks to develop a new product and get it to stores, compared to the six-month industry average, and launches around 10,000 new designs each year. Zara has resisted the industry-wide trend towards transferring fast fashion production to low-cost countries. Zara stores have men's clothing and women's clothing, each of these subdivided in Lower Garment, Upper Garment, Shoes, Cosmetics and Complements, as well as children's clothing (i.e. Zara Kids).

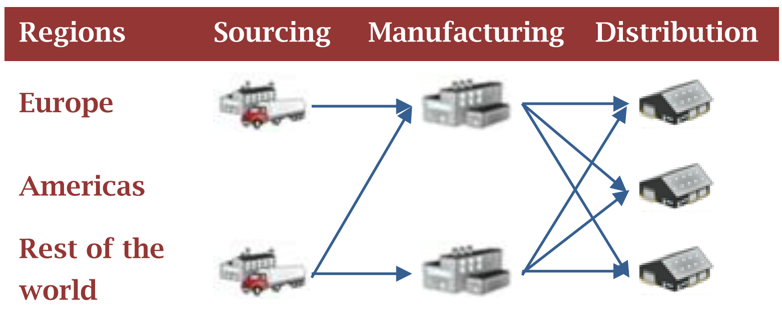
Strategic supply chain configuration in Zara

Zara operates the business on the basis of a truly global strategic supply chain configuration, Global Sourcing – Global Manufacturing – Global Distribution, in order to maximize resource used, minimize inventory and lead time.



Supply chain process in Zara

Zara deeply understands the procurement has direct connection with company profit. In its supply chain, Zara is benefiting from the cost advantages of mostly Asian-Pacific countries. The Asian suppliers are the main providers of raw materials, components and sub-assemblies, and they send the purchased items both to local plants and European plants. In order to minimize the delivery lead time, Zara establishes the manufacturing sites close to the market, except the America market due to the small sales and high production cost. The Zara basic label is daily commodity (e.g. underwear, basic t-shirts, socks, etc.), and they are mainly produced in China, which presume cheaper production and longer lead time. On the other hand, the labels like Zara RTF, mainly consisting of up-to-date fashion designs are produced in Portugal and Spain, meaning higher production cost and shorter lead time, but helping fast reaction on demand. The Europe market consume nearly 70% of the total sales, the America market and Asia market take on 18% and 12% of the sales.



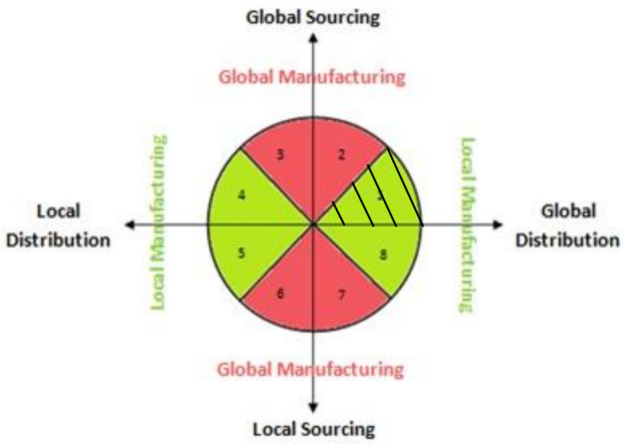
5.2.4. Sergio Tacchini

Company information

The Company was founded in 1966 in northern Italy, by Sergio Tacchini, the International Tennis player who was a player in the Davis Cup for Italy from 1959 to 1966. The brand immediately introduced great innovation in style, using colors and stripes at a time when tennis players only wore white. The vision of Sergio Tacchini is Italian style and creativity, innovation and quality together with tennis DNA. The distribution in Italy is mainly done through monobrand stores, but the brand is well distributed abroad in the countries such as France, Greece, Germany, Czech Republic, Spain, Belgium, Sweden and other main countries.

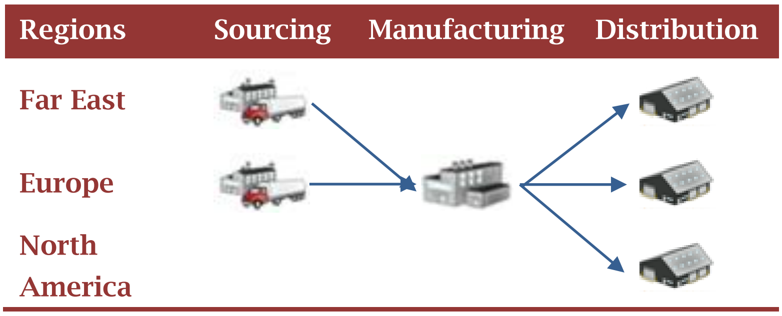
Strategic supply chain configuration in Sergio Tacchini

Sergio Tacchini adopts the strategic supply chain configuration as Global Sourcing – Local Manufacturing – Global Distribution. The structure is represented as the following figure.



Supply chain process in Sergio Tacchini

Company's competitive priority about sourcing is the cost. By taking into account the raw materials required are cheaper in China, it sources majority of the supplies from Far East. The company also takes advantage of low exchange rates and supplier competition. 100% of production is made in Italy which ensures the high quality perception for the customers. In addition, approximately 85% of overall sales is taken place in Europe, the other regions only occupies a small part of the sales.



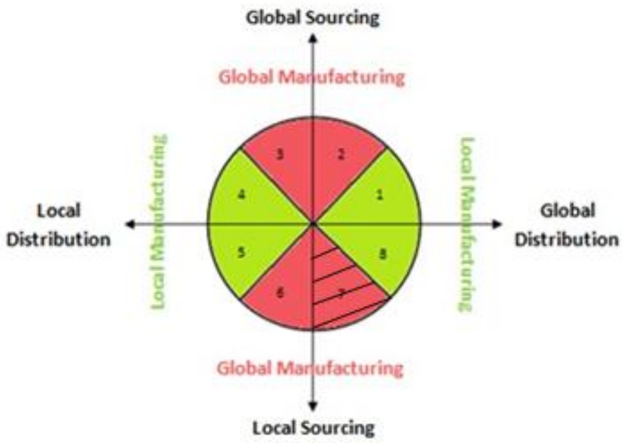
5.2.5. Levi Strauss Europe

Company information

The group company Levi Strauss & Co was founded in San Francisco by Bavarian immigrant Levi Strauss in 1853. The products are sold under the names of Levi's, Dockers, Denizen, and Signature by Levi Strauss & Co. ™ brands. Levi Strauss & Co. is today a well-established global business. It operates in 110 countries, and approximately half of its net revenue comes from outside of the United States. The presence of the company in the United States, Canada, Western Europe and Japan is well established. In the years ahead, it wants to expand the Levi Strauss & Co. brands in India, China, Russia, Brazil and other emerging markets. Europe division of the company is headquartered in Brussels. Across the region, there are nine sales offices, six distribution centers and three production facilities. Levi's and Dockers brand products are marketed and sold in more than 40 countries in this region.

Strategic supply chain configuration in Levi Strauss Europe

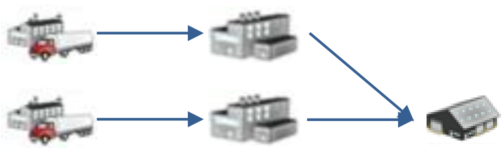
Levi Strauss Europe is responsible for the design, production and sale of Levi's, Dockers and Levi Strauss Signature in the European countries, both Eastern and Western. Therefore, the majority of the finished products are produced in Europe, and the remaining small part derives from Asian countries. The raw materials suppliers only provide the items to the local plants in order to decrease the total manufacturing costs. The strategic supply chain configuration of Levi Strauss Europe is Local Souring – Global Manufacturing – Global Distribution.



Supply chain process in Levi Strauss Europe

Levi Strauss Europe has a turnover of approximately $ 980 million, of which 15% in Italy and 85% in the rest of Europe. The production activities are mainly organized by external partners, dealing with the supply of finished products of Levi Strauss Europe. There are, however, still owned establishments in Poland and Turkey for specific operations or emergencies. The finished products suppliers are located in Europe (i.e. 60% in Turkey and Romania), Pakistan (30%) and Morocco (10%). They take on their own supply of raw materials and dispose of the goods according to the guidelines of the American group headquarters. The main logistics center is located in Brussels (Belgium), where they are managed articles intended for the market of Belgium, Holland, Luxembourg and Denmark. Other important deposits are found in Italy, Spain and UK for their national markets, the warehouse in Poland provides the products for Eastern Europe and Germany, Austria and Switzerland. What is more, 70% of the finished products managed in European logistics facilities are offered in the European plants, and the remaining part is supplied from Asian plants.

Regions	Sourcing	Manufacturing	Distribution
Asia			
Europe			
Rest of the world			



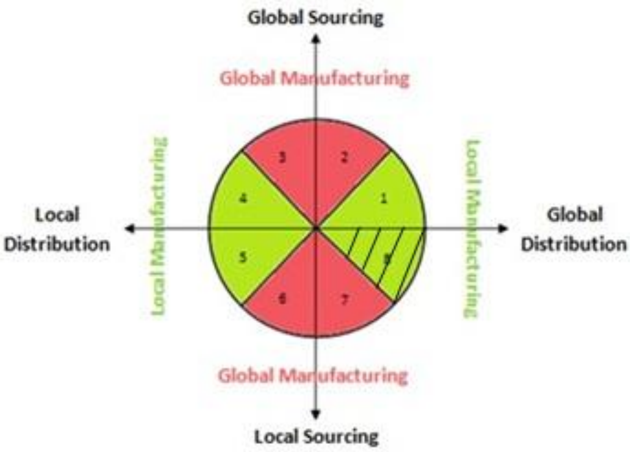
5.2.6. Alpargatas S.A. (Havaianas)

Company information

Alpargatas is the largest footwear manufacturing company in Latin America and its growth strategy is focused on the management of brands that are competitive and strategic assets. The company heavily invests in its global expansion and exports products to 80 countries. At the beginning of the 20th century, Scotsman Robert Fraser arrived in Brazil and began manufacturing flip flops based on the traditional zori sandals brought to the country by Japanese immigrants. By 1958 he had developed the rubber version known as Havaianas – a name that he trademarked in 1962. After completing 50 years of existence in 2012, Havaianas is the most recognized Brazilian consumer goods brand internationally.

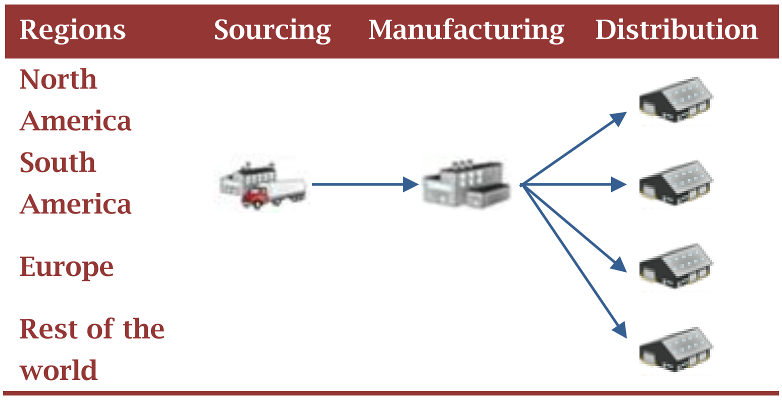
Strategic supply chain configuration in Havaianas

Alpargatas S.A. procures the raw materials and produces the Havaianas products in Brazil, and distributes the final products to global market. Therefore, the strategic supply chain configuration is Local Sourcing – Local Manufacturing – Global Distribution.



Supply chain process in Havaianas

The sourcing of Havaianas products is made inside of Brazil because all of the required raw materials can be found within the border. Despite Alpargatas is a desired brands with 13 manufacturing units in Brazil and Argentina, Havaianas are 100% made in Brazil, not even a single pair is made abroad.



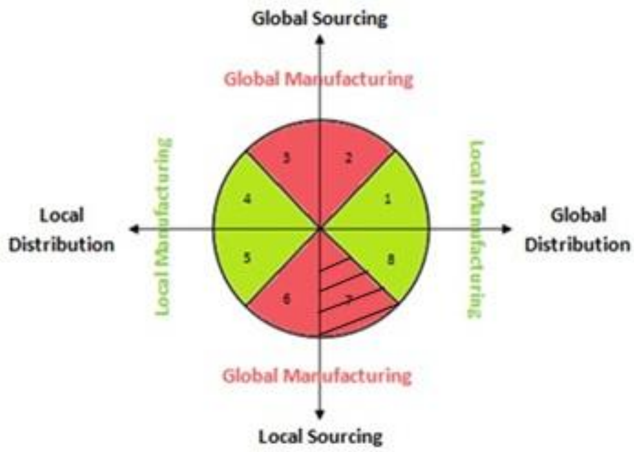
5.2.7. H&M

Company information

H&M Group (Hennes & Mauritz AB) is a Sweden-based company, and is one of the world's largest and fastest growing clothing retailers. The company is a pioneer of "fast fashion". It operates under such brand names, as H&M (be analyzed in this research), H&M Home, COS, Monki, Weekday, Cheap Monday and & Other Stories. H&M targets the Hip & Modish, and designs cheap yet chic clothing, mainly for men and women ages 18 to 45, children's apparel, and its own brands of cosmetics. By the end of 2012, fast-growing H&M operates some 2, 774 stores in some 48 countries and offers online shopping in eight countries. The firm doesn't own factories but buys its goods from suppliers primarily in Asia and Europe. H&M opened its first women's clothing store in 1947 as Hennes (Swedish for "hers"); it later bought the hunting and men's clothing store Mauritz Widforss. H&M is controlled by the family of chairman Stefan Persson (the billionaire son of founder Erling Persson).

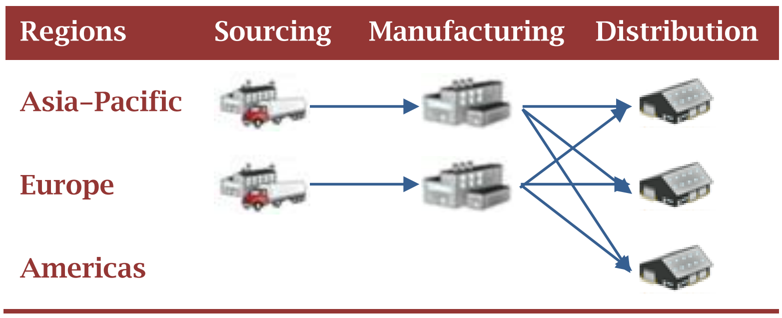
Strategic supply chain configuration in H&M

H&M does not own any factories, whereas the products are sourced from independent suppliers, mainly in Europe and Asia. These suppliers manufacture our products and generally source fabrics and other components needed. All the final products are delivered to the market in Europe, Asia-Pacific and Americas globally. Therefore, the supply chain configuration of H&M is Local Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in H&M

Initially, all the production activities of H&M took place in Sweden. In the 1960s, production was carried out in other Scandinavian countries and in the UK. In the late 1960s, some of the production activities were shifted to southern European countries like Italy and Portugal. By the early 1970s, H&M was also producing in Hungary, Poland, and erstwhile Yugoslavia. In 1978, H&M ventured into the Far Eastern countries with a production office in Hong Kong. As of 2000, H&M had 22 production offices worldwide. Nowadays, the clothes designed by the headquarters at Stockholm are produced in more than 20 countries in Europe and Asia. After the garments are manufactured, they are shipped to stores across the world. The products with higher lead times are made in Asia, and those that are in high demand are made in Europe. All the products are distributed across the world to its stores, located in prominent shopping districts in 25 countries across the world.



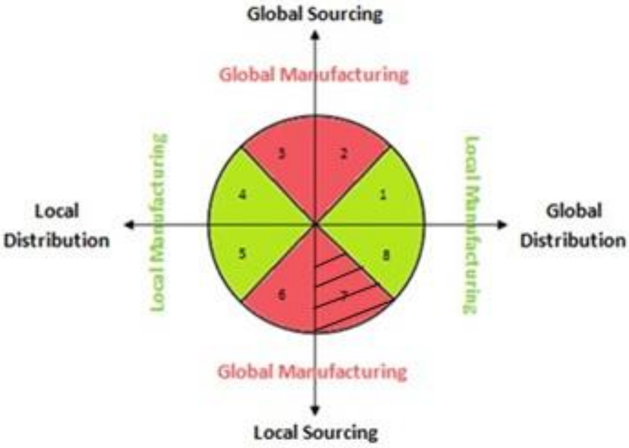
5.2.8. Nike

Company information

Nike, Inc. (Nike), incorporated on September 8, 1969, is engaged in the design, development and worldwide marketing and selling of footwear, apparel, equipment, accessories and services. Nike is a seller of athletic footwear and athletic apparel worldwide. The Company sells its products to retail accounts, through Nike-owned retail stores and Internet sales, and through a mix of independent distributors and licensees, in approximately 170 countries around the world. The Company focuses its product offerings in seven key categories: Running, Basketball, Football (Soccer), Men's Training, Women's Training, Nike Sportswear (its sports-inspired products) and Action Sports. It also markets products designed for kids, as well as for other athletic and recreational uses, such as baseball, cricket, golf, lacrosse, outdoor activities, football (American), and tennis, volleyball, walking and wrestling. Nike's athletic footwear products are designed primarily for specific athletic use. The Company sells sports apparel and accessories, as well as athletic bags and accessory items. It also markets apparel with licensed college and professional team, and league logos.

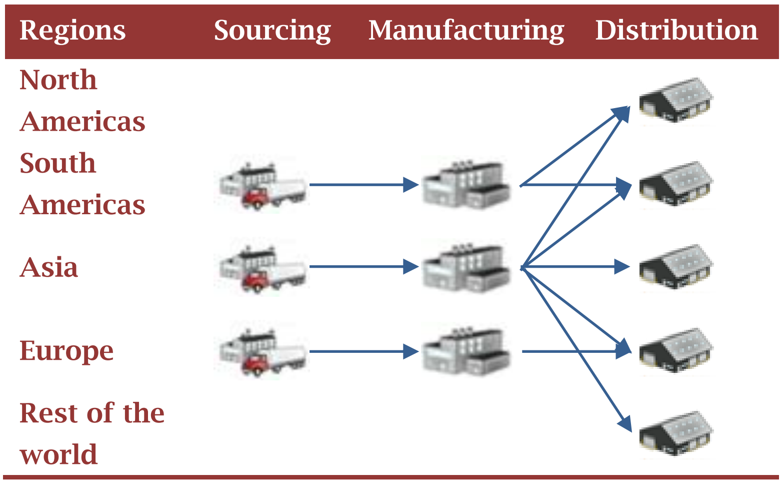
Strategic supply chain configuration in Nike

Nike produces apparel and footwear in 463 factories in 37 countries mainly in Asia and Latin America. Those factories purchase the raw materials from the local suppliers basically. The footwear products are produced in Asian plants and delivered to global market, whereas the apparel is mainly sold in local market. Therefore, the supply chain configuration of Nike is Local Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in Nike

Generally, all of the footwear is produced outside of the United States. The main contract suppliers are in China, Vietnam, Indonesia and Thailand. Nike also has manufacturing agreements with independent factories in Argentina, Brazil, India, and Mexico to manufacture footwear for sale primarily within those countries. Almost all of Nike brand apparel is manufactured outside of the United States by independent contract manufacturers. The Most of this apparel production is occurred in China, Thailand, Indonesia, Malaysia, Vietnam, Turkey, Sri Lanka, Cambodia, Taiwan, El Salvador, Mexico, India and Israel. The principal materials used in the footwear products are natural and synthetic rubber, plastic compounds, foam cushioning materials, nylon, leather, canvas, and polyurethane films. The wholly-owned subsidiaries of NIKE, and independent contractors in China and Taiwan, are the largest suppliers of the Air-Sole cushioning components used in footwear. The principal materials used in the apparel products are natural and synthetic fabrics and threads, plastic and metal hardware, and specialized performance fabrics designed to repel rain, retain heat, or efficiently transport body moisture. Most raw materials are available in the countries where manufacturing takes place. The North America is the largest market taking on 44% of the total sales, followed by Asia, South America and Europe markets.



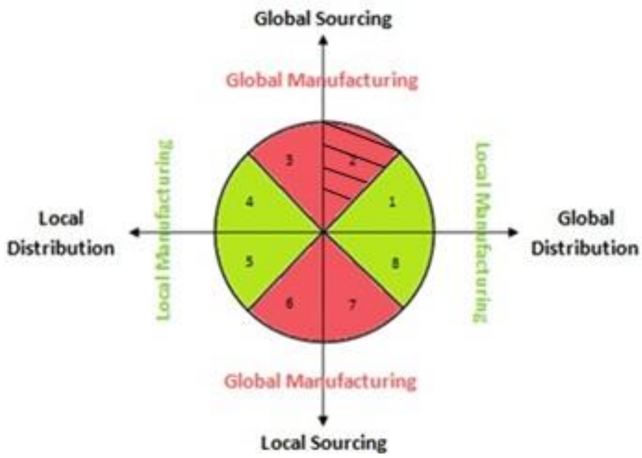
5.2.9. Ray-Ban

Company information

Ray-Ban, found in 1937 by Bausch & Lomb, is one of the world's best-selling brands of sun and prescription eyewear. In 1939, Ray-Ban launched a new version of the aviator called the Indoorsman. In 1952, Ray-Ban created a classic style, the Ray-Ban Wayfarer, with plastic frames. The brand remained popular during the 60s and 70s, and gained popularity during the 1980s. In the 90s, Ray Ban came out with a series of innovation and sleek looking design shown in the series of the following models: Predators, Inertia, Prophecy, Gatsby, Sidestreet, Cutters, and so on. During the late 90s, as rivals like Oakley gained popularity among younger customers, Ray-Ban started to struggle – and in 1999, it is sold to the Italian Luxottica Group that the brand currently operates under this group.

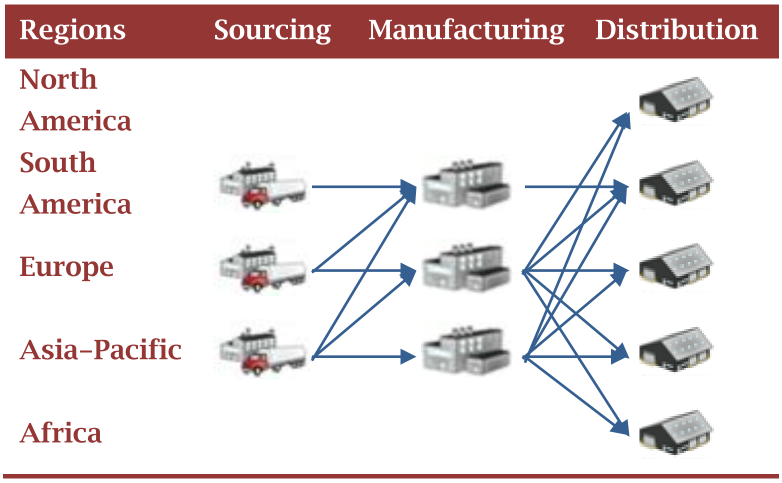
Strategic supply chain configuration in Ray-Ban

In order to reduce the total costs and maintain the high service level, Ray-Ban operates a purely global supply chain system structured as Global Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in Ray-Ban

Ray-Ban operates a complex supply chain, all of the raw materials or components are sourced from South America, Asia and Europe. The manufacturing plants are also located in those three regions, even if the final products are sold in more regions, including North America, Pacific and Africa. More in detailed, the production is taken place in Brazil and China as well as Italy due to cost and market proximity concerns. Those facilities out of Italy provide Ray-Ban a cheaper production by the cheap labor and material offerings of those regions.



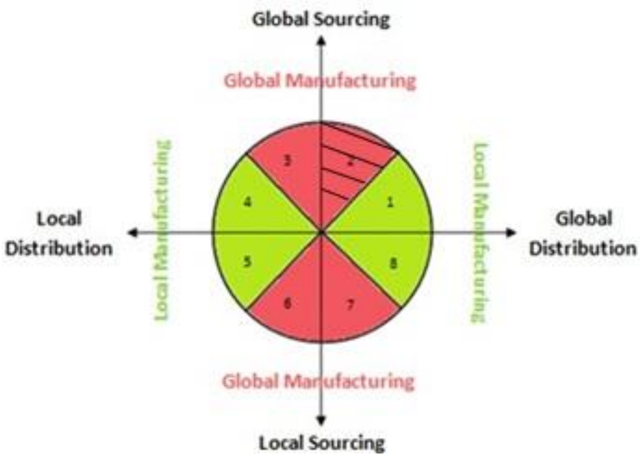
5.2.10. Barilla S.p.A.

Company information

Barilla S.p.A. is an Italian and European food company founded in 1877 in Ponte Tarro, Italy by Pietro Barilla. The company is privately held, and remains in the fourth generation of Barilla family ownership. The Group employs over 8,000 people and owns 30 production sites. Barilla owns 13 brands. It produces several kinds of pasta and it is the world's leading pasta maker with 40-45% of the Italian market and 25% of the US market. It produces pasta in over 120 shapes and sizes. Barilla brand pasta is sold in numerous restaurants worldwide, such as those belonging to the Pastamania chain. It is also the leading seller of bakery products in Italy. Through its acquisition of the Swedish company Wasa, it is the world's leading producer of flatbread (a Scandinavian staple), selling 60,000 tons annually.

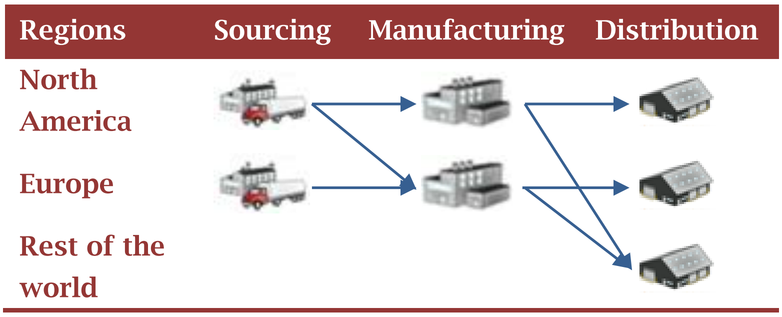
Strategic supply chain configuration in Barilla

The main location of the suppliers and plants are both located in North America and Europe, and the North American suppliers provide the raw materials not only for the local manufacturing sites, but also for European plants. The most of the finished products are distributed to local market from the plants, but a small part of the products are delivered to other markets except North America and Europe. Therefore, the strategic supply chain configuration of Barilla is Global Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in Barilla

There are more than 800 raw materials and 50 types of packaging materials that Barilla uses for its portfolio of more than 1000 products. It has strategic materials that it mostly uses which are wheat, tomatoes, eggs, oils, flexible film paper and cardboard. These materials are not difficult to find in local market, taken into account that most of the materials have short life which makes better to source from the region. Moreover, production facilities are located near to market in order to decrease lead time. Barilla Group has 30 production plants all over the world: in Italy, Greece, France, Germany, Norway, Russia, Sweden, Turkey, the United States (in Ames, Iowa and Avon, New York), and Mexico. Over one thousand products, matching different moments of everyday consumption, are distributed to 100 countries. 25% of Barilla products are fresh, moreover, there is extreme demand fluctuations observed in distributors' order pattern. These facts put pressures in terms of production lead time and perishability of the product. That leads Barilla to produce most of its products in the region where it is consumed.



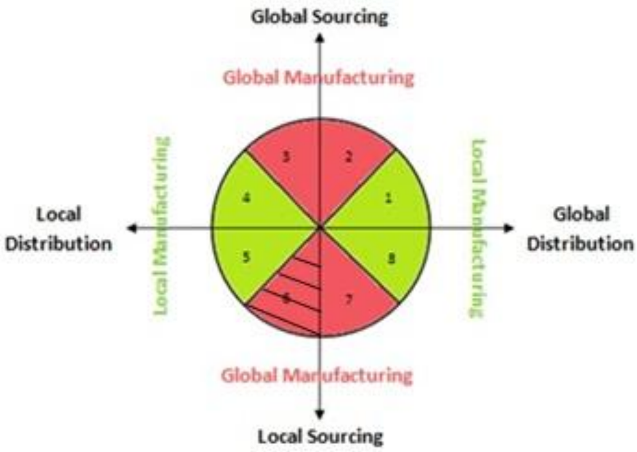
5.2.11. Nestlé S.A.

Company information

Nestlé S.A. is a Swiss multinational food and beverage company, found in 1866 in Vevey, Switzerland. It is the largest food company in the world measured by revenues. Nestlé's products include baby food, bottled water, breakfast cereals, coffee, confectionery, dairy products, ice cream, pet foods, and snacks. 29 of Nestlé's brands have annual sales of over 1 billion Swiss francs (about $1.1 billion), including Nespresso, Nescafé, Kit Kat, Smarties, Nesquik, Stouffer's, Vittel, and Maggi. Nestlé has around 450 factories, operates in 86 countries, and employs around 328,000 people.

Strategic supply chain configuration in Nestlé

In general, all of the main raw materials can be found from the local suppliers for the plants in every region, and the final products are distributed to local market. Therefore, the strategic supply chain configuration of Nestlé is Local Sourcing – Global Manufacturing – Local Distribution.



Supply chain process in Nestlé

Nestlé prefers local sourcing due to the perishability of its supplies, the main reason for this choice is understood. Dairy products and most of the ingredients are easy to find in different regions. Therefore, by this way, both the transportation cost can be decreased; meanwhile, frequent and fresh procurement can be made. After production, most of the markets are supplied locally because of the fact that most of the products have short shelf life. Thus, by being close to market, frequent deliveries can be made with low volumes. From other production sites, there is also a support to America to meet its high consumption rate, but the amount of the global delivery is quite small.

Regions	Sourcing	Manufacturing	Distribution
Americas			
Europe			
Rest of the world			

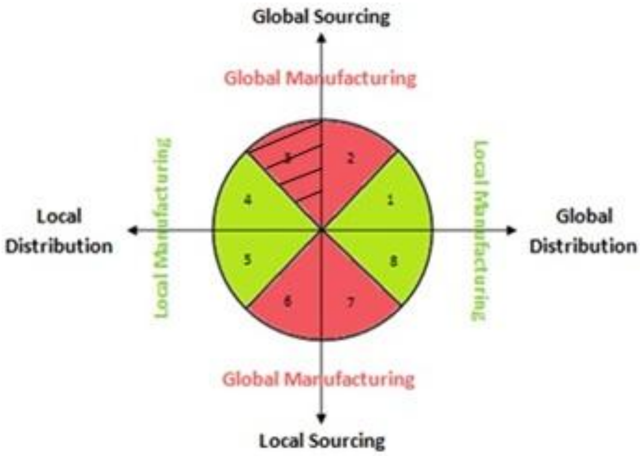
5.2.12. Unilever Food

Company information

Unilever is an Anglo-Dutch multinational consumer goods company. Its products include foods, beverages, cleaning agents and personal care products. It is the world's third-largest consumer goods company measured by 2011 revenues (after Procter & Gamble and Nestlé) and the world's largest maker of ice cream. Unilever has 400 products which are sold in more than 190 countries, generating sales of €51 billion in 2012. Unilever Food is one of the three main global divisions of Unilever Corporation.

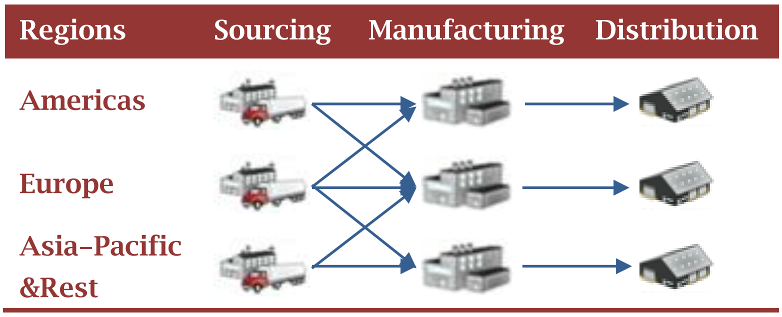
Strategic supply chain configuration in Unilever Food

The sourcing of Unilever Food is operated globally in order to provide different raw materials to the plants in each region. The final products are distributed from the local production sites to the local market for decreasing the total distribution cost and the delivery lead time. Therefore, the strategic supply chain configuration of Unilever Food is Global Sourcing – Global Manufacturing – Local Distribution.



Supply chain process in Unilever Food

As a food maker company, Unilever Food is able to source most of the raw materials from local suppliers according to the local customer's taste and preference, whereas some special intergradient have to be sourced from other regions. Unilever Food is multinational with operating factories in every continent. It has subsidiaries in almost 100 countries. The main production sites are located in England, Germany, France, Netherlands, United States, Brazil, South Africa, India and China. What is more, the expiration constraint, unpredictable and fluctuating demand trend lead food company to determine a local strategy in terms of distribution. In addition, some major changes in customers' expectations are observed in this sector more solidly. Therefore, being close to market and follow the changes in the market and serve in accordance with the regions eating habits and culture, is the dominant motivation in determining the supply chain configuration. The Europe market occupies 27% of the total sales, while the American market consumes more, nearly 33% of the total sales, and the other revenue is generated in the rest markets.



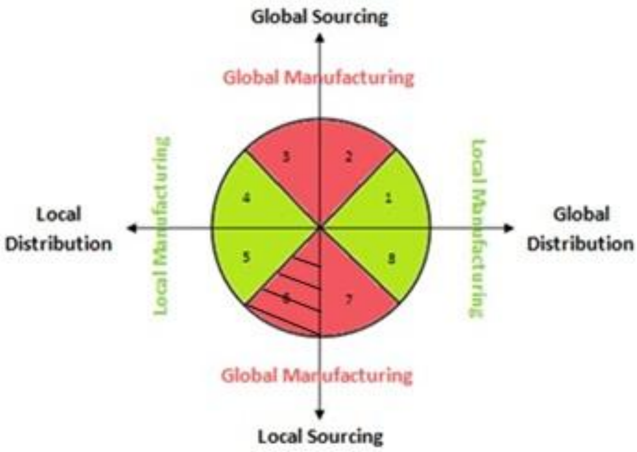
5.2.13. Kellogg's Cereal

Company information

Kellogg Company is a multinational food manufacturing company headquartered in Michigan, United States. The company was founded in 1906 and incorporated in Delaware in 1922, and its subsidiaries are engaged in the manufacture and marketing of ready-to-eat cereal and convenience foods. Its principal products are ready-to eat cereals and convenience foods, such as cookies, crackers, savory snacks, toaster pastries, cereal bars, fruit-flavored snacks, frozen waffles and veggie foods. These products are marketed under the Kellogg's name in more than 180 countries.

Strategic supply chain configuration in Kellogg's Cereal

The raw materials for the Kellogg's Cereal products can be found in every region. By taking into consideration the various customers' preference, the plants are also located in different regions in order to provide the goods to their local market. Therefore, the strategic supply chain configuration of Kellogg's Cereal is Local Sourcing – Global Manufacturing – Local Distribution.



Supply chain process in Kellogg's Cereal

When the supply chain is analyzed for the cereals produced, it is seen the flow of goods is done totally local (i.e. the raw materials are supplied locally), and the facilities are close to market. Raw materials of Kellogg's Cereal are mostly agricultural commodities which are generally not specific to a region but able to be grown in many places. In the same way, packaging materials which contains mainly carton board, corrugated, and plastic are obtained from local region. The products are manufactured in 35 countries worldwide. The largest factory is located in Manchester, United Kingdom, which is also the location of its European headquarters. Kellogg's Cereal's production does not required high skilled labors and it does not require a high investment to build a facility. Moreover, the products have the features of low shelf life and low product-value density which makes worthless to carry the products from another region. These drivers indicate the rightfulness of the company to produce in each market that it operates.

Regions	Sourcing	Manufacturing	Distribution
North America			
South America			
Europe			
Asia-Pacific			
Africa			

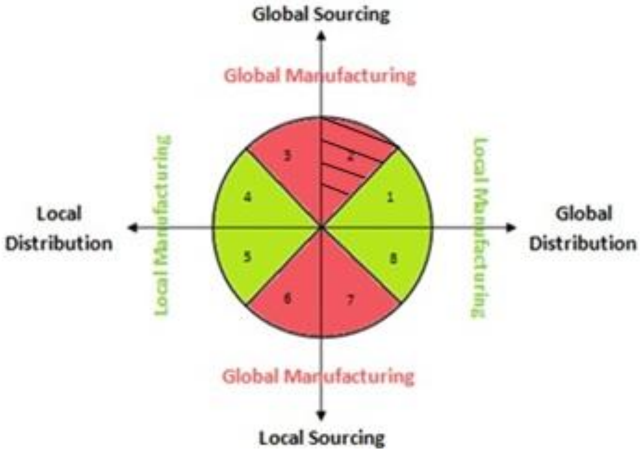
5.2.14. Lindt & Sprüngli

Company information

The Lindt & Sprüngli Group is a luxury Swiss chocolate and confectionery company which is globally active, developing, producing, and selling chocolate products in the premium quality segment. The holding company, Chocolade fabriken Lindt & Sprüngli AG, has its headquarters in Zurich. Lindt & Sprüngli is offering a large selection of products in more than 120 countries around the world with Lindt, Ghirardelli and Caffarel brands. It has also 20 subsidiary companies worldwide which is excluded from our work. At present there are around 200 Lindt shops worldwide.

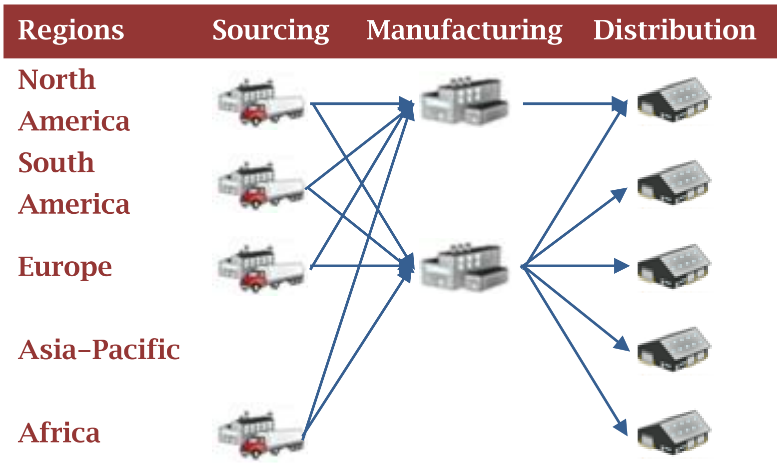
Strategic supply chain configuration in Lindt & Sprüngli

The required raw materials, such as cacao, milk, sugar, etc., are sourced from different regions, and then the plants in Europe and North America distribute the final products to global market. Therefore, the strategic supply chain configuration of Lindt & Sprüngli is Global Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in Lindt & Sprüngli

Analyzing Lindt's supply chain configuration, it is realized that the company prefers both local and global sourcing for different types of supplies having different characteristics. The essential raw material of the company is cacao as it can be predicted. Beside this, milk, sugar, hazelnuts and almonds and palm oil are required primarily as ingredient for Lindt & Sprüngli's premium chocolate. These fillings and raw materials are supplied as following: local sourcing is preferred for dairy products, sugar and packages. Milk and sugar is sourced within the boundaries close to where factories are located because of availability, decreasing transportation cost and shelf life. There is no point supplying milk globally as it is easy to find nearby with the same quality and thus increases the control level which is critical for especially dairy products to be fresh and hygienic. Moreover, packaging materials are sourced locally because of environmental concerns and decreasing costs. However, other ingredients (cacao, hazelnuts, almond and palm oil) should be procured with different strategy mostly because of availability. These raw materials are not growing everywhere in the world, but specific regions. Combining availability and sustainability concerns, Lindt chooses the locations to obtain these ingredients such as Nuts from Turkey and Italy, cacao from Ghana and Latin America and almonds from USA. In order to acquire high quality supplies and fulfill its environmental and social responsibilities, it makes long term relations with the suppliers applying improvement projects in farms and in region. Analysis related to production facility network, it can be seen that the company prefers to be close to its customers when it is considered that 93% of its sales occur in USA and EU. Lindt & Sprüngli has 6 production sites in Europe, 2 in North America. It manufactures various products of its renowned Lindt brand in Switzerland, Germany, France, Italy, and Austria, as well as in the United States. This preference can be linked with the reasons to decrease lead time and increase delivery frequency. Lindt distributes remaining 7% of the products globally from those facilities to the rest of the world.



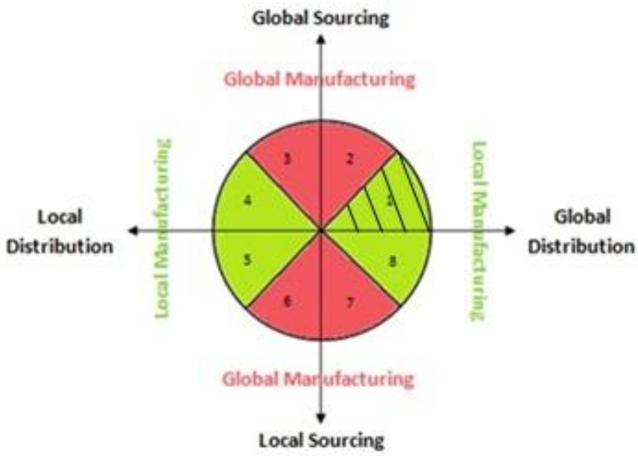
5.2.15. IllyCaffè S.p.A.

Company information

The company is based in Trieste and found in 1933. It is led by the third generation of the Illy family: IllyCaffè S.p.A. belongs (100%) to the Illy family's holding company – Gruppo illy S.p.A. IllyCaffè produces and sells worldwide a single blend of premium quality coffee made from nine varieties of pure Arabica beans. A balance of the finest beans from South America, Central America, India and Africa produces the distinctively illy flavor and aroma, consistent cup after cup, wherever it is enjoyed around the world. Illy's products are enjoyed in more than 140 countries, on all five continents, and are served in about 100,000 establishments. Illycaffè operates internationally, through a network of corporate offices and subsidiary companies that maintain Illy's strong presence across Europe, North America and Asia.

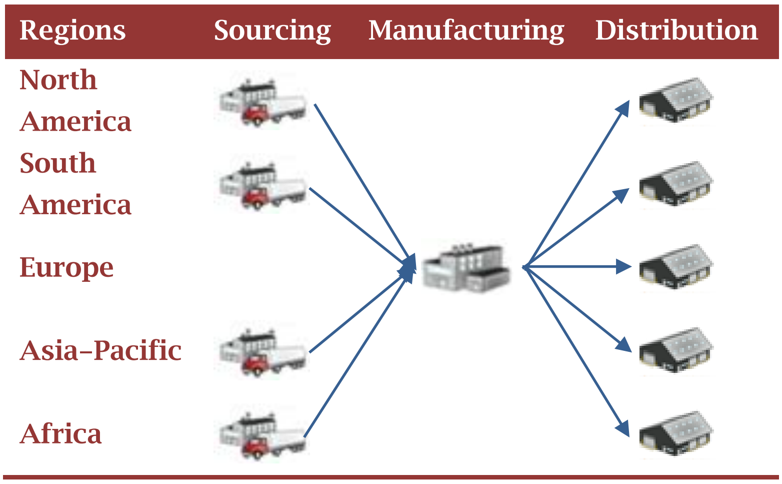
Strategic supply chain configuration in IllyCaffè

IllyCaffè imports the finest coffee beans from different regions to Italy in order to produce the premium quality coffee, and then distribute to global market. Therefore, the strategic supply chain configuration of IllyCaffè is Global Sourcing – Local Manufacturing – Global Distribution.



Supply chain process in IllyCaffè

Quality is important for Illy, so it believes that quality begins with raw material. In order to guarantee it, the company purchases green coffee for twenty years direct from its source. For this purpose, Illycaffè has developed long-term relationships with the best coffee growers in the world, in conformity with its principle that only a relationship of mutual exchange and improvement can guarantee quality, as well as an increase of the product's value. As being a coffee producer, sourcing is the most important stage in this sector where the main value is the taste. In manufacturing side, it adds value by labeling it “Italian” which is famous with good coffee. With the high quality perception created with the steps taken in sourcing and manufacturing, it is distributed to all around the world. The biggest market is Europe, mainly in Italy, generating more than 40% of the total sales.



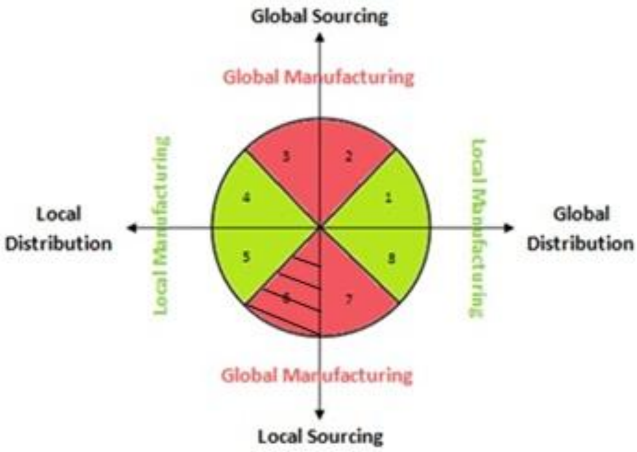
5.2.16. Carlsberg Beer

Company information

Carlsberg was founded in 1847 by the brewer J.C. Jacobsen, just outside the city ramparts of Copenhagen, Denmark. In fact, in 1883, Carlsberg's Emil Christian Hansen develops a method for propagating pure yeast, which revolutionises the brewing industry. This date is a real milestone in the brewing industry. The yeast is named Saccharomyces Carlsbergensis and given freely to the world. It was isolated in the Department of Chemistry and Department of Physiology. The concept of pH was developed there as well as advances in protein chemistry. The laboratory was part of the Carlsberg Foundation until 1972 when it was renamed the Carlsberg Research Centre and transferred to the brewery. Other important dates in the company’s history are 1906, when Ny Carlsberg and Gl. Carlsberg join forces under the name Carlsberg Breweries with Carl Jacobsen as Director, and 1939, when 55% of all beer imported to the U.K. is from Carlsberg. Another significant moment in the history of the company is represented by the merge of Carlsberg and rival Danish brewer Tuborg in 1970, to form the United Breweries A/S. Similarly, in 1992 Carlsberg merges with English brewery Tetley, and five years later Carlsberg becomes unique owner of Carlsberg-Tetley. In 2007, with Kronenbourg's acquisition, Carlsberg has completed a significant growth, which led the company to a leading position in the brewing sector. Since 2009, Carlsberg became the 4th largest brewery group in the world employing around 45,000 people.

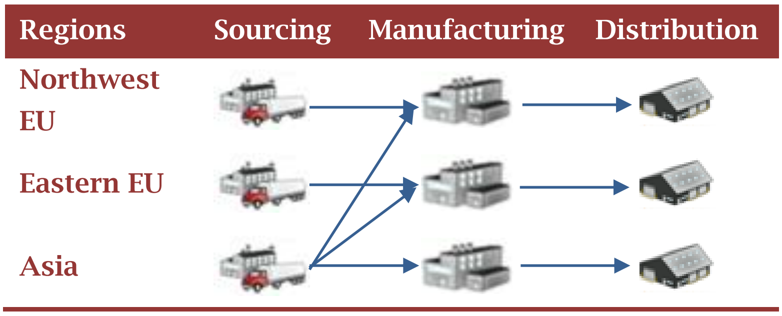
Strategic supply chain configuration in Carlsberg

In general, Carlsberg uses the local strategy for the supply chain design, indicating sourcing from local suppliers and fed to local plant in order to meet the demand of local customers. Therefore, Carlsberg's strategic supply chain configuration is Local Sourcing – Global Manufacturing – Local Distribution.



Supply chain process in Carlsberg

A brewery can produce beer if it has water, barley (a basic cereal grain), hops (flowering vine to balance sweetness of malt) and yeast (unicellular fungi). Therefore, most of brewing raw materials can be sourced directly from nature. Carlsberg, supplies those raw materials locally due to being available in all existing markets and reducing transportation cost. Only some less important raw materials, such as plugs, are sourced from Asia. The Carlsberg Group's business is completely dependent on the availability of quality barley. Malting barley is a niche cereal accounting for less than 2% of world grain production, and further water scarcity and flooding may affect future availability and quality. For these reasons, in order to secure its supply in all regions, the company gives significant importance to its investments on supply. On the basis of the developed projects, it improves yields and higher the quality of crops, benefiting both farmers and Carlsberg. Moreover, the company prefers to locate the manufacturing sites close to its customers and suppliers, as well as local distribution with mainly same reasons. Beer, as being a fast consuming good, has to follow customer demand and react quickly. In addition, the short shelf life leads the product has a fast turn over in the stores and supermarkets. Therefore, refreshment should be made very quickly that makes lead time and frequency of the supply critically important to satisfy customer. This leads being proximate to market quite important for determining distribution strategy.



5.2.17. Coca-Cola Beverage

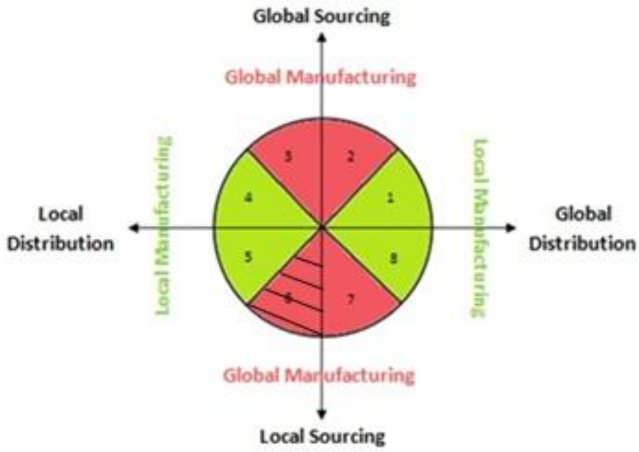
Company information

The Coca-Cola Company is an American multinational beverage corporation and manufacturer, retailer and marketer of nonalcoholic beverage concentrates and syrups, which is headquartered in Atlanta, Georgia. It is found in 1892 in Atlanta by John Pemberton, Asa Griggs Candler. The company produces concentrate, which is then sold to licensed Coca-Cola bottlers throughout the world. The bottlers, who hold territorially exclusive contracts with the company, produce finished product in cans and bottles from the concentrate in combination with filtered water and sweeteners. The bottlers then sell, distribute and merchandise Coca-Cola to retail stores and vending machines. The Coca-Cola Company also sells concentrate for soda fountains to major restaurants and food service distributors. The Coca-Cola Company has, on occasion, introduced other cola drinks under the Coke brand name. The most common of these is Diet Coke, with others including Caffeine-Free Coca-Cola, Diet

Coke Caffeine-Free, Coca-Cola Cherry, Coca-Cola Zero, Coca-Cola Vanilla, and special versions with lemon, lime or coffee. Coca-Cola has been officially available in every country in the world except Cuba and North Korea.

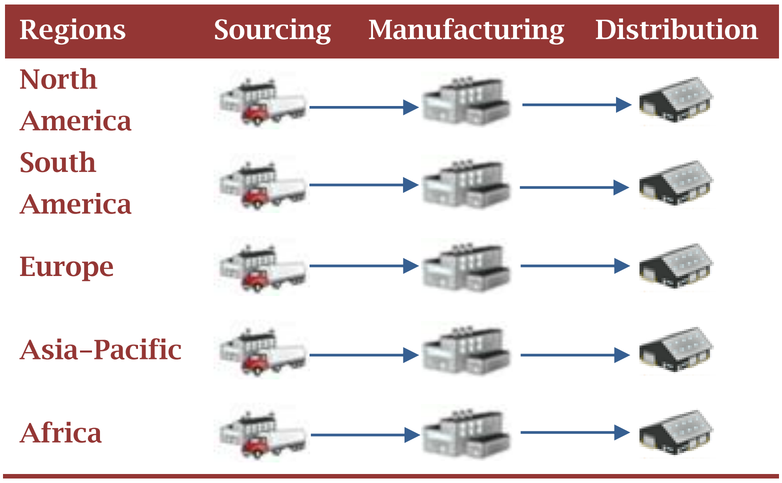
Strategic supply chain configuration in Coca–Cola

The company conducts sourcing, manufacturing and distribution independently in each region. Therefore, the strategic supply chain configuration of Coca-Cola is Local Sourcing – Global Manufacturing – Local Distribution.



Supply chain process in Coca–Cola

Coca-Cola's production is not a complicated and various ingredients required process. Main activities are to mix water, sweetener and CO_2 with Coca-Cola syrup whose recipe is kept as secret known as merchandise "7X". All of the intergradient can be found in every region easily. The company produces the concentrated syrup itself which is then sold to licensed Coca-Cola bottlers throughout the world. Among the more than 200 countries where Coca-Cola operates business in, most of them have the plants in order to provide common and specialized products. Local distribution has substantial benefits to the sales because of the dynamic nature of coke demand. It is very important to replenish shelves in the retail outlets with the maximum fill rate to be available anytime to customer. In order to achieve it, distribution should be made decentralized and thus closer to market. By this way, Coca-Cola shortens the delivery time, decrease transportation cost, bring innovations to market faster, and reduce time to send returns to suppliers.



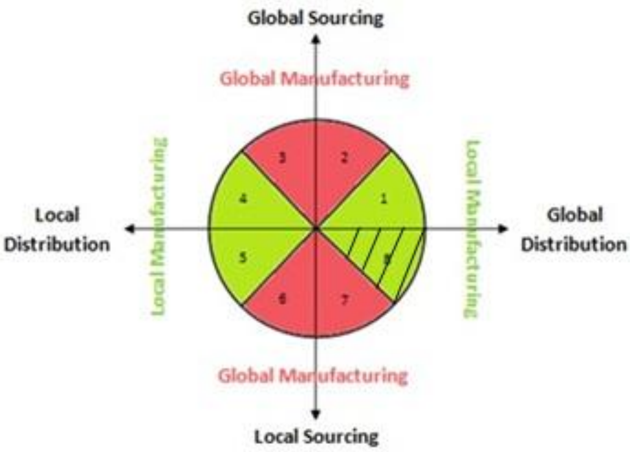
5.2.18. Absolut Vodka

Company information

Absolut Vodka is a brand of vodka, which is the third largest spirits worldwide after Bacardi and Smirnoff. It is sold nearly in 130 countries. The headquarters of the company is in Stockholm, Sweden. Since its launch in 1979, Absolut Vodka has achieved significant worldwide sales growth, from 10,000 nine-liter cases (i.e. 90,000 liters) to 11.0 million nine-liter cases in 2010 (i.e. 99.0 million of liters).

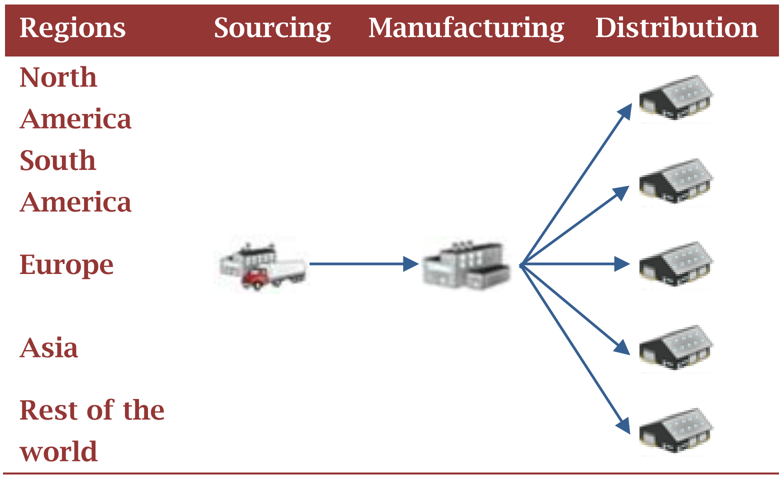
Strategic supply chain configuration in Absolut Vodka

In order to provide the premium quality products, all the raw materials are sourced from local suppliers, and manufactured in the plant in Sweden, whereas the final products are sold worldwide. Therefore, the strategic supply chain configuration of Absolut Vodka is Local Sourcing – Local Manufacturing – Global Distribution.



Supply chain process in Absolut Vodka

Sourcing is preferred to be 100% local by using the hardy wheat grains and water as the main ingredients of the very same region. Åhus provides the distillery with the raw materials to produce the millions of bottles of Absolut Vodka sold around the world because of the quality of the grains which ensures to satisfy the high quality standards of the company. Manufacturing is done in Åhus as well to represent the country Sweden and exploit its recognition with this high quality raw materials and production standards. Since each bottle is produced in one plant and this is the prior decision of company in terms of its supply chain design and it is consumed worldwide, global distribution is the only option to complete its supply chain and reach all its markets, mainly in Americas and Europe.



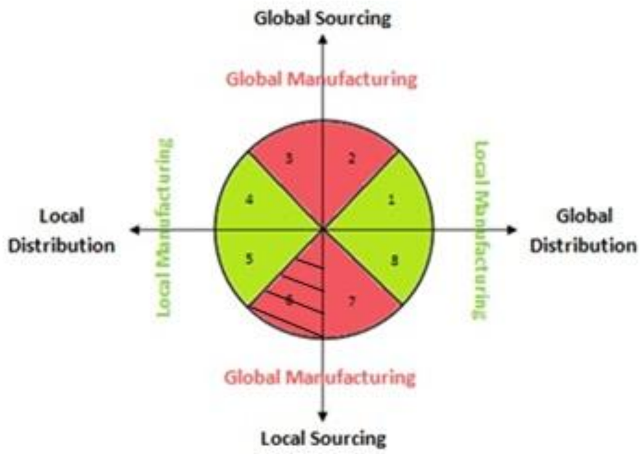
5.2.19. PepsiCo Beverage

Company information

PepsiCo, a Fortune 500, American Multinational Corporation is under the food consumer product industry and is the world leader in convenient foods and beverages. The Company makes, markets, sells and distributes a range of foods and beverages in more than 200 countries and territories. PepsiCo is organized into four business units: PepsiCo Americas Foods (PAF), which includes Frito-Lay North America (FLNA), Quaker Foods North America (QFNA) and all of its Latin American food and snack businesses (LAF); PepsiCo Americas Beverages (PAB), which includes all of its North American and Latin American beverage businesses; PepsiCo Europe, which includes all beverage, food and snack businesses in Europe, and PepsiCo Asia, Middle East and Africa (AMEA), which includes all beverage, food and snack businesses in AMEA. It manufactures and sells a range of salty, convenient, sweet and grain-based snacks, carbonated and non-carbonated beverages, dairy products and other foods. PepsiCo beverage Company (PBC) is an operating unit of PepsiCo Inc., the second largest food and beverage Company in the world. PBC was formed in 2010 when PepsiCo acquired two large bottlers, PepsiCo bottling Group and PepsiCo America Inc., and named combine PepsiCo Beverage Company.

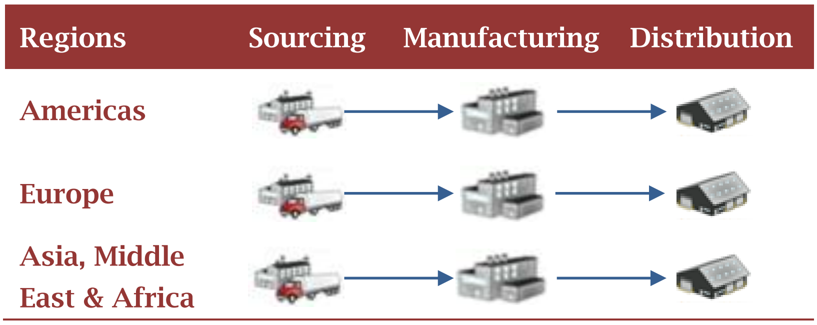
Strategic supply chain configuration in PepsiCo Beverage (PBC)

The main raw materials needed by PBC can be sourced in the local suppliers, and transformed in local plants in different regions. The final products are offered for local demand. Therefore, the supply chain configuration of PepsiCo Beverage is Local Sourcing – Global Manufacturing – Local Distribution.



Supply chain process in PepsiCo Beverage (PBC)

The raw materials used in manufacturing PepsiCo's beverage, such as fruits, sweeteners, flour, flavoring, sugar, vegetable, also included packaging material — plastic resins used for plastic beverage bottles, can be purchased from the local suppliers and provided by local plants. Production at PepsiCo plants begin with the unloading of empty bottles from the trucks via the conveyor and their being moved to the depalletizer. PepsiCo uses different distribution strategies to bring its products to market depending upon product characteristics, local trade practices, and customers' needs. It delivers products from its local manufacturing plant and warehouses to local customer warehouses and retail stores.



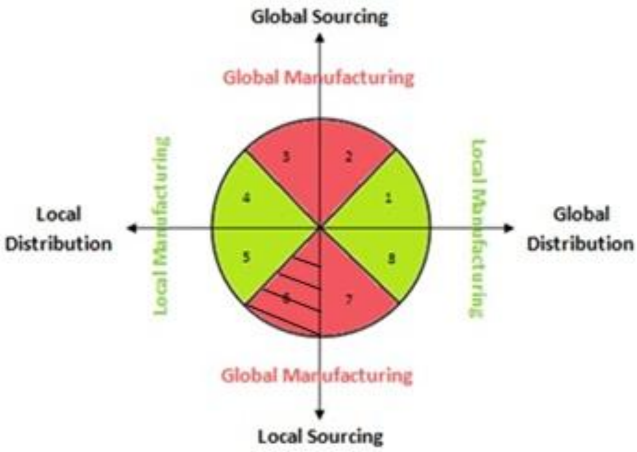
5.2.20. Heineken NV

Company information

Heineken NV is the Netherlands-based company, founded in 1864 by Gerard Adriaan Heineken in Amsterdam, and engaged in manufacturing and selling beer. It owns and manages a portfolio of beer brands. Its principal brand is Heineken. In addition, the Company has more than 170 international, regional, local and specialty beers, including Amstel, Birra Moretti, Cruzcampo, Deperados, Dos Equis, Foster's, Newcastle Brown Ale, Ochota, Primus, Sagres, Sol, Star, Tecate, Zlaty Bazant and Zywiec, among others. Additionally, it produces cider with brands such as Strongbow Gold and Bulmer's. Its operations business comprises five segments: Western Europe, Central and Eastern Europe, The Americas, Africa and the Middle East, and Asia Pacific. The Company is active through numerous subsidiaries, license agreements, affiliates and strategic partnerships and alliances, worldwide. Heineken ranks as the third largest brewer in the world after Anheuser-Busch InBev and SABMiller, based on volume.

Strategic supply chain configuration in Heineken

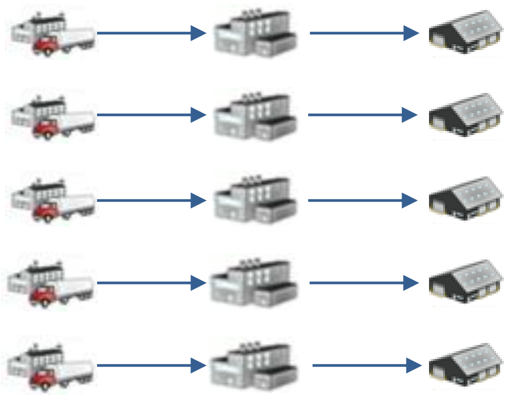
Beer is brewed from 100% natural ingredients, which can be sourced in each region of the world. Heineken purchased the raw materials with local sourcing strategy. The suppliers work together with local plants in order to fulfill the local demand. Therefore, the supply chain configuration of PepsiCo Beverage is Local Sourcing – Global Manufacturing – Local Distribution.



Supply chain process in Heineken

Heineken is running local sourcing projects linked to raw materials in many regions in order to guarantee both the supply of raw materials and the supply of local communities. Local sourcing also eliminates import duties, secures a sustainable supply of raw materials and reduces the transportation. Heineken owns over 190 breweries in more than 70 countries and employs approximately 85,000 people. Heineken organizes the company into five main territories which are then divided into regional operations. The regions are: Western Europe, Central and Eastern Europe, The Americas, Africa and the Middle East, and Asia Pacific. These territories contain 115 brewing plants in more than 65 countries, brewing local brands in addition to the Heineken brand.

Regions	Sourcing	Manufacturing	Distribution
Americas			
Western Europe			
Central and Eastern EU			
Asia – Pacific			
Africa & Middle East			



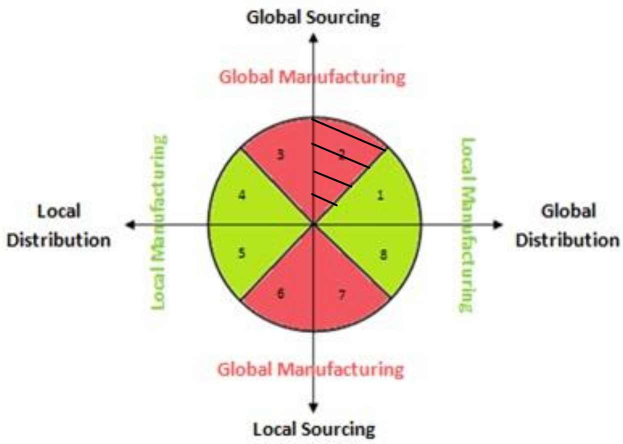
5.2.21. Chicco Toys

Company information

Chicco is an Italian baby care brand established in 1958 and it is the most important brand of Artsana, an Italian company founded in 1946. Chicco specializes in making clothing and equipment for babies and toddlers, including strollers, high chairs, car seats and toys. Chicco is a multinational company that is presented in more than 170 different countries through its offices or licensed distributors. Other than Italy, the biggest markets for Chicco products are Spain, USA, Portugal, France, Brazil, Germany, Greece, Russia and Ukraine. There are over 400 Chicco shops in the world.

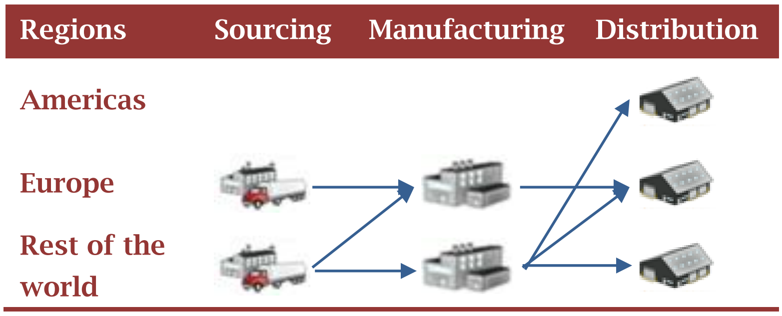
Strategic supply chain configuration in Chicco Toys

Chicco operates in a highly globalized level, and all the three main operating processes are conducted on the global base as Global Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in Chicco Toys

China provides the majority of the raw materials, components, and finished products for Chicco Toys, the total quantity accounts on 90% of the overall procurement capacity, and the remaining suppliers are located in Europe. Chicco Toys establishes 8 plants around the whole world. There are 6 manufacturing centers n China, which is linked to nearly 90% of total production of the toys. Moreover, the production in Europe is allocated to two plants in Italy and Romania. As the biggest market, 65% of the products are consumed in Europe. It's about 10% of the finished products are sold in Americas, and remaining 25% of the products are distributed to other markets.



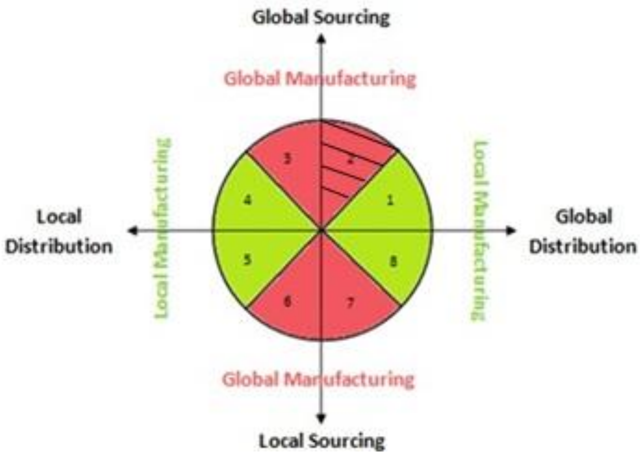
5.2.22. LEGO

Company information

The LEGO Group is a privately held company based in Billund, Denmark. The company is still owned by the Kirk Kristiansen family who founded it in 1932. The LEGO Group is engaged in the development of children's creativity through playing and learning. Based on the world-famous LEGO® brick, the company today provides toys, experiences and teaching materials for children. The LEGO Group has approximately 10,000 employees, and it is the world's third largest manufacturer of play materials. Its head office is in Billund, Denmark and LEGO products are sold in more than 130 countries.

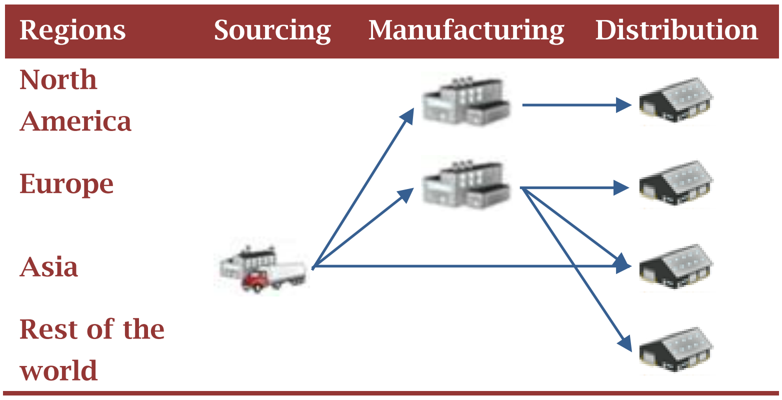
Strategic supply chain configuration in LEGO

Asian suppliers provide the raw materials or final products to the plants located in Europe and North America, and then all the products are distributed to global market. Therefore, the strategic supply chain configuration of LEGO is Global Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in LEGO

LEGO has small portion of outsourcing from Asia in order to support local consumption in that region. The main raw material of LEGO is crude oil that the company is depended on in order to produce bricks. Crude oil is sourced from Saudi Arabia which is transported to Indonesia in order to obtain plastic granules. By the entry of those plastic granules, major supply of the production is met. LEGO owns production plants in Denmark (headquarter, still most of R&D studies take place here), Czech Republic, Hungary and Mexico. Most of the demand of the world is met by the factories in Europe beside North America. That's what the plant in Mexico is dedicated for. LEGO makes its distribution to Australia, EU, Asia and European markets as it is seen in the network chart below. The dominant strategy followed can be said as to be closer to market as the main consumption is done in Europe and North America, which the deduction is also supported by the annual report of the company with the statement of "LEGO produces where it is used".



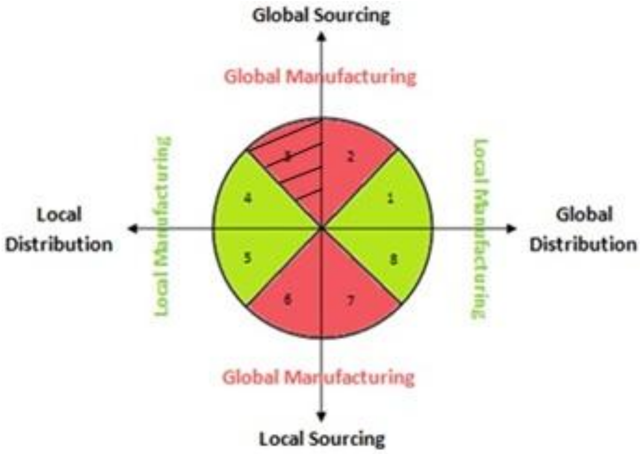
5.2.23. Colgate–Palmolive

Company information

The Colgate-Palmolive Company is an American multinational consumer products company focused on the production, distribution and provision of household, health care and personal products, such as soaps, detergents, and oral hygiene products (including toothpaste and toothbrushes). It is found in 1806 in New York City. Colgate-Palmolive has market leadership around the world, primarily operating in North America, Latin America, Europe, and Greater Asia/Africa.

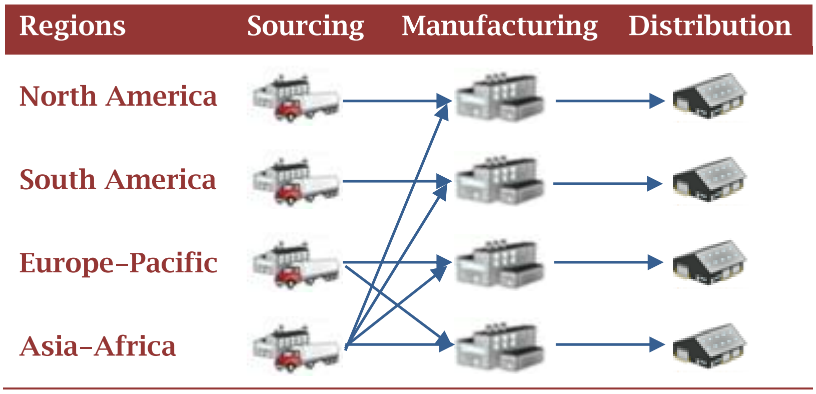
Strategic supply chain configuration in Colgate–Palmolive

Colgate-Palmolive establishes the plants in every region in order to offer the products to their local market, while the procurement is global conducted. Therefore, the strategic supply chain configuration of Colgate-Palmolive is Global Sourcing – Global Manufacturing – Local Distribution.



Supply chain process in Colgate–Palmolive

The most of the common raw materials can be sourced in the local market's region, while some items have to be procured globally. Tallow is a key ingredient in bar soap production and is derived from cattle. Colgate sources tallow from suppliers in North America, Latin America and Europe. In addition, sourcing of palm oil, which is an important ingredient for the company, is made from Malaysia, Indonesia and Thailand. In the U.S., the company operates approximately 60 plants of which 14 are owned. Overseas, the company operates approximately 280 production sites of which 80 are owned in over 70 countries. Major overseas facilities used by the Oral, Personal and Home Care segment are located in Australia, Brazil, China, Colombia, France, Guatemala, Italy, Mexico, Poland, South Africa, Thailand, Venezuela and elsewhere throughout the world. It prefers local distribution due to the fact that its demand shows high fluctuation and the product has to be on shelf when customer wants to purchase that product loyalty is low. Therefore, company wants to be close to customer in distribution stage in order to supply market frequently and increase its flexibility in order to adopt changes in customer demand.



5.2.24. GlaxoSmithKline Ltd.

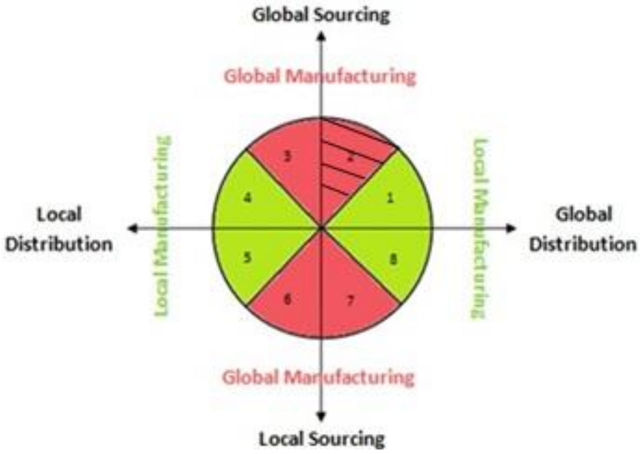
Company information

GlaxoSmithKline (GSK) is a multinational pharmaceutical company formed in 2000 through the merger of two companies (i.e. Glaxo Wellcome and SmithKline Beecham). Actually, the history of the company starts in 1715, with the establishment of Plough Court Pharmacy in London. Moving from this date, a series of progressive mergers between pharmaceutical companies and specific drug manufacturers and specialists led to the foundation of the current GSK group. Headquartered in London, GSK is nowadays one of the world's leading research-based pharmaceutical and healthcare companies, with more than 15.000 researchers operating in a number of countries all over the world. GSK is known as a research leader in asthma, virus control, infections, mental health, diabetes and digestive conditions. In addition, the company is a major player in the important area of vaccines and it is developing new treatments for cancer. GSK is one of the few pharmaceutical companies researching both medicines and vaccines for the World Health Organization's three priority diseases – HIV/AIDS, tuberculosis and malaria. Moreover, the company markets other products, many of which are among the market leaders: over-the-counter (OTC) medicines, dental products, smoking control products and nutritional healthcare drinks.

Strategic supply chain configuration in GSK

GSK purchases the intergradient from different regions in order to receive the best quality goods, and the Asian suppliers provide the purchased items both for local plants and other regions plants. The main manufacturing sites are established in

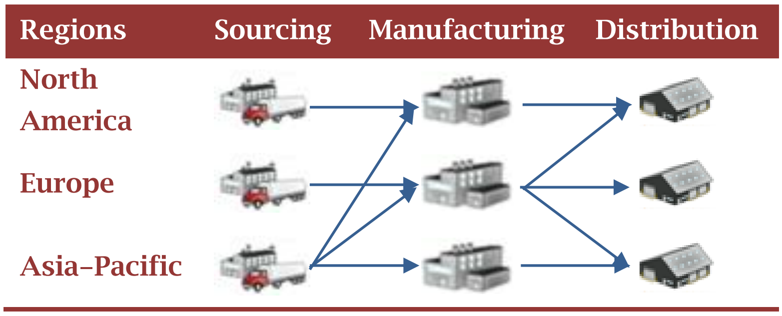
Europe, and the remaining production is carried out in Asia and North America. The products are distributed globally in order to fulfil the global demand. The strategic supply chain configuration is Global Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in GSK

It is essential for GSK to have an effective and responsibly managed supply and distribution systems to get high quality products to the right places at the right time for patients because of its critical responsibility to provide medicine. While achieving this, cost is an important factor to consider additional to the main issue of quality. In order to understand the complexity of the supply chain of the company, we believe the necessity to give the following facts: Each year GSK spend around £9 billion on goods and services with 6000 suppliers in 73 countries. The ingredients and materials purchased from suppliers are fed into their network of more than 87 GSK sites in 37 countries. Nearly 28000 products are manufactured and 4 billion packages are produced annually. This supply is sourced globally from all around the world from the suppliers conforming GSK standards on ethical conduct, anti-bribery practices, labor and human rights protection, and environmental, health and safety management. Moreover, although global sourcing takes an important place in China, it is also supports and works on sourcing from local suppliers which helps to comply with the regulations in the markets which is highly diversified from country to country. Europe is the main region for manufacturing, the relevance of Asian production sites is poor, and they supply the Asian local areas only. Similarly, the

American sites serve the American market only. What is more, the manufacturing sites are divided into prescription products sites and consumer products sites, more plants are designed for the former products.GSK's single largest market is in the United States, which generates approximately 45% of its revenues, although the company sells its products in around 100 countries.



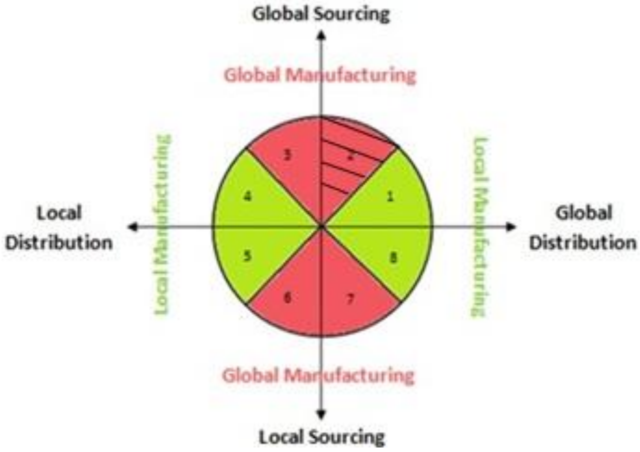
5.2.25. Astra Zeneca

Company information

AstraZeneca was formed on 6 April 1999 through the merger of the Swedish pharmaceutical company Astra and the English Zeneca PLC Group, two companies with similar science-based cultures and a shared vision of the pharmaceutical industry. Astra was founded in 1913 and headquartered in Södertälje, Sweden. It was an international pharmaceutical group engaged in the research, development, manufacture and marketing of pharmaceutical products, primarily for four main product groups: gastrointestinal, cardiovascular, respiratory and pain control. Some research effort was also aimed at the central nervous system. Headquartered in London, Zeneca was a major international bioscience group engaged in the research, development, manufacture and marketing of pharmaceuticals (focusing on cancer, cardiovascular, central nervous system, respiratory and anaesthesia), agricultural chemicals and specialty chemicals, and the provision of disease-specific healthcare services. Its businesses were research and technology intensive, with extensive international development and marketing skills, and a strong common science base. The merger aimed at improving the combined companies' ability to deliver long term growth and enduring shareholder value through a global power and reach in sales and marketing, a stronger R&D platform for innovation-led growth and a greater financial strategic flexibility. Nowadays AstraZeneca is one of the world's leading pharmaceutical companies, with a broad range of medicines designed to fight diseases in important areas of healthcare (cardiovascular, oncology, gastrointestinal, neuroscience, infection, respiratory and inflammation diseases). Active in over 100 countries with growing presence in relevant emerging markets, the company has its corporate office in London and the major R&D sites in Sweden, UK and US. AstraZeneca has over 67,000 employees.

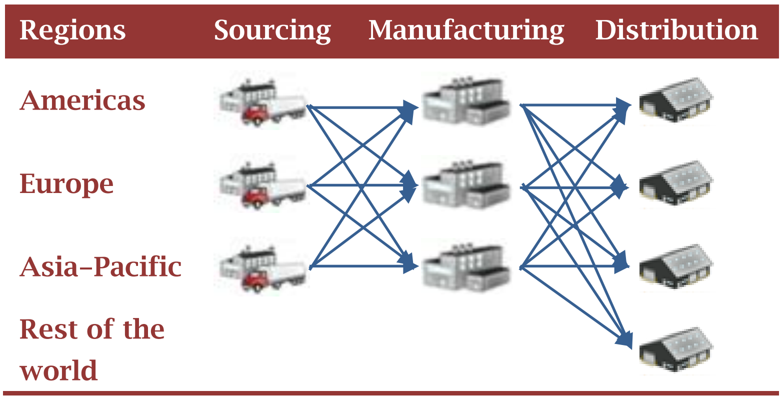
Strategic supply chain configuration in AstraZeneca

AstraZeneca adopts purely global strategic supply chain configuration organized as Global Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in AstraZeneca

As AstraZeneca operates in an industry where quality and availability is critical, it places particular importance to have an uninterrupted, complete and fast supply chain meanwhile assuring low level of inventory and low prices of raw material. Analyzing the network, it is observed that it makes global supply due to innumerous variety of supplied materials, that each of them can be found and acquired with desired price and quality in different region of the world. Moreover, having uninterrupted supply is crucial for this sector which is the basic reason for the company to make dual or multi sourcing of key raw materials from different regions to maintain appropriate stock levels in any occasion. In particular, almost half of the required raw materials are sourced from European suppliers, and the remaining parts are provided from Asia and Americas. Through the transformation of raw materials to finished products, the final medicine is distributed globally. The biggest market is in Northern & Southern America, despite the company's headquarter is located in Europe, and the main production sites are established in European countries as well.



5.3. Case study on Electronics industry

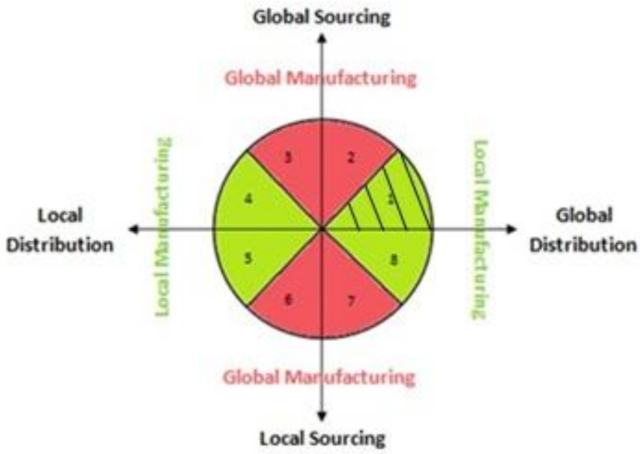
5.3.1. Hewlett-Packard Europe

Company information

Hewlett Packard is a multinational company founded in 1939 in Palo Alto, California (USA) and nowadays it is still headquartered in the same location. Originally HP started its activity as a manufacturer of electronic products, such as audio oscillators, becoming a market leader worldwide. Moving from the electronic sector, the company soon developed its business towards the computer industry, obtaining a significant success thanks to a series of innovative hardware solutions. HP bases its success on a business strategy centred on the concepts of technological leadership for Personal System products, Imaging and Printing devices and Technology solutions. Moreover, HP is oriented towards a strong global citizenship for a constant growth aimed at supporting customers in their activities. Nowadays, HP serves more than 1 billion customers in more than 170 countries on six continents.

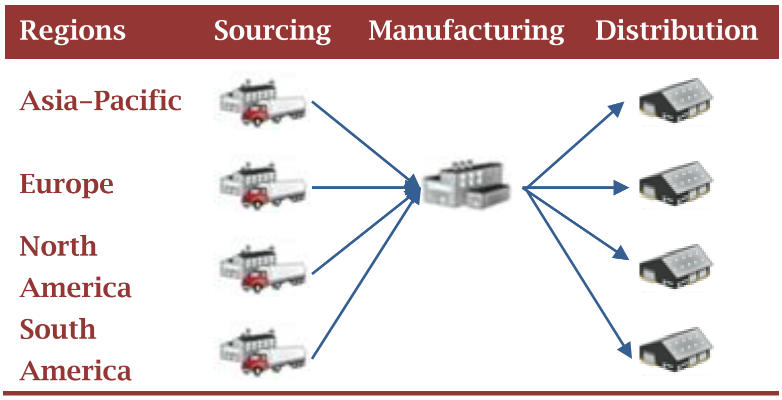
Strategic supply chain configuration in HP Europe

In Europe, HP adopts hybrid supply chain configuration as Global Sourcing – Local Manufacturing – Global Distribution. The suppliers ship directly spare parts to HP's European plants. Then the finished products are delivered from Central WH (i.e. a single CW in the Netherlands) to customers around the world.



Supply chain process in HP Europe

The plants of HP in Europe purchase and distribute globally. Electronic products contain numerous components that are purchased from different regions. It's a better choice for some components to source from Asia that can be brought in big amounts, but the others are a better choice to supply from Europe in order to meet technological requirements and shorten the lead time.



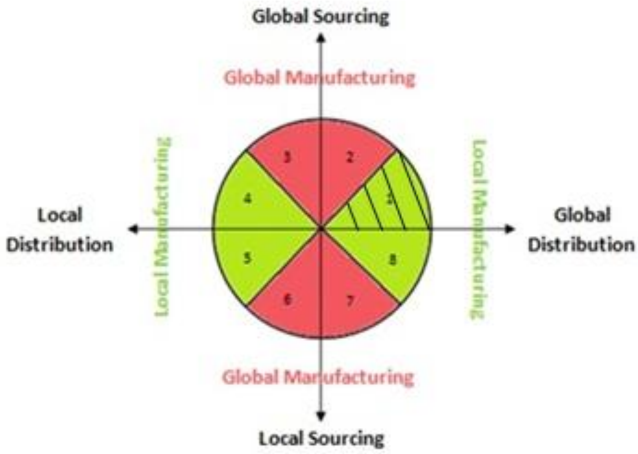
5.3.2. Apple Inc. Hardware

Company information

Apple Inc., formerly Apple Computer Inc., is an American multinational corporation headquartered in Cupertino, California that designs, develops, and sells consumer electronics, computer software and personal computers. The best-known hardware products of Apple Inc. are the Mac line of computers, the iPod music player, the iPhone Smartphone, and the iPad tablet computer. The company was founded on April 1, 1976. Apple is the world's second-largest information technology company by revenue after Samsung Electronics. Apple maintains 408 retail stores in fourteen countries as well as the online Apple Store and iTunes Store.

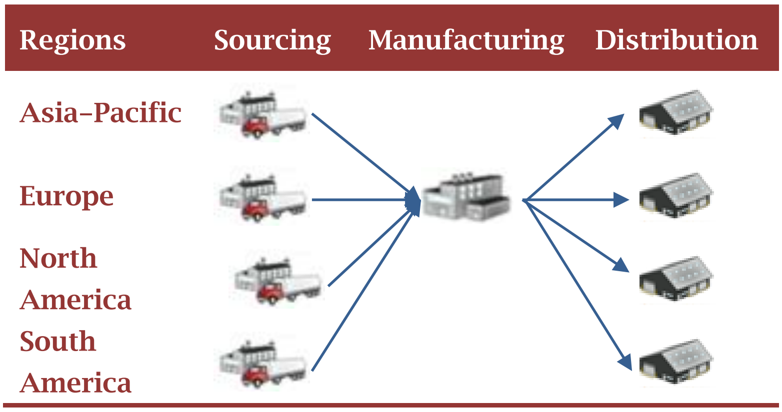
Strategic supply chain configuration in Apple Hardware

The hardware products of Apple Inc. are assembled from various components. The components and sub-assemblies are purchased from different regions, but the final assembly plants are mainly located in China, Asia, then the finished products are distributed to different countries. Therefore, the strategic supply chain configuration of Apple Hardware is Global Sourcing – Local Manufacturing – Global Distribution.



Supply chain process in Apple Hardware

When the supply chain is analyzed, it is obvious to see that the quality is the priority factor rather than the cost on the procurement process, because all the main electronic components are sourced from Japan, Korea, Germany, UK, USA and Taiwan. Those countries and district have the technology advantage on the electronic items, but with high price. However, the cost is decreased from manufacturing side by carrying out production activities in Asia that benefiting from cheap labor and exchange rate. Considering distribution, although the value of item is not so low which in fact influences configuration choice shorter distribution network, Apple chose centralized production as size of orders are enough to meet from one region to world, by being able to fill transportation mode.



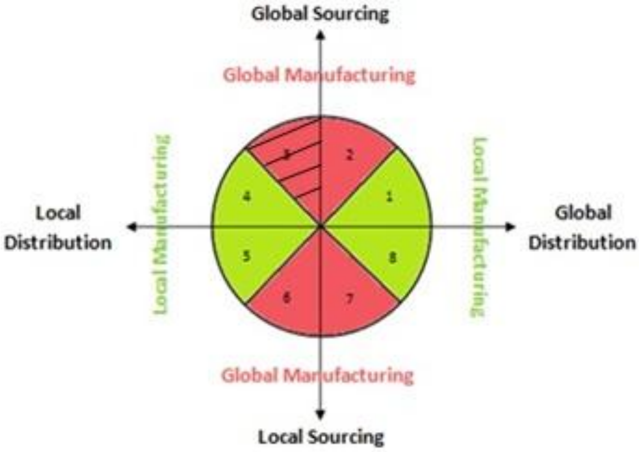
5.3.3. Dell Inc. Hardware

Company information

Dell Inc., is an American multinational computer technology corporation based in Round Rock, Texas, United States, provides a range of technology solutions worldwide. The company offers client computing devices, including desktop personal computers, notebooks, and tablets; rack, blade, tower, and hyper-scale servers for enterprise customers and value tower servers for small organizations, networks, and remote offices; networking solutions; and storage solutions, including storage area networks, network-attached storage, direct-attached storage, and backup systems. It also sells peripherals, including monitors, printers, projectors, and other client and enterprise peripherals, as well as third-party software products. In addition, the company offers support and extended warranty services, enterprise installation services, and configuration services; and infrastructure and security managed services, cloud computing and infrastructure consulting services, and security consulting and threat intelligence services. Further, it provides applications services, such as application development and maintenance, application migration and management, package implementation, testing and quality assurance functions, business intelligence and data warehouse solutions, and application consulting services; business process services comprising back office administration, call center management, and other technical and administration services; and system management, security software, and information management services. Additionally, the company offers financial services, including originating, collecting, and servicing customer receivables primarily related to the purchase of its products. It serves corporate businesses; educational institutions, government, health care, and law enforcement agencies; small and medium-sized businesses; and consumers directly, as well as through retailers, third-party solution providers, system integrators, and third-party resellers. Bearing the name of its founder, Michael Dell, the company is one of the largest technological corporations in the world, employing more than 103,300 people worldwide.

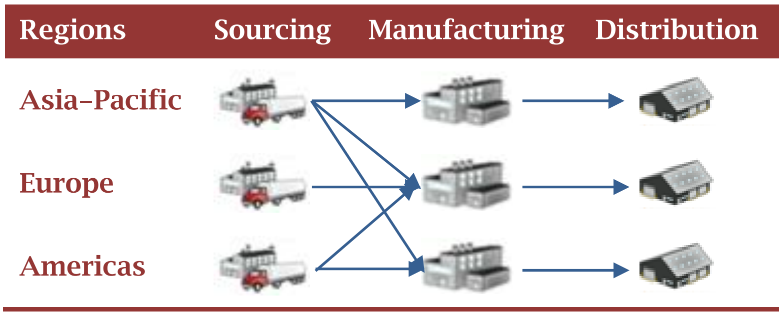
Strategic supply chain configuration in Dell

Compared to the competitors, Dell has a different business model which can be identified as "direct model". It is an approach to sell computers to the consumer through direct distribution by eliminating wholesalers. Therefore, Dell establishes the plants close to the market in order to deliver the products to the customers within the minimum lead time and decrease the distribution costs. The strategic supply chain configuration of Dell is Global Sourcing – Global Manufacturing – Local Distribution.



Supply chain process in Dell

Most sourcing of Dell is global, which means that Dell sources major components for all locations from their headquarters. This allows Dell to consolidate its buying power and get better terms from suppliers. While sourcing of materials for PCs is done centrally, sourcing of consumables is local. The majority of sourcing is from low cost suppliers in Asia, but some sourcing is from local producers. Dell coordinates a global production network that spans the Americas, Europe and Asia. The manufacturing of printed circuit board assemblies, subassemblies, and some final products is handled by contract manufacturers or original design manufacturers. Each region has its own regional headquarters and its own assembly plants and supply network. The main production sites are located in United States, Brazil, China, Malaysia, and Ireland. The "direct distribution" is the main feature of Dell's business model. The final products are distributed to customers direct from the regional plants.



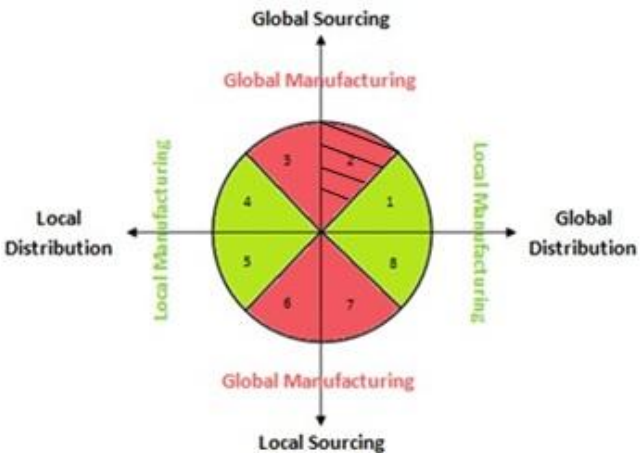
5.3.4. Nokia Mobile

Company information

Nokia Corporation is a Finnish multinational communications and information technology corporation that is headquartered in Espoo, Finland. The principal products of Nokia Mobile are mobile telephones and portable IT devices. Nokia Corporation also offers Internet services including applications, games, music, media and messaging, and free-of-charge digital map information and navigation services through its wholly owned subsidiary Navteq. Nokia owns a company named Nokia Solutions and Networks, which provides telecommunications network equipment and services. Nokia was the world's largest vendor of mobile phones from 1998 to 2012. Nokia employs 101,982 people across 120 countries, conducts sales in more than 150 countries, and reports annual revenues of around €30 billion.

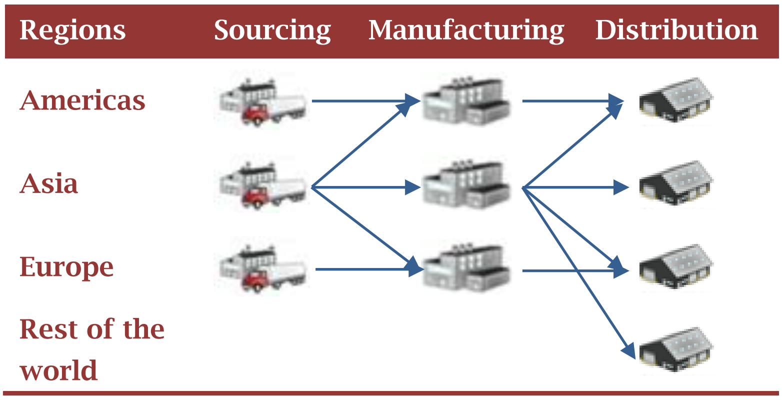
Strategic supply chain configuration in Nokia Mobile

Nokia Mobile adopts hybrid global strategic supply chain configuration indicating Global Sourcing – Global Manufacturing – Global Distribution, while the most of the sourcing are from Asia, and more plants are located in Asian countries that distribute the final products to global market.



Supply chain process in Nokia Mobile

Nokia has employees in 120 countries, sales in more than 150 countries, and establishes the plants in Europe, Asia, and South America. Although there are some local supplies for each facility, the main sourcing is done from Asian countries as well as manufacturing. By this strategy, Nokia is enjoying both low labor and material costs and distributes its products mainly from this region. Nokia operates a total of 7 manufacturing facilities in 6 countries located at Manaus, Brazil; Beijing and Dongguan, China; Komárom, Hungary; Chennai, India; Reynosa, Mexico; and Changwon, South Korea. Nokia's industrial design department is headquartered in Soho in London, UK with significant satellite offices in Helsinki, Finland and Calabasas, California in the US. So far, the biggest market is Asia, which occupies 40% of the total sales, followed by Europe that takes 31% of the total sales.



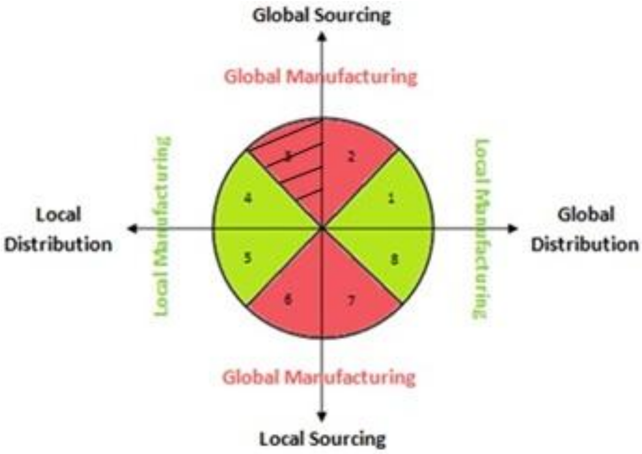
5.3.5. Candy Washing

Company information

Candy's business activities in the electrical appliances sector started in 1945, due to the invention of the first home washing machine. As an Italian family company, the initial organization structure is easy and clear, Eden Fumagalli, the father of this family, and his three sons are the main founders, and they have different experience in mechanics and management fields. Since the very beginning, Candy washing machines are designed to meet the needs of the Italian families, where the demands for reducing the housekeeping labor and the need for comfort are growing. In 1950, Candy moved to a new factory located in Monza and launched the Bi-Matic, the first semi-automatic washing machine Italian. At the end of the fifties, the first fully automatic washing machine designed and built in Italy. In 1961, Candy moved to new headquarters in Brugherio that joins research and development laboratories, factory, warehouse spare parts. In 1970, Candy widened the range of appliances with the acquisition of the Sovereign of Sorbolo (Parma), the famous brand in cooking. In the eighties, Candy acquired Zerowatt, a manufacturer of washing machines and dryers. In 1995, Candy acquired Hoover European Appliances Group that is a European leader in the floor-care, i.e. care products and cleaning floors. The Candy Group has built a portfolio of prestigious brands, including two international brands, Candy and Hoover, and with national brands Rosières, Hibernate, Otsein, Vyatka, Zerowatt, Jinling, Hoover-Helkama, Hoover-Grepa, Süsler. Today, Candy plays a leading role in the international arena depending on long and comprehensive experience in the appliance industry.

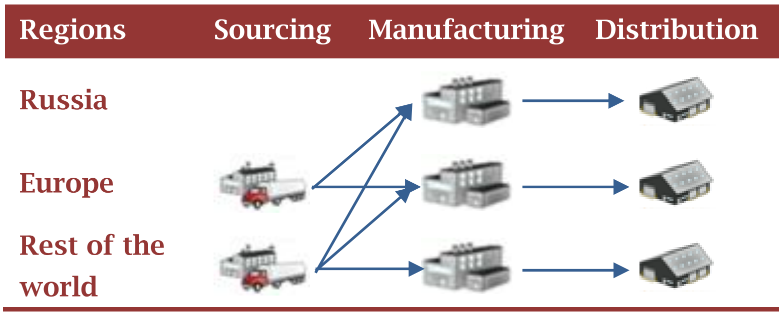
Strategic supply chain configuration in Candy Washing

Candy Washing is using the hybrid supply chain strategy, Global Souring-Global Manufacturing-Local Distribution, which can be presented as the following figure.



Supply chain process in Candy Washing

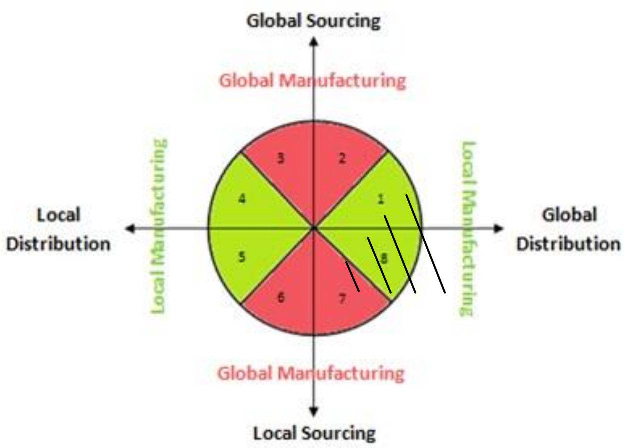
Material sourcing in Candy washing appliances is made globally. The purchased items of Candy Washing can be divided into two classes. The items in the first class are finished products purchased from the particular suppliers. On the other side, the second class represents the raw materials and components. Generally, the 80% of the purchased items whatever the finished goods or raw materials and components stems from Turkey and China, whereas the remaining 20% volume is bought from the European suppliers. Candy Washing provides front loading and top loading washing machine, washer, dryer, front loading and top loading dishwasher. The four product lines are produced in 6 plants, which are located in Italy, Spain, Russia, Turkey and China. According to the production capacity allocation, 72% of the finished products are assembled in Europe (Italy, Spain, Turkey, and Russia), and 28% of them are produced in overseas plant (China). As market it serves all around the world. In Europe, it mainly serves to Italy, France and UK (50%), in Western Europe its main market is Russia (3.5%) and for the rest of the world, crucial markets for Candy are China, Turkey, Morocco, Iran, South Mediterranean countries, India and Argentina (16%). It can be deducted that the drivers that affect the supply chain strategy and configuration of Candy washing are mainly availability and quality of labor force, proximity to the suppliers and served markets. The Supply chain process from suppliers to the customers are represented as the below chart.



5.3.6. Candy Cooling

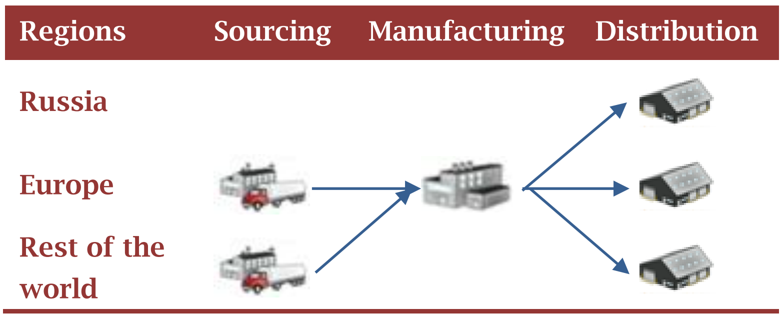
Strategic supply chain configuration in Candy Cooling

Candy Cooling is using another type hybrid supply chain strategy, Global Souring-Local Manufacturing-Global distribution, which can be summarized as the following figure.



Supply chain process in Candy Cooling

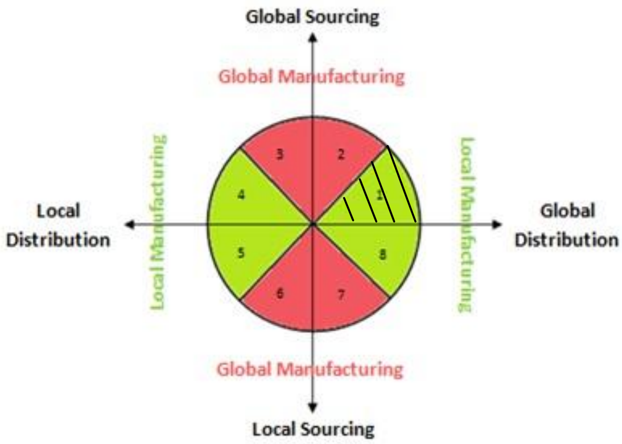
Candy Cooling has the same sourcing strategy as Candy Washing, the 80% of the purchased items main products of Candy Cooling are refrigerators, wine cellars, upright freezers, and chest freezers, etc. The eight product lines are produced only in one plant in Czech Republic, and distributed to different markets, including Europe, North Africa, Asia and South America.



5.3.7. Candy Cooking

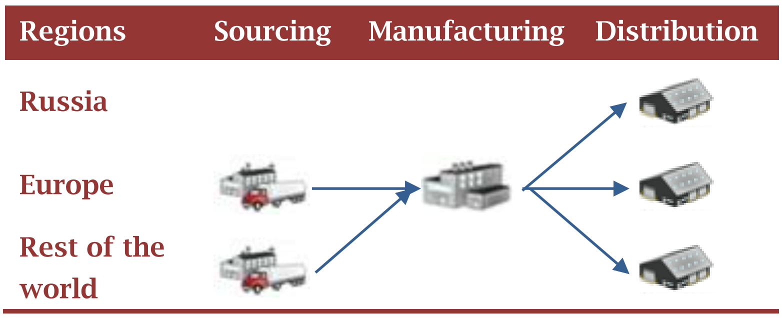
Strategic supply chain configuration in Candy Cooking

Candy Cooking is using the same hybrid supply chain strategy as Candy Cooling, Global Souring-Local Manufacturing-Global distribution, which can be summarized as the following figure.



Supply chain process in Candy Cooking

As the same as the sourcing strategy of Candy Washing and Candy Cooling, Candy Cooking purchases the 80% of the raw materials, components, and finished products stemming from Turkey and China, and the 20% remaining volume from the European suppliers. The main products of Candy Cooking are the ovens and furnaces with different energy power (i.e. electric or gas). The eight products lines are produced in two plants, one in France and another bigger one in Turkey. What is more, as the dominant plant in Turkey, it takes on over 70% of the total production capacity. All the products are distributed from the plants located in Europe to different markets, including Europe, North Africa, Asia and South America.



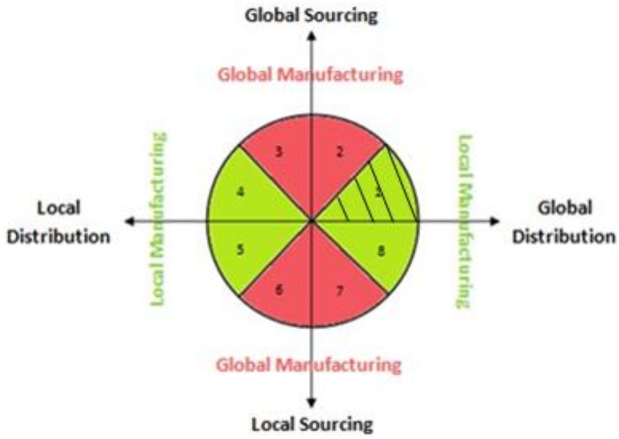
5.3.8. Whirlpool Europe

Company information

Whirlpool was founded in St. Joseph, Michigan (US), in 1911 as Upton Machine Corporation, as a manufacturer of electrical washing machines. In 1929 the company merged with Nineteen Hundred Washer Co, another manufacturer operating in the same industry. In the following years, the company expanded in the American market, increasing the range of manufactured products, towards a wider range of home appliances, and in 1950 developed into Whirlpool Corporation. In the following decades, the company expanded in the European market by means of a joint venture with Philips (1989): in 1991 Whirlpool became the exclusive owner. Nowadays, after the acquisition of several brands in the home appliance sector (Bauknecht, Kitchen Aid, Brastemp), Whirlpool consolidates 32 markets worldwide in a single industrial group. The product range includes cooking appliances, refrigerators, dishwashers, washing machines and dryers. Nowadays, the high innovation rate of the products brings the company to deal with high percentages of electronic components. With the local subsidiaries, Whirlpool is able to serve a worldwide market being present in 170 countries and providing appliances to more than 200 million households. The company organises its worldwide coverage by clustering the local markets in geographical regions, namely Americas (i.e. US + Canada, Central America, South America), Europe (i.e. all the continent and part of Africa), and Asia Pacific.

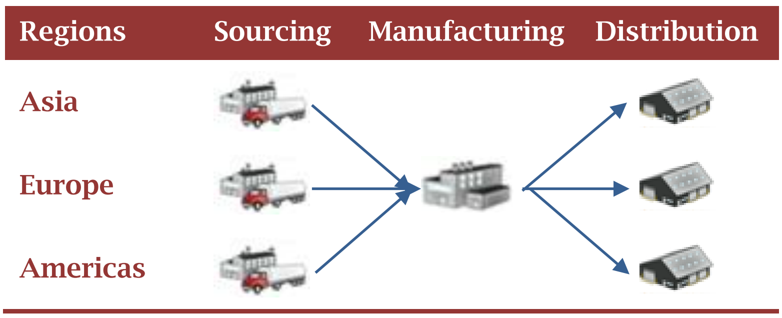
Strategic supply chain configuration in Whirlpool Europe

Plants in Europe source globally and distribute its products to Europe, Asia and America markets but basically Europe and Asia. It can be interpreted as balance is tried to be set by enjoying lower cost options in Asia and staying closer to its suppliers which gives a higher control in Europe. Therefore, the strategic supply chain configuration of Whirlpool Europe is Global Sourcing – Local Manufacturing – Global Distribution.



Supply chain process in Whirlpool Europe

White good products contain numerous components. Therefore, it's a better choice for some components to source from Asia that can be brought in big amounts (55%), but the others are supplied from Europe (44%) in order to meet technological requirements and shorten the lead time. In order to offer the appliance to customer within 48 hours, besides applying improvement efforts in inventory management, critical components are procured from close. Delayed sourcing of components would cause delays in the production of a new refrigerator, and thus, a later launch of new products. Within the home-appliance industry, the fierce level of competition meant that any delays in launching new products would result in a loss of sales for the stragglers. The European market is the main target for Whirlpool Europe, while it does not mean that is the exclusive market. Whirlpool Europe also provides finished products to Asia and Americas even if the sales on those regions are not high.



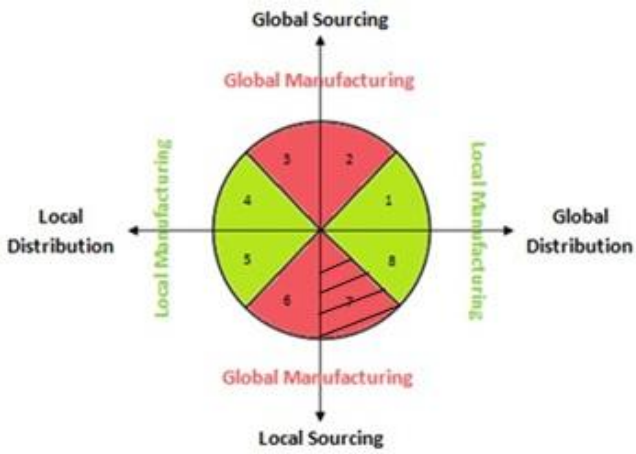
5.3.9. Indesit Company

Company information

Indesit Company is an Italian multinational company based in Fabriano, Ancona province, Italy, and is one of the European leading manufacturers and distributors of major domestic appliances (washing machines, dryers, dishwashers, fridges, freezers, cookers, hoods, ovens and hobs). It is the undisputed leader in major markets such as Italy, the UK and Russia. Founded in 1975 and listed on the Milan stock exchange since 1987, the Group posted sales of €2.9 billion in 2012. Indesit Company has 8 industrial areas (in Italy, Poland, the UK, Russia and Turkey) and 16,000 employees. The Group's main brands are Indesit, Hotpoint and Scholtès.

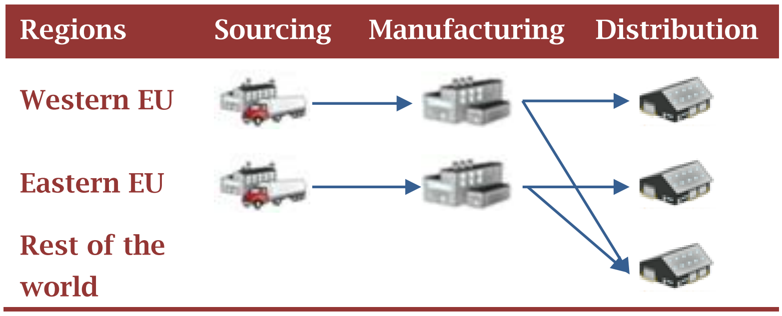
Strategic supply chain configuration in Indesit

The main market of Indesit is in Europe, thus, the company purchases the raw materials and components from local suppliers, and distributes the final products to different countries, including the market outside Europe. Therefore, the strategic supply chain configuration of Indesit is Local Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in Indesit

Indesit Company has 16 production facilities, 8 in Italy (Fabriano – Albacina and Melano-, Brembate, Carinaro, Comunanza, None, Refrontolo and Teverola), and 8 abroad (Poland, the UK, Russia, Turkey). All the products are produced in those plants and distributed to Europe and overseas market. Indesit has its major demand in Europe with 95%, more detail, 60% in Western Europe and 35% in Eastern Europe, and 5% in other regions. Therefore, it produces close to its market which leads to decrease its leading time and have a better delivery performance.



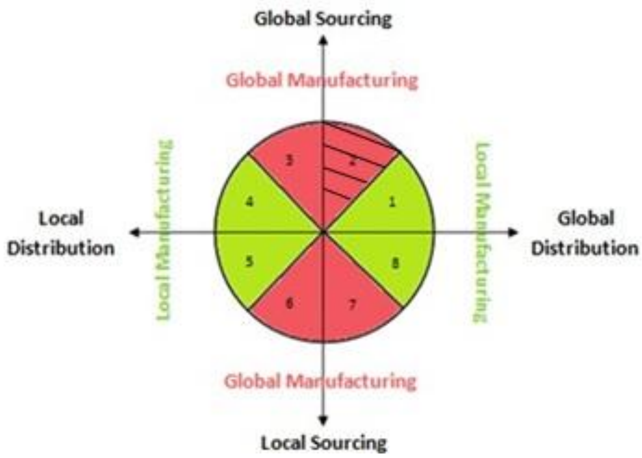
5.3.10. Black & Decker

Company information

Black & Decker is a global manufacturer and marketer of power tools and accessories, hardware and home improvement products, and technology based fastening systems. Black & Decker Corporation was founded in 1910 by S. Duncan Black and Alonzo G. Decker as a small machine shop in Baltimore, Maryland. Nowadays, the company is based in Towson (Maryland) and it is present in more than 170 countries in almost all the continents (only Africa is not included), with manufacturing operations in 11 countries. The company manages its worldwide organisation by means of headquarters located in four regions, corresponding to the EMEA area, North America, Latin America and Asia Pacific – Australia. Throughout B&D's businesses, the company has established a reputation for product innovation, quality, end-user focus, design, and value.

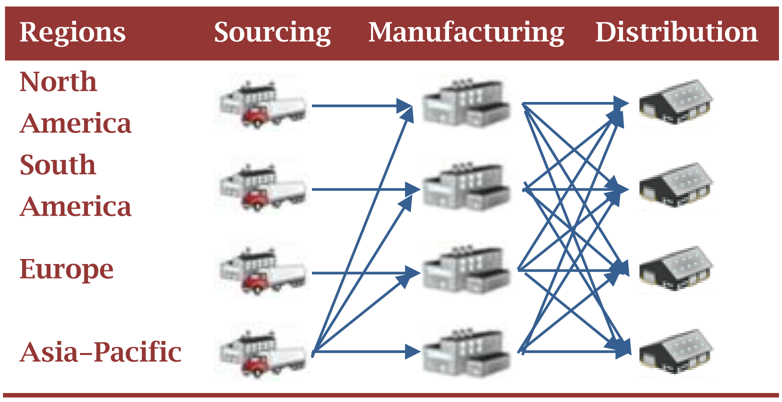
Strategic supply chain configuration in Black & Decker

Black & Decker has a highly global strategic supply chain configuration structured as Global Sourcing – Global Manufacturing – Global Distribution. The plants in different regions receive the raw materials and components from both local suppliers and overseas suppliers, and distribute the products to the customers around the world.



Supply chain process in Black & Decker

Black & Decker operates all over the world. It occupies a mixed sourcing strategy that most of the supplies are coming from Asia-Pacific countries which gives cost advantage to the company meanwhile some sourcing is done locally that gives transportation time saving for some materials. In production and distribution stages, Black & Decker establishes the plants in different continents in order to operate the manufacturing activities close to the local suppliers. The Hub & Spoke model is adopted for the transportation of the raw materials, components and finished products. From ports, parts and components are shipped to plants, while finished products are directed to the regional Distribution Centres, acting as Central Warehouses (3 in North America and one in Europe, in Belgium). Plants can ship directly to customers, in case of large orders, or they can serve local customers warehouses, depending on the demand and on the specific supplied products. Otherwise, customers are replenished by regional Distribution Centres. As the largest market, North America occupies almost 65% of the total sales, followed by Europe whose share is 24%.



5.4. Case study on Luxury industry

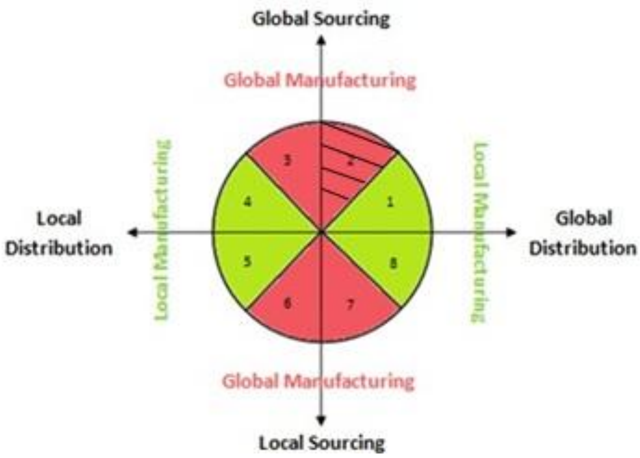
5.4.1. Mantero

Company information

The company is founded in Como, in 1902, by Riccardo Mantero. Mantero operates in luxury and fashion industry serving to the international customer portfolio. Its operating structure is divided into two main areas: Womenswear Division and Menswear Division. The products include jacquards, prints and accessories. Its licensed brands are distributed through its own-name branches abroad as well as through a widespread network of agents and distributors. To guarantee the excellence of the finished product, Mantero directly controls each stage of the manufacturing process and has an important unit dedicated to quality control which takes place during each and every stage of the production process. A logistics hub and computerized warehouse have been developed to better manage and fulfill individual customer requirements.

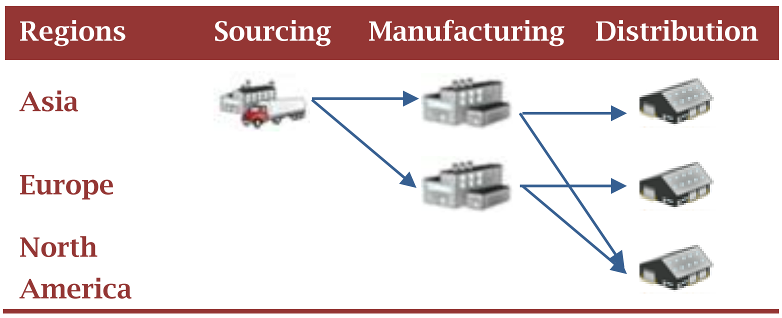
Strategic supply chain configuration in Mantero

In a global context, Mantero has a structure internationalized with commercial offices and brokerage in France, America and China. The Headquarter - Mantero Seta - is located in Italy whose main activities consist of product design, marketing and communications, manufacturing and logistics, and finally the organization and services. The suppliers are all located in the Asian region, production is established in Italy and China, and the distribution is global. Therefore, the strategic supply chain configuration of Mantero is Global Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in Mantero

All the raw materials and semi-finished products are sourced from China, since it provides the best qualified materials. We can make a deduction of company's priority is to source cheap. Therefore, it sources its supplies from Far East in order to benefit from mainly exchange rate and supplier competition. In manufacturing side, different drivers dominate with accomplishing the aim of high quality products and being more flexible. All the finished products are produced in the plants in Italy and China after the shipment of the raw materials and components from Far East. The plant in Como, Italy offers at least 70% of the total production that transport to local market and American market. The remaining 30% production is provided from south China, and distributed to Asian countries and North America. As the main market, European countries consume 77% of the products, and second largest market is North America, which contributes 17% of sales.



5.4.2. Patrizia Pepe

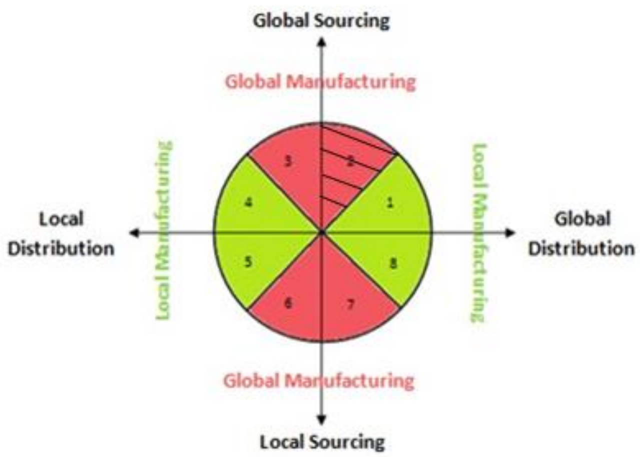
Company information

Patrizia Pepe brand was set up as an entrepreneurial initiative in Florence in 1993, by

Patrizia Bambi, the creative and stylistic spirit, and Claudio Orrea, head of management and administration, within another of their creations, the Tessilform textile manufacturing company. From the start they achieved recognition as being among the world's best modern fashion designers with clothing stores to match. The firm is best known for its women's clothes, accessories and shoes. Patrizia Pepe launched her first men's collection in Spring-Summer 2005, and the Junior Girls' line in Spring-Summer 2007. Starting from Fall-Winter 2008-09 Patrizia Pepe also had a lingerie, home-wear and beachwear collection. Patrizia Pepe has achieved a stable market position mainly thanks to its original designs, high-quality clothing and flamboyant marketing. The company is constantly developing its internationalization program. Already present in France, Germany, Scandinavia, Benelux, England, Russia, China and Japan, the company has set foot in the Persian Gulf, Greece, Turkey, Spain, Poland, Morocco, Ukraine, Cyprus and Azerbaijan.

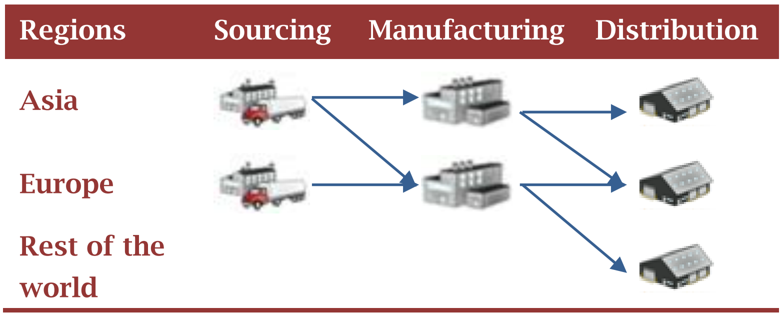
Strategic supply chain configuration in Patrizia Pepe

“Internationalization” is the symbol of the strategic supply chain configuration in Patrizia Pepe, the main suppliers are in Far East where provides the raw materials to the plants in China and in Europe. Therefore, the strategic supply chain configuration of Patrizia Pepe is Global Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in Patrizia Pepe

The cost of the raw material is crucial, therefore, it sources 85% of raw materials from China and send to the plants located both in Far East and Europe. Sourcing from Far East provides company to take the advantage of exchange rate and high supplier competition. About the production part, the company has the strategy of manufacturing both in Far East and Europe in order to be closer to the served markets, to be flexible and to decrease the lead time. Moreover, ensuring the high quality is another reason lying behind the manufacturing side. The Florentine company has its own production and is supplied entirely by Italian manufacturers. Patrizia Pepe has a good percentage of sales in the Asian market, while the production of Italian suppliers is not sufficient to support the growth of this market. Therefore, the company set up the plant in China in order to fulfill the demand of Asian market. About 40% of its turnover is gained from the foreign market. The choice of the distribution differentiates the company from its competitors. The clothing lines are distributed through showrooms where the retailer can go to buy the clothes. As for the sales, the marketing of products Patrizia Pepe has to be considered on a global scale, 35% of the market served is Italian, and 25% is related to Asia.



5.4.3. Ermenegildo Zegna S.p.A.

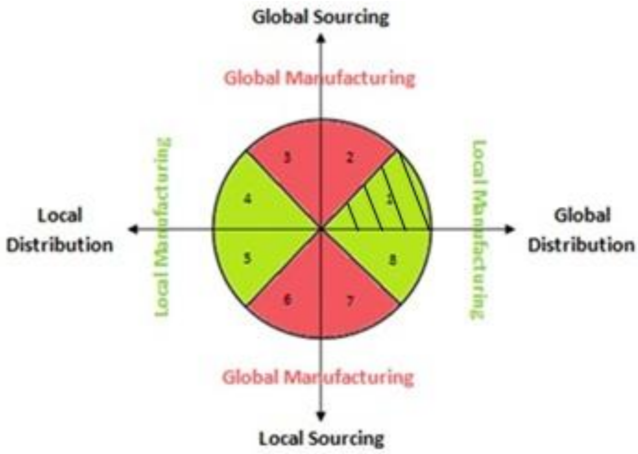
Company information

Ermenegildo Zegna is the world's leading luxury men's suit maker which is found in 1910. Based in the mountain village of Trivero, Italy, near the Swiss border, Zegna is a vertically integrated business, producing more than two million meters of fabric, more than 350,000 finished suits, and another two million shirts, ties, sportswear, and accessories per year. Zegna develops its own fabrics from the world's finest wools--although the company does not itself own sheep herds, it works closely with breeders and farmers in Australia, South Africa, and Mongolia to ensure its supply of top-grade cashmere, mohair, and merino wool. This commitment to top quality enables the company to produce fabrics from threads as fine as just 11 microns.

Zegna is present in more than 380 shops throughout the world, of which 135 are full-scale retail stores owned by the company, while the others operate as boutiques within department stores.

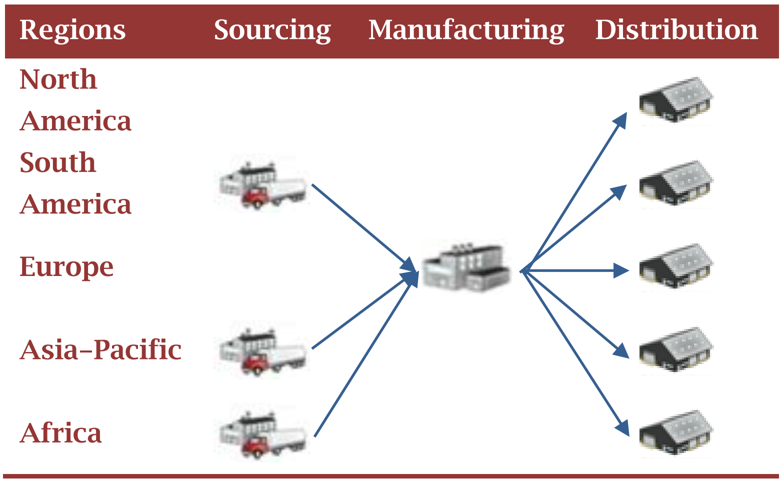
Strategic supply chain configuration in Ermenegildo Zegna

As one of the biggest global luxury fashion producer, the sources of raw materials and components are located in different countries where could provide the best quality goods with low cost. The manufacturing sites are only in Italy, and the final products are distributed to global market from Italy. Therefore, the strategic supply chain configuration of Ermenegildo Zegna is Global Sourcing – Local Manufacturing – Global Distribution.



Supply chain process in Ermenegildo Zegna

On the supply side, Zegna procures from the countries offering low cost but high quality raw materials and components. However on the manufacturing side, as most of the brands known as "Italian", Zegna prefers to make its production within borders in order to gain value from customers perceived quality from Italian design and fabric. As being a global company which serves different markets around the world, it distributes its products from its centralized production facility. More than 85 percent of the company's sales are achieved outside of Italy, primarily through the company's own store network. Europe is the company's largest market, at 38 percent of sales, followed by North America, at 33 percent of sales. The company also has a strong presence in the Asian region, which accounts for 25 percent of its sales and includes China, one of the group's fastest-growing markets.



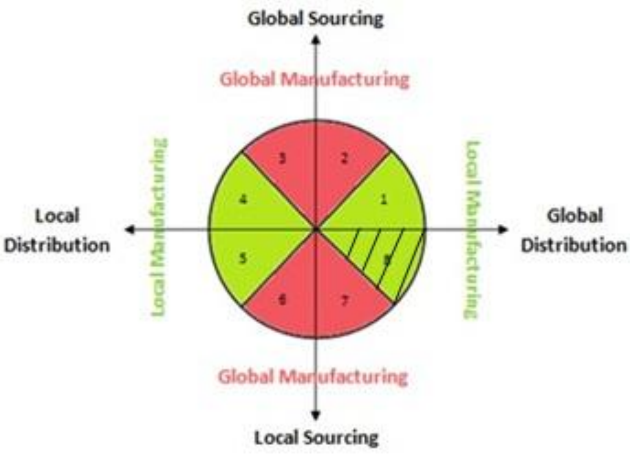
5.4.4. Gucci Leather

Company information

Gucci is an Italian, and on e of the world's leading luxury fashion and leather goods brand, part of the Gucci Group, which is owned by French company Kering previously known as PPR. Gucci was founded by Guccio Gucci in Florence in 1921. With a renowned reputation for quality and Italian craftsmanship, Gucci Leather designs, manufactures and distributes highly desirable leather goods. Gucci operates about 278 directly operated stores worldwide (as of September 2009) and it wholesales its products through franchisees and upscale department stores.

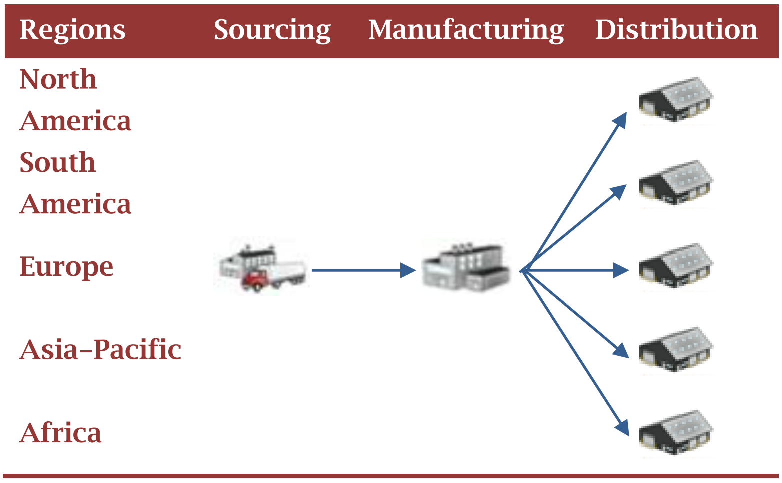
Supply chain configuration in Gucci Leather

The brand of Gucci has one main dominant factor to increase its value and perceived quality to its customers: being "Made in Italy". In order to maintain the quality and reputation advantage, Gucci Leather purchases the raw materials, produces the final products only in Italy, and distributes the high quality products to the global market. Therefore, the strategic supply chain configuration of Gucci Leather is Local Sourcing – Local Manufacturing – Global Distribution.



Supply chain process in Gucci Leather

The brand image is quite exclusive so that the customers are willing to pay high since Gucci serves to top customers. Therefore, quality is Gucci's main asset that it cannot overcome any mistrust of decreasing quality. In order to protect this image, Gucci Leather procures all its leather and supplementary materials in Italy in order to assure the best quality. Moreover, its production is made in Italy and the region of Tuscany as well to represent its fame with fashion. Afterwards, the final products are distributed worldwide to the stores.



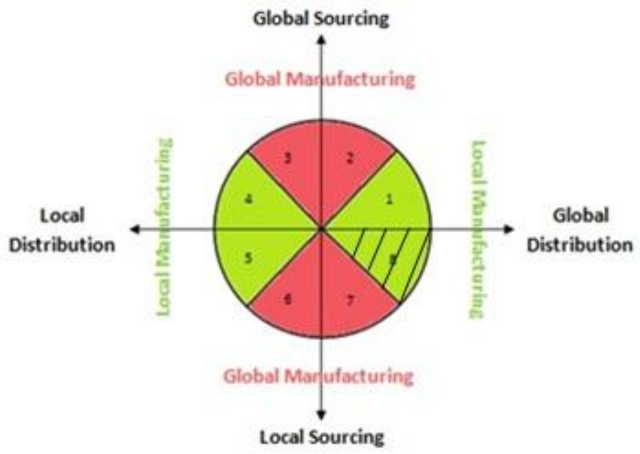
5.4.5. The Bridge

Company information

The company Ponte Pelletteria S.p.A is established in 1975, producing the brand of "The Bridge", which stands out for the production and marketing of high-grade leather goods and accessories. The range of "The Bridge" includes luggage, travel bags, briefcases, ladies handbags and small leather goods for a total of about 700 items, mainly briefcases, doctor bags and lady's shoulder bags. The heart of the market of "The Bridge" is represented by Europe, in particular Italy. Currently, more than 50% of the brand's turnover is realized in Italy while 40% is obtained from export, especially to countries in the north of Europe such as Germany and the United Kingdom, where the products can be found in personalized corners in several retail stores.

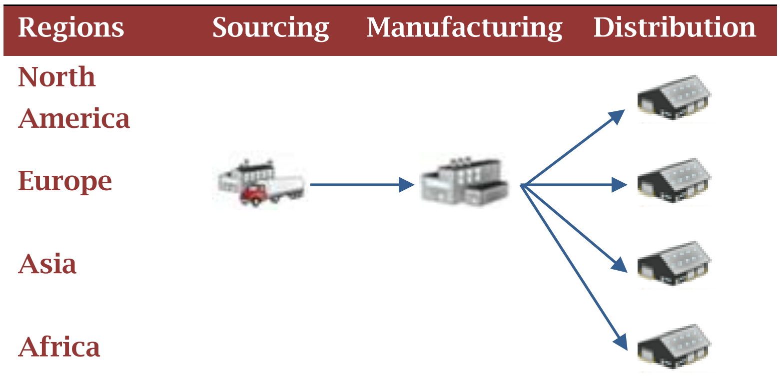
Strategic supply chain configuration in Bridge

The sourcing and manufacturing are conducted in Italy due to the endowment of the required raw materials and skills, whereas the distribution is carried out on a global level. Therefore, the strategic supply chain configuration of The Bridge is Local Sourcing – Local Manufacturing – Global Distribution.



Supply chain process in Bridge

The Bridge aims to be recognized as an "Italian" producer due to the relevance to good quality and luxury fashion reputation. As it is stated, 90% of the demand is from EU countries. Therefore, manufacturing occurs near to market which can ease the adoption to any kind of change in demand. Moreover, the company explains the best quality sourcing strategy with these words: "The raw hides are carefully selected from European farms and are worked with traditional techniques which are combined with the latest technological solutions and chemicals which respect the environment. Only the finest fabrics are selected for the linings and threads, ranging from cotton to synthetics depending on the product being created, and German yarn, among the most durable on the market, is used for the stitching". The varieties of raw materials are not excessive and can be found locally with the best quality. Therefore, the company prefers local sourcing.



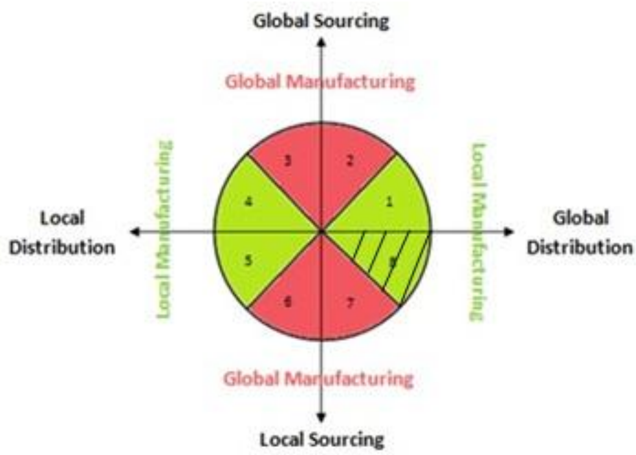
5.4.6. L'occitane en Provence

Company information

L'occitane en Provence, known as simply L'occitane, is an international retailer of body, face, and home products based in Manosque, France. The company was founded in 1976 by Olivier Baussan with the purpose to create a company that celebrates and preserves the traditions of his native Provence. L'Occitane means "the woman from Occitania". L'Occitane owns shops in 90 countries in North America, South America, Europe, Asia, and Australia; with 170 shops in the United States.

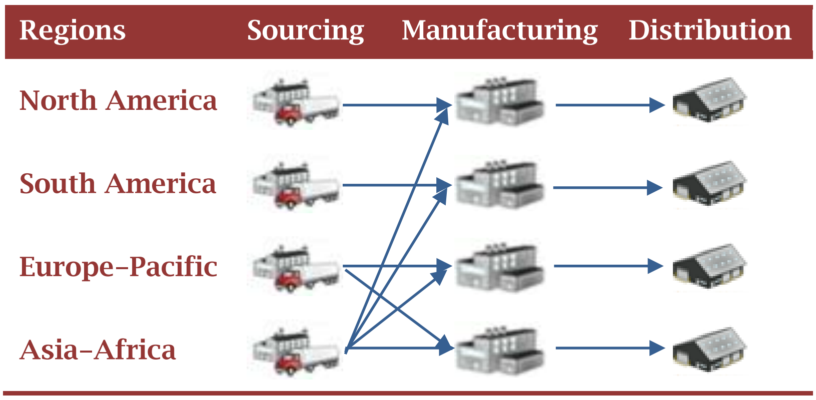
Strategic supply chain configuration in L'occitane en Provence

In order to secure the high quality and protect the manufacturing know-how, L'occitane adopts the local strategic supply chain configuration as Local Sourcing – Local Manufacturing – Global Distribution.



Supply chain process in L'occitane en Provence

L'Occitane obtains the raw materials it uses from local suppliers who use traditional techniques, and develops all of its products in Manosque. The products are formulated with plant active ingredients, following the principles of physiotherapy and making use of local know-how. These formulas combine effectiveness and seasonality, providing textures and fragrances inspired by the Mediterranean art de vivre. Moreover, L'Occitane sources its raw materials from a unique region which increases perfectionist image in customers' eye. Therefore, supply chain of the company is formed based on this fact and constraint. Since most of those raw materials are made from plants and fresh materials, production facility is required to be nearby. By the effect of those restrictions, distribution is made from one center to the world.



5.4. Case study on Automotive industry

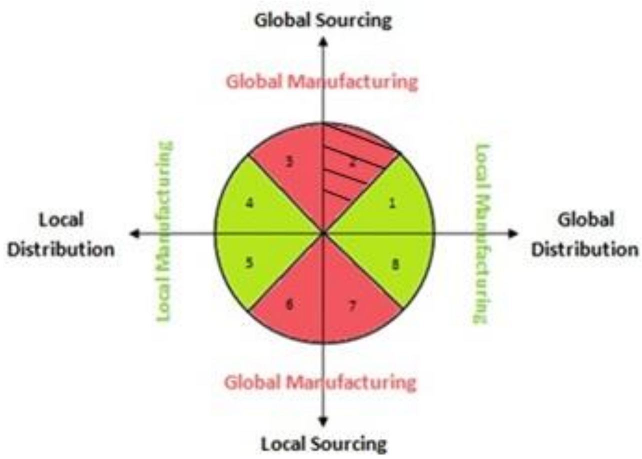
5.4.1. General Motor

Company information

General Motors Company is an American multinational holding corporation headquartered in Detroit, Michigan. The company designs, manufactures, markets and distributes vehicles and vehicle parts and sells financial services. The company markets its vehicles primarily under the Buick, Cadillac, Chevrolet, GMC, Opel, Holden, and Vauxhall brand names, as well as under the Alpheon, Jiefang, Baojun, and Wuling brand names. It also sells cars and trucks to dealers for consumer retail sales, as well as to fleet customers, including daily rental car companies, commercial fleet customers, leasing companies, and governments. In addition, the company offers connected safety, security and mobility solutions, and information technology services. The company, through its subsidiary, General Motors Financial Company, Inc. provides automotive financing services and lease products through GM dealerships in connection with the sale of used and new automobiles that target customers with sub-prime and prime credit bureau scores. General Motors is divided into five business segments: GM North America (GMNA), GM Europe (GME), GM International Operations (GMIO), GM South America (GMSA), and GM Financial.

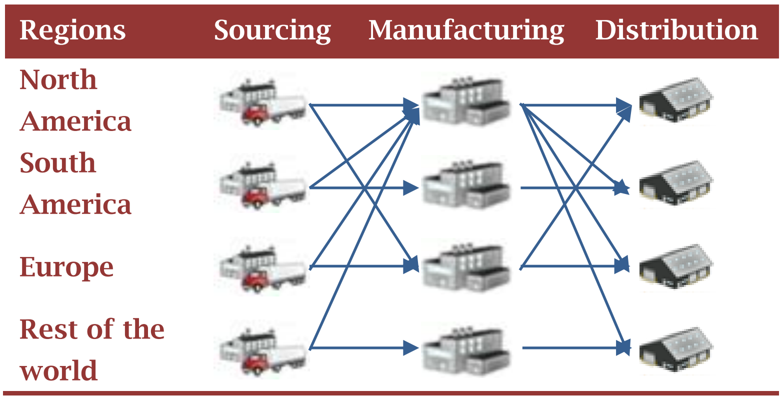
Strategic supply chain configuration in General Motor

General Motor produces vehicles in 37 countries, while the majority of the production is carried out in US, therefore the raw materials, components and sub-assemblies are provided from both local and global suppliers. Then the American plants distribute the vehicles to different region, despite the other region's local plants can deliver the final products to their local market. Therefore, the strategic supply chain configuration of General Motor is Global Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in General Motor

GM operates one of the world's largest digital supply chains with a network of 182 plants, 650 logistics service providers and 3200 suppliers to build 8.7M vehicles and deliver to over 15,000 dealers worldwide. Its supplier footprint is global and optimized to minimize total enterprise cost. They buy parts from the best suppliers and best locations globally. One-third of their suppliers deliver to GM plants in more than one region. Therefore, integration of the regions makes GM to operate as one company. When manufacturing part is investigated, it is seen that majority of the production takes place in North America. It can be explained with the technology level and existing infrastructure that is not easy to carry outside. On the other hand, recently, GM has been passing through a change in strategy in order to adopt world present challenges by implementing localization policy, having benefits in terms of lead time as well as sustainability. Although localization policy has been continuing to be implemented, still the majority of production takes place in North America. Among the 71 assembly plants, the main manufacturing sites are located in United States, Canada, Colombia, Brazil, Ecuador, Mexico, Argentina, Venezuela, Austria, Spain, France, Germany, England, Poland, Hungry, Russia, South Korea, Japan, Vietnam, China, India, Thailand, Indonesia, Australia, and Egypt. The final products are delivered to 157 countries in 5 continents. The North America is the biggest market, which occupies almost 60% to the total sales.



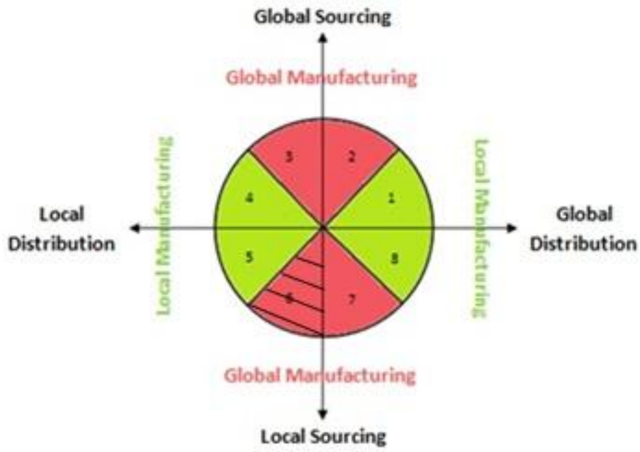
5.4.2. Toyota Motor Corporation

Company information

Toyota Motor Corporation is a Japanese multinational automaker found in 1937 and headquartered in Toyota, Aichi, Japan. It was defined as the third-largest automobile manufacturer in 2011 by production behind General Motors and Volkswagen Group. Toyota has been the largest automobile manufacturer in 2012 by production. And at the end of that year, Toyota conducts its business worldwide with 52 overseas manufacturing companies in 27 countries and regions. Toyota vehicles are sold in more than 160 countries and regions.

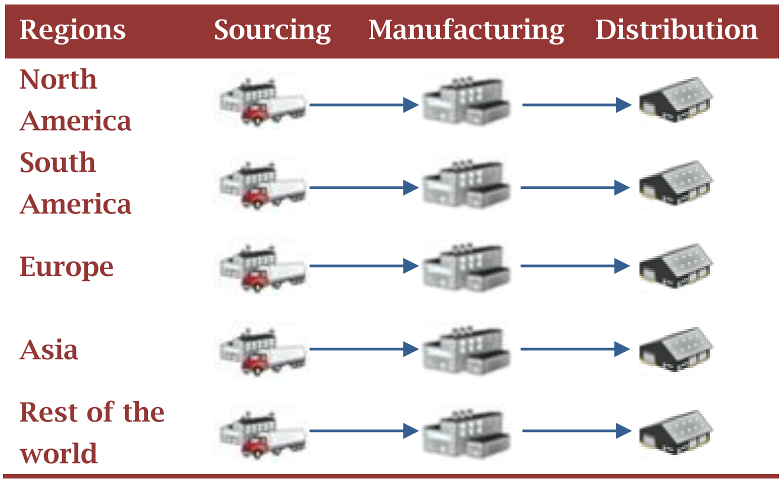
Strategic supply chain configuration in Toyota

Toyota adopts the local strategy to manage its strategic supply chain configuration summarized as Local Sourcing – Global Manufacturing – Local Distribution.



Supply chain process in Toyota

It is seen that Toyota manages its sourcing and distribution unlike its competitors in the same sector. It is achieved by placing regional general managers in charge of localizing car making in each region. By developing ties with local sales and R&D units, Toyota can ascertain the needs of each market and improve both quality and product appeal. Toyota aims for 100% local procurement, rather than procurement from Japan, so as to strengthen its responsiveness to foreign exchange fluctuations. Also in this way, it minimizes the parts procurement risk. Toyota has factories in most parts of the world, manufacturing or assembling vehicles for local markets. Toyota has manufacturing or assembly plants in Japan, Australia, India, Canada, Indonesia, Poland, South Africa, Turkey, Colombia, the United Kingdom, the United States, France, Brazil, Portugal, and more recently, Argentina, Czech Republic, Mexico, Malaysia, Thailand, Pakistan, Egypt, China, Vietnam, Venezuela, the Philippines, and Russia.The local manufacturing and distribution strategy insures that Toyota could provide the vehicles to customer's position within the minimum lead time in order to achieve better service level.



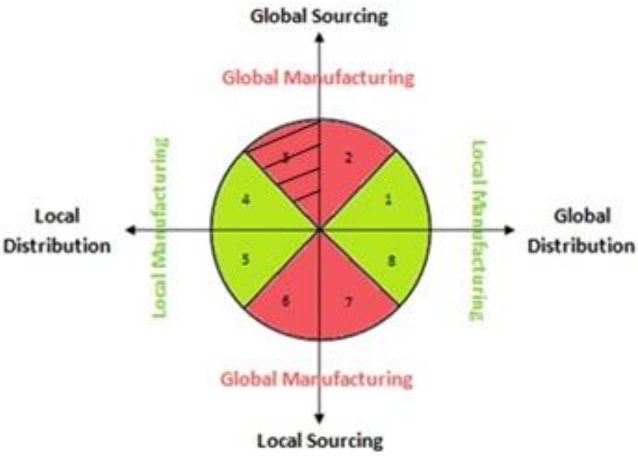
5.4.3. Fiat Automobiles

Company information

Fiat S.p.A. is an Italian automobile manufacturer based in Turin (Fabbrica Italiana Automobili Torino). Fiat was founded in 1899 by a group of investors. Fiat is an international auto group that designs, produces and sells vehicles for the mass market under the Fiat, Alfa Romeo, Lancia, Abarth and Fiat Professional brands, as well as luxury and performance cars under the Ferrari and Maserati brands. Fiat Automobiles S.p.A. produces Fiat branded cars, and is part of Fiat Group.

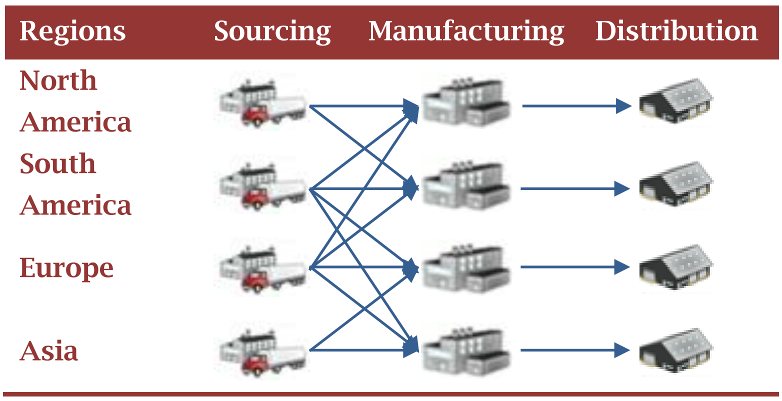
Strategic supply chain configuration in Fiat Automobiles

Fiat Automobiles sources the raw materials, components and sub-assemblies globally, and then send them to the manufactures sites that produce and distribute the vehicles to their local market. Therefore, the strategic supply chain configuration of Fiat Automobiles is Global Sourcing – Global Manufacturing – Local Distribution.



Supply chain process in Fiat Automobiles

Sourcing stage of Fiat's supply chain is observed to be global contrary to its distribution. It is caused by the desire to reach worldwide suppliers with high standards of quality, service, and technology with the lowest possible price. This approach allows Fiat to have opportunities for communization, cost savings, mass reduction, quality improvements, and the introduction of advanced technologies. When manufacturing and distribution side is considered, it is observed that localization took place for environmental and customer proximity reasons. Fiat is Italy's largest industrial concern. It also has significant worldwide operations, operating in 61 countries. The main assembly sites are located in Italy, Poland, Brazil, Argentina, Mexico, Canada, United States, France, Turkey, India, Serbia, China and Hungary. Local distribution strategy is explained in annual report of the company as the way to achieve meeting corporate and customer requirements, striving to maximize efficiency and reducing the impact of transport on the environment. Fiat's main market is European one, mainly focused in Italy. South America is the second biggest market outside Europe, mainly in Brazil and in Argentina.



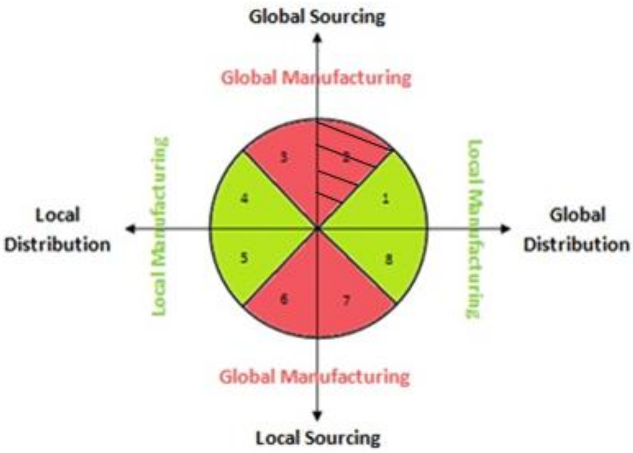
5.4.4. Pirelli Tire

Company information

Pirelli & C.S.p.A is a multinational company based in Milan, Italy. The company, the world's fifth-largest tire manufacturer behind Bridgestone, Michelin, Goodyear, and Continental, but it is market leader in the luxury/prestige segment. Pirelli is present in over 160 countries, has 22 manufacturing sites around the world and a network of around 10,000 distributors and retailers. The goal of the company is to constantly improve the quality of Pirelli products in terms of performance, safety and environmental impact, all in line with the company's 'green performance' strategy. In pursuing these objectives, Pirelli always aims to unite financial profitability with social responsibility.

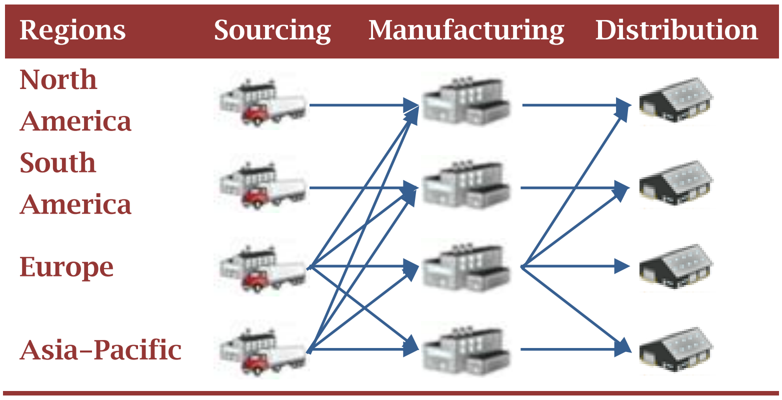
Strategic supply chain configuration in Pirelli

In Pirelli, each plant serves both its local market and the worldwide market, even if the European market is the prevailing and vertical supply chains are the primary structure. Anyway, the company is trying to cluster the customers served by each plant according to a continental level, in order to avoid the massive presence of expensive ocean flows. Therefore, the strategic supply chain configuration of Pirelli is pure global structured as Global Sourcing – Global Manufacturing – Global Distribution.



Supply chain process in Pirelli

The supply process is organised on a worldwide basis. The suppliers are basically concentrated in specific areas (e.g. Asia and Brazil for natural rubber). Raw materials are generally ocean shipped to the plants, which in general have a factory warehouse acting as a distribution centre for the local and surrounding markets (where applicable). Through its 22 plants located in 13 countries, Pirelli can count on production facilities across 4 continents with a capacity of 68 million Consumer tires (Car and Moto) and 6 million Industrial tires (Truck and Agro) in 2012. The plants in Asian and South America are mainly located in China and Brazil in order to meet the growing demand in those districts. The final physical distribution is performed starting from the various regional/factory distribution centres: the products are delivered by local expert external transport providers, in order to serve all the customers, represented also by numerous small dealers.



6. Data collection

6.1. Data conversion method

On the basis of company case study, the driver's original data of each firm have been obtained. In order to facilitate the statistical analysis, the strategic supply chain configuration and each driver's actual data need to be represented in numerical way. Therefore, the original value of each strategic supply chain configuration and driver stemming from case study are converted to the criticality value (i.e. 1-5 numerical scale), exemplified as Figure 6.11, that can be used in statistical models easily. By taking into account each supply chain operational process is affected by different drivers, the entire strategic supply chain configuration is divided into three parts in terms of sourcing, manufacturing, and distribution, aiming to understand how the drivers influence strategic location alternative on each individual supply chain stage.

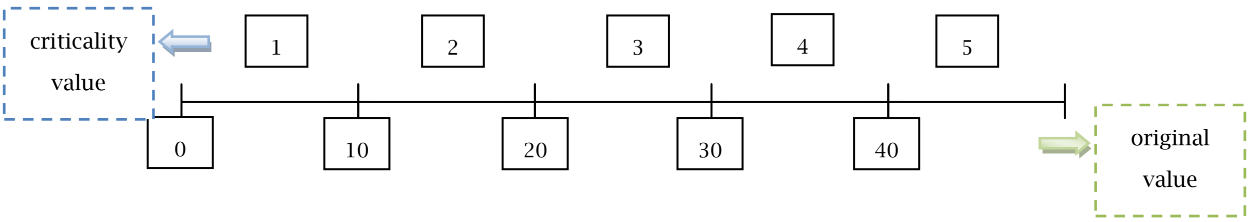


Figure 6.1 – Example of numerical scale

In this research, 40 company cases were selected at random in order to develop the decision-making support model through identifying the relationships between strategic supply chain configuration and supply chain problems, and the remaining 5 cases were used to validate the developed model by comparing the result generated from decision model and existing solution. The 40 randomly selected company cases are listed and numbered in the Table 6.1. The criticality value of each supply chain operational process and each identified driver for every investigated company is presented in Appendix Part C.

Number	Company	Number	Company
1	Hewlett-Packard Europe	21	The Bridge
2	Apply Hardware	22	Ray-Ban
3	Dell Inc. Hardware	23	Barilla S.p.A.
4	Nokia Mobile	24	Nestlé S.A.
5	Candy Washing	25	Unilever Food
6	Candy Cooling	26	Kellogg’s Cereal
7	Candy Cooking	27	Lindt & Sprüngli
8	Whirlpool Europe	28	IllyCaffè S.p.A
9	Indesit Company	29	Chicco Toys
10	Black & Decker	30	Lego
11	Parah Underwear & Beachwear	31	Colgate-Palmolive
12	BasicNet Group	32	L’occitane en Provence
13	Zara	33	GlaxoSmithKline Ltd.
14	Sergio Tacchini	34	Astra Zeneca
15	Levi Strauss Europe	35	Carlsberg Beer
16	Alpargatas S.A. (Havaianas)	36	Coca-Cola Beverage
17	Mantero	37	Absolut Vodka
18	Patrizia Pepe	38	General Motor
19	Ermenegildo Zegna S.p.A.	39	Toyota Corporation
20	Gucci Leather	40	Fiat Automobiles

Table 6.1 – Company list for data analysis

6.2. Data conversion of strategic supply chain configuration

According to the case study, 5 types of strategic supply chain configuration on sourcing, manufacturing, and distribution were identified respectively based on the complexity of the material flow. Therefore, each type of the structure on different supply chain process was analyzed and represented in a numerical way through the numerical scale developed.

6.2.1. Data conversion on sourcing stage

Sourcing 1: the first configuration indicates all of the procurement activities are conducted within the borders of a country or a region (i.e. purely local sourcing), and the raw materials are sourced only for local production facilities. The material flow chart is shown as bellow.

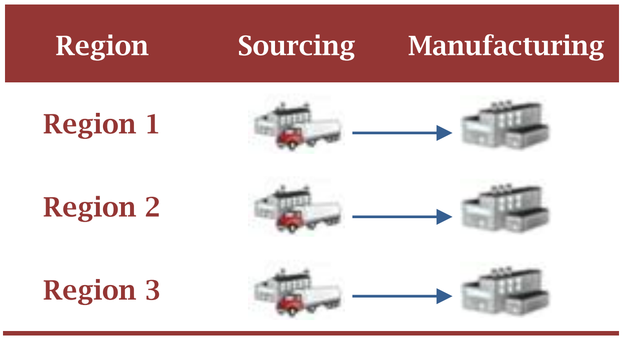


Figure 6.2 – Configuration 1 of sourcing process

Sourcing 2: the second configuration is a simple global sourcing structure (i.e. all the items are purchased from one region), but they are transported to manufacturing sites worldwide. The suppliers have to implement the international transportation, which are a bit more complicated than local transportation.

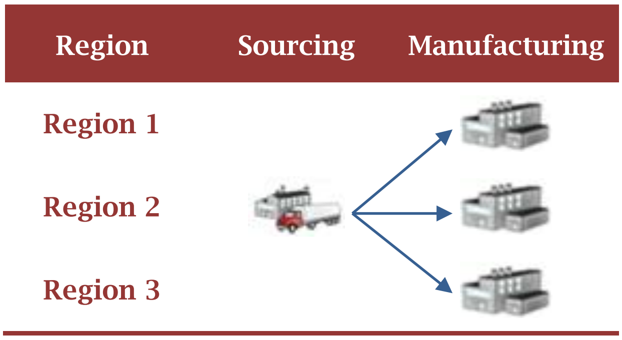


Figure 6.3 – Configuration 2 of sourcing process

Sourcing 3: in this configuration, multiple regions supply the items to the production facilities that are located in one region. More in detailed, a company establishes the manufacturing plants in a specific region, whereas the raw materials are sourced from the suppliers from different regions in this world. The complexity of this configuration is that a company has to manage the suppliers not only in the local region, but also in other regions. In this case, some barriers need to be overcome, such as the import tariff for local plants, the currency stability, and so on.

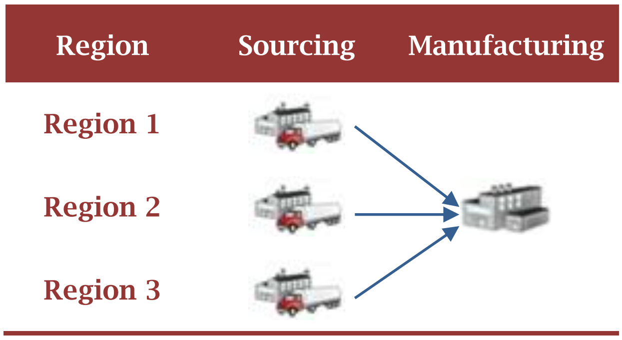


Figure 6.4 – Configuration 3 of sourcing process

Sourcing 4: this can be called hybrid configuration. It represents that some facilities in the same region are supplied only by local suppliers, whereas other facilities located in another region are served by both the local suppliers and global suppliers. Compared with the configurations mentioned above, this structure is more complex, since a company has to not only conduct procurement activities for the facilities with their local suppliers in each region, but also coordinate the global sourcing and manage international transportation in order to fulfill the needs of global manufacturing.

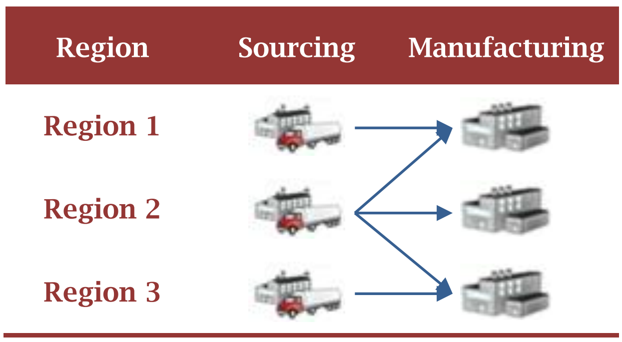


Figure 6.5 – Configuration 4 of sourcing process

Sourcing 5: this is the purely global sourcing, indicating all of the suppliers in different regions not only provide items to their local manufacturing plants, but also transport the items to other regions' plants. In this case, each plant needs the purchased items provided from the suppliers in different regions to implement the manufacturing activities. This requires the highly coordination between every supplier and every plant, since any mistake on sourcing could lead to the disruption of manufacturing.

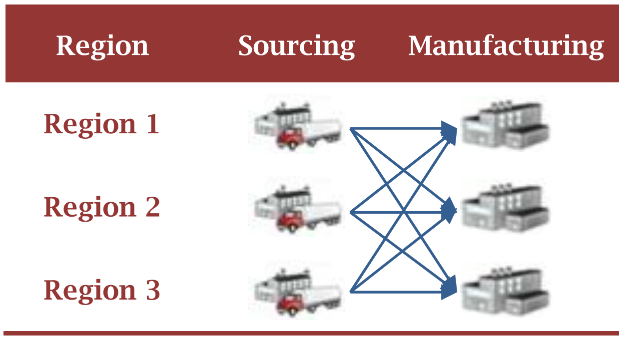
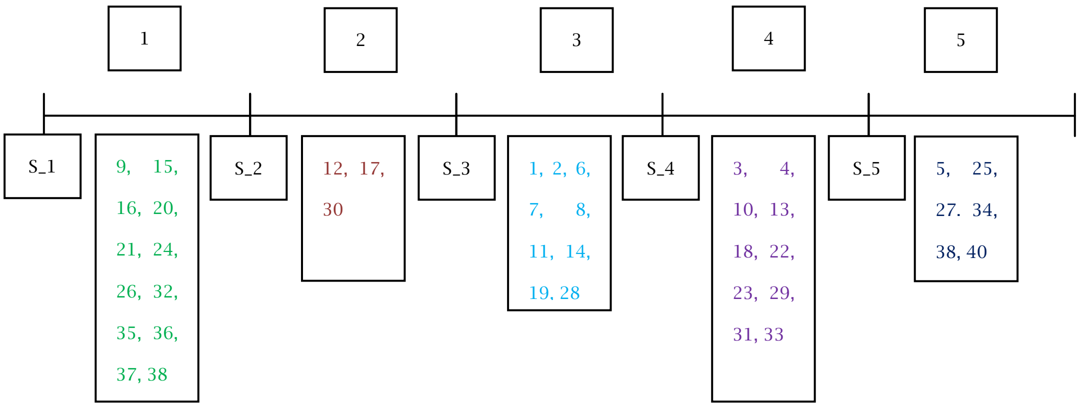


Figure 6.6 – Configuration 5 of sourcing process

In the numerical criticality scale, the numbers of the companies adopting different sourcing configuration were inserted in order to understand which company implements which sourcing strategy.



6.2.2. Data conversion on manufacturing stage

Manufacturing 1: it is local manufacturing case, whereas the difference is that the plants not only provide finished products to local market, but also transport them to other markets. Therefore, the production process is more complex, since a plant has to produce different products in order to fulfill the customer's needs in different regions.

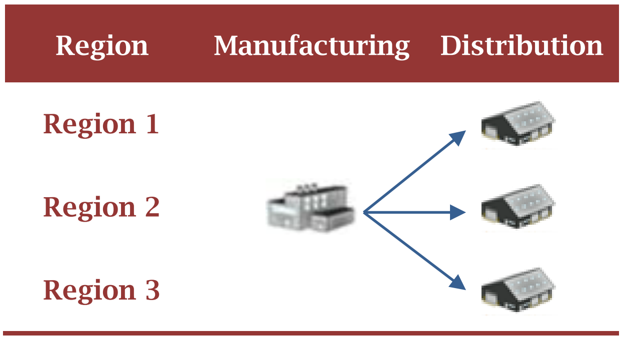


Figure 6.7 – Configuration 1 of manufacturing process

Manufacturing 2: in this case, all of the plants should only produce the products for the local market (i.e. each market is served from local production facilities), and there is no transportation across borders between plants and markets.

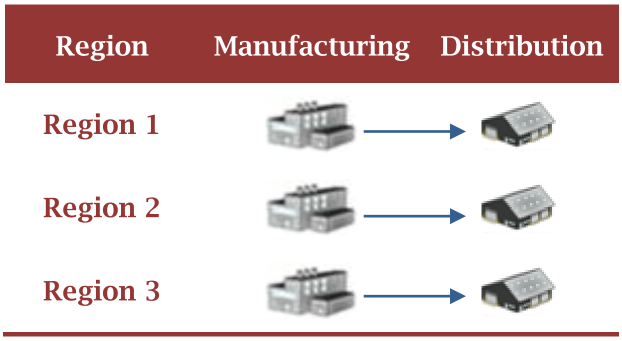


Figure 6.8 – Configuration 2 of manufacturing process

Manufacturing 3: this structure indicates the manufacturing plants are located in different regions and produce products for only one regional market. In this case, the plants in different regions transport the final products to only one specific market. Despite the manufacturing sites are located worldwide, the production process is not quite complex because the products requirements are determined by only one market.

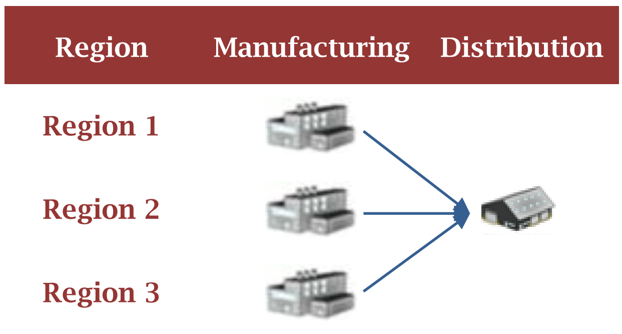


Figure 6.9 – Configuration 3 of manufacturing process

Manufacturing 4: this configuration is more complex than the previous one due to the increase in production process and dimension of market. More specifically, the plants are located in different regions, and at least one region's plants provide products to both local and global market, and the plants in other regions only focus on the demand of their local markets. This is a sort of the combination of the two cases of prior configuration.

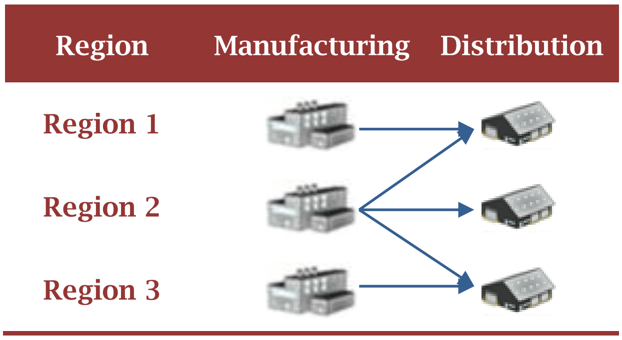


Figure 6.10 – Configuration 4 of manufacturing process

Manufacturing 5: it is the most mixed global manufacturing structure, because the plants are located in multi regions and provide products to different markets. In this case, both the production requirements and the transportation lines are the most complex. Every plant not only produces the products in order to meet the local market's need, but also fulfill the demand of abroad markets.

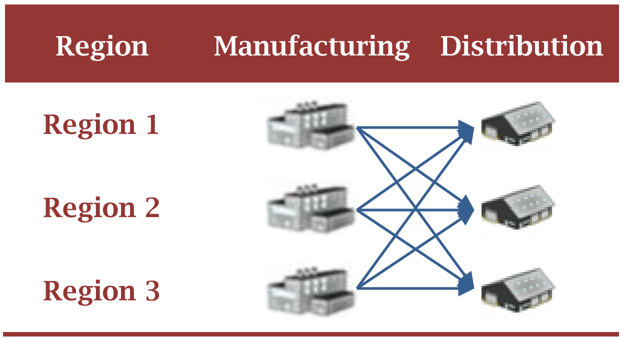
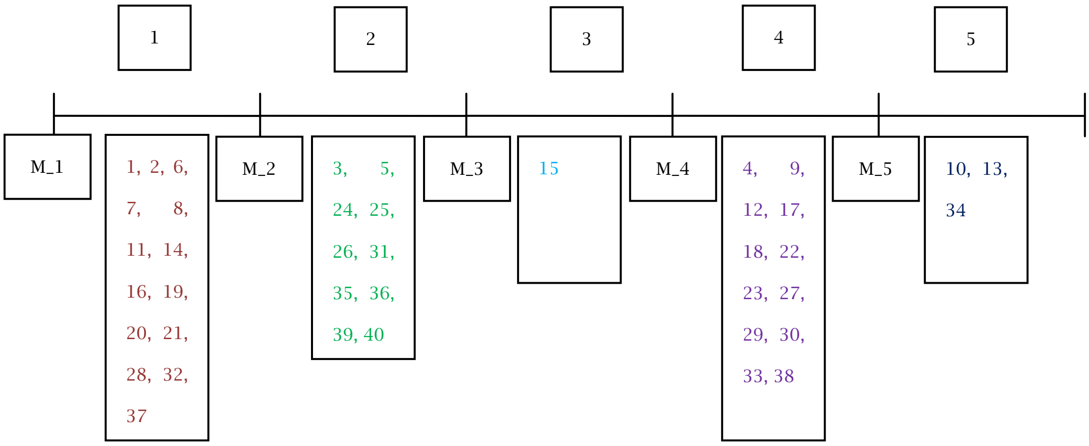


Figure 6.11 – Configuration 5 of manufacturing process

In the following figure, the criticality value is increasing along with the increase in the complexity of manufacturing configuration.



6.2.3. Data conversion on distribution stage

Distribution 1: the first distribution configuration is typical local distribution structure, which indicates the products distributed to local market only from local plants. In this case, a company does not need to manage any international transportation.

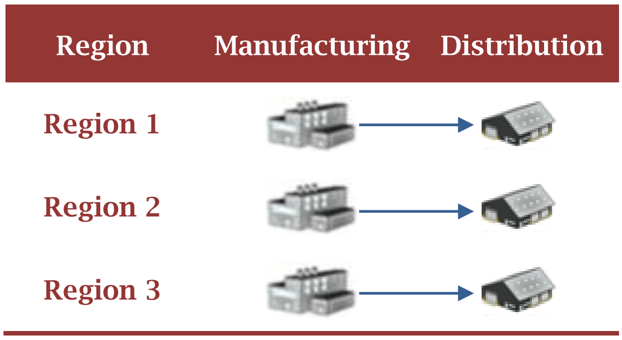


Figure 6.12 – Configuration 1 of distribution process

Distribution 2: a company only has one market in a specific region, whereas the plants located in different regions provide the products to this market. Therefore, the local distribution and global distribution serve one market in this case. The complexity of material flow is higher than the first case, since the global transportation is identified while the market is only available in one region.

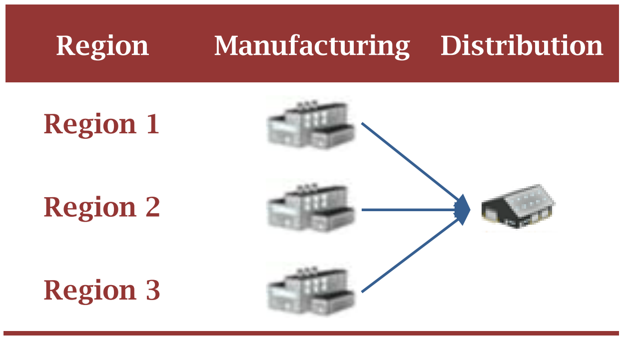


Figure 6.13 – Configuration 2 of distribution process

Distribution 3: in this case, a company should carry out business not only in local market, but also across the borders, whereas the manufacturing activities are implemented in the plants located in home country. The structure of distribution configuration is opposed to the previous case, i.e. one region's plants serve multiple markets. Therefore, the production facilities have to manage different products and transport them to different destinations at the same time.

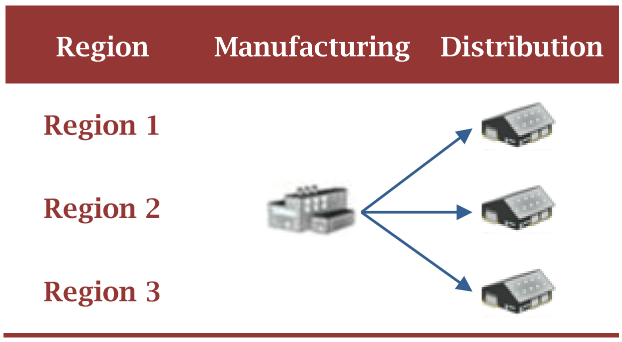
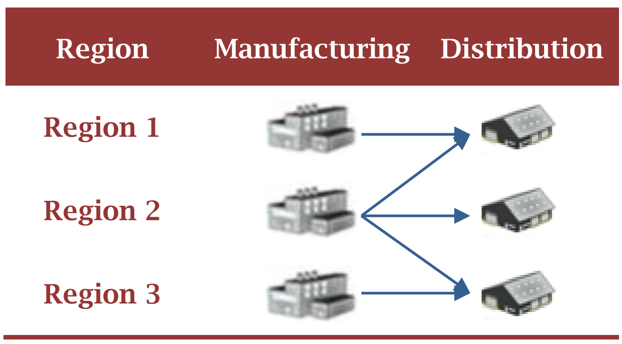


Figure 6.14 – Configuration 3 of distribution process

Distribution 4: this configuration represents multiple markets need to be served by a company. More specifically, there is at least one market are fed by local plants through local distribution, while remaining markets are fulfilled based on either international distribution or local distribution, or both.



and

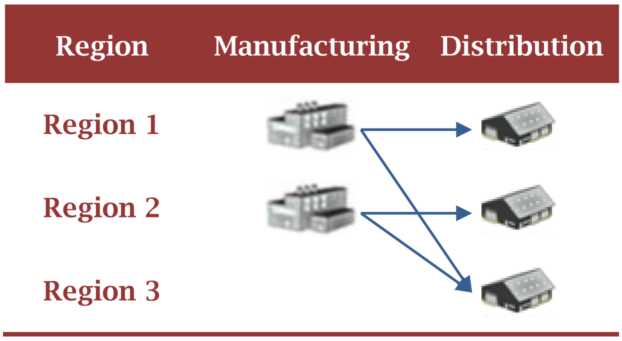


Figure 6.15 – Configuration 4 of distribution process

Distribution 5: this is the most complex structure of distribution configuration. Each market in the world is served by the facilities in different regions (i.e. every market is not only fed by local plants), but also the abroad plants.

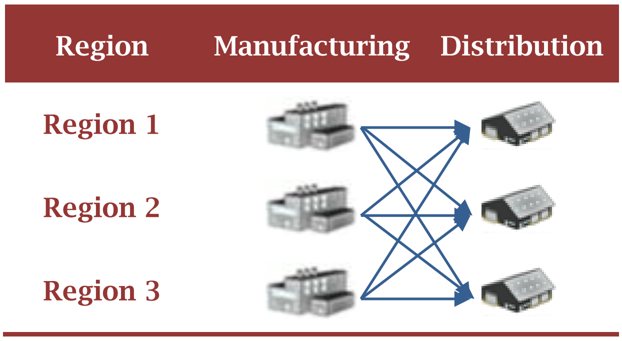
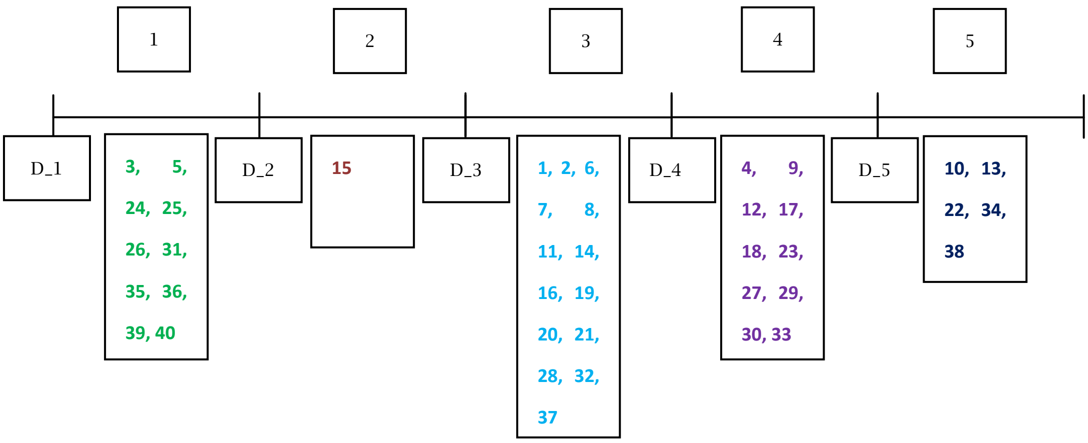


Figure 6.16 – Configuration 5 of distribution process

In the following figure, the criticality value is increasing along with the increase in the complexity of distribution configuration.

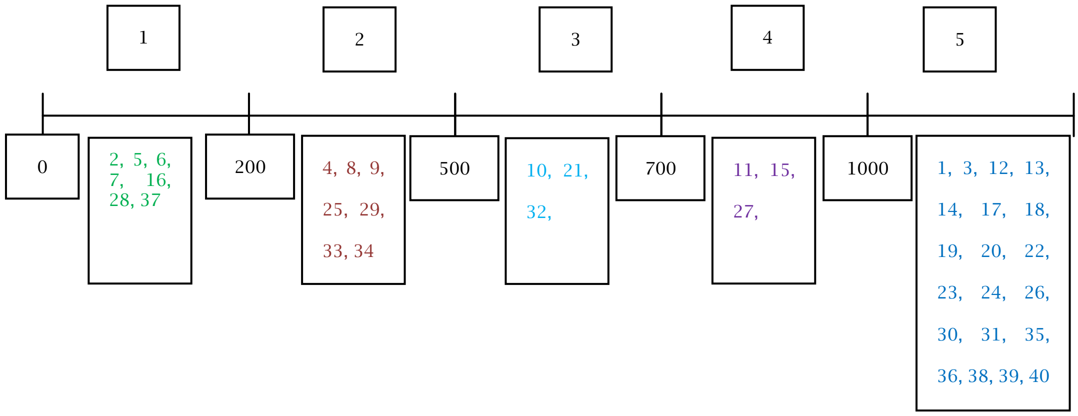


6.3. Data conversion of the driver's data

The principle of the data conversion from original value to criticality value is the impact of the driver on the supply chain costs. More in detailed, if an increasing of a driver's original value results in the rise of supply chain costs, the criticality value is increased from 1 to 5 on the numerical scale as well. Whereas, the criticality value decreases when the original value of a driver is inversely proportional to supply chain costs.

Product variety

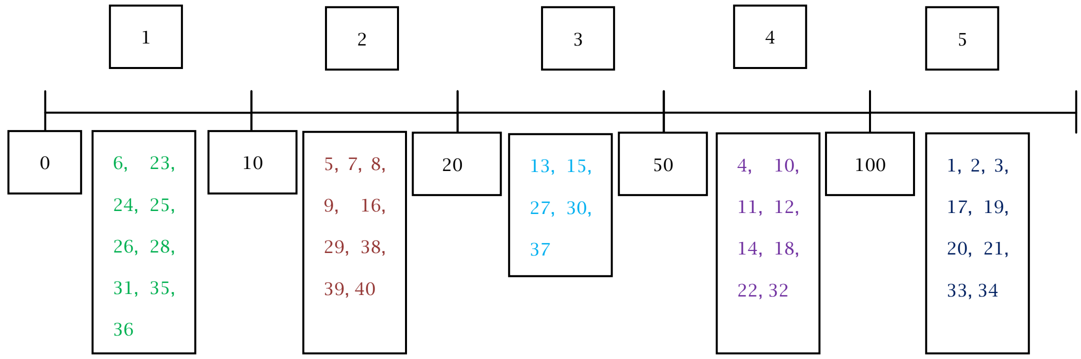
The product variety has the effects on the globalization of sourcing and distribution stages. An increasing in the variety of the products offered leads to a company has to face the risk of lack of required raw materials in domestic suppliers, and causes an increase in the total supply chain costs due to more expense on inventory carrying cost and material handling cost. Therefore and theoretically, the criticality value of the driver rises under the case of great product variety. According to the case study, Candy Washing provides only 17 different product codes in the market, whereas Zara has the largest product variety that is over 40000. Considering these thresholds and the number of product codes in other firms, the scale of criticality of product variety is represented as following graph.



Product value density

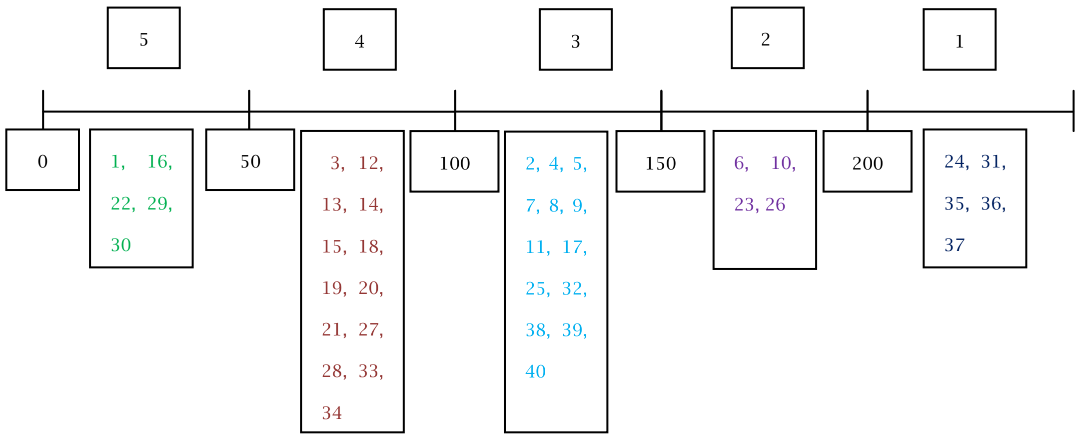
The product value density affects the localization of distribution process. An increase in the value density of the products causes increase in the supply chain costs. The reduction of delivery cycle time results in the decrease on inventory carrying cost.

Therefore, local distribution is the more suitable for the high value density products. The lower threshold of product value density is around 1-2€/kg (i.e. Colgate-Palmolive and Coca-Cola Beverage), and the upper limit is over 100€/kg, mainly for the computer industry companies. Therefore, the criticality scale is represented between the two limitations.



Physical density

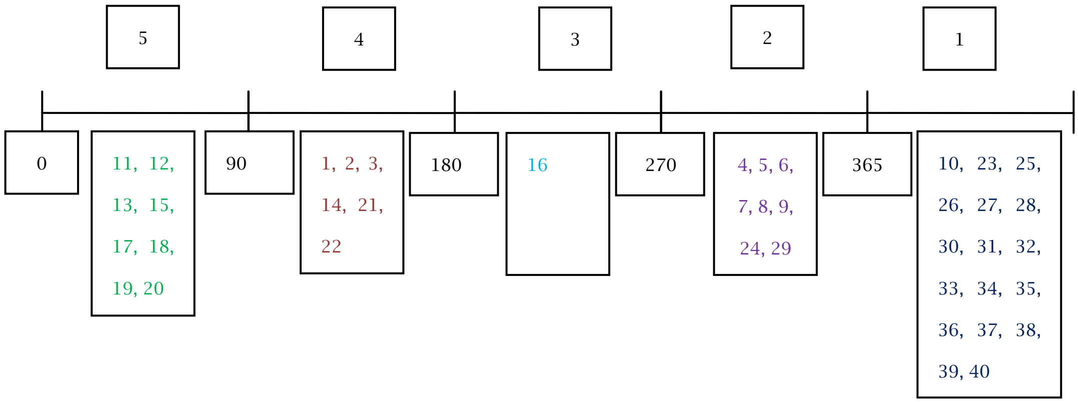
Physical density has the impact on the globalization of distribution process. A decrease in the physical density generates an increase in supply chain costs. A high physical density product can meet the saturation of the transportation mean, allowing the reduction of transportation costs. Moreover, an augment in density can decrease the storage cost due to the reduction of space needed to store the goods. The threshold values of physical density stemming from company case study are 20kg/m^3 and proximately 500kg/m^3. The numerical scale is represented as following by taken into consideration other companies' data.



Risk of obsolescence

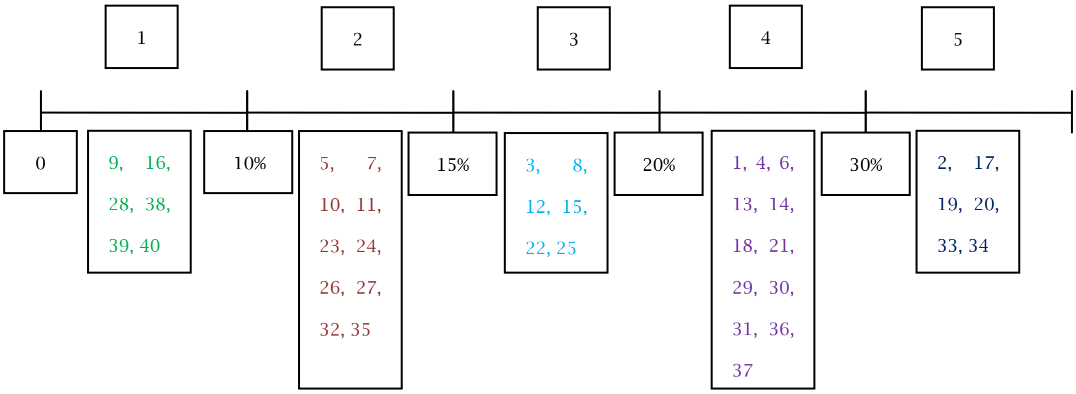
The obsolescence period of product affects the localization of distribution process. A high risk of obsolescence of products implies an increase in the supply chain costs. A product with short obsolescence period requires faster transportation mode in order to complete the distribution as soon as possible. Therefore, the local distribution is suitable for the high risk obsolescence products due to the small delivery cycle time.

The investigated companies clearly show that the innovational and fashionable products have higher risk of obsolescence than that of commodity goods. Whereas, the obsolescence period is long in automobiles despite they are highly innovational product.



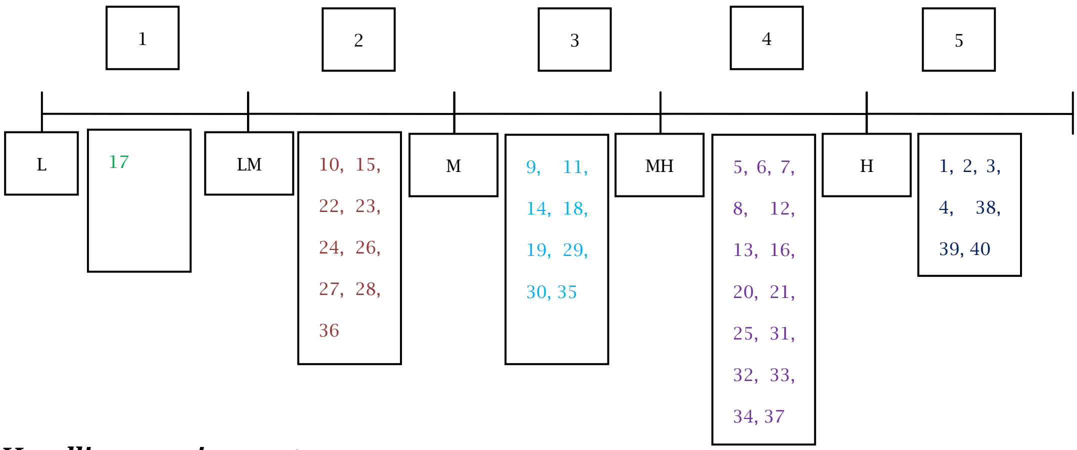
Profit margin

Profit margin has impacts on scouring stage, since the globalization is an efficient way to reduce the procurement costs in order to reach the targeted profit margin. In general, it is reasonable to say that the increase of profit margin causes an increasing in supply chain costs. The lowest profit margin is happened in automotive industry, and in general it is less than 5%. On the other hand, the fashion industry and pharmaceutical industry are higher than other sectors, normally higher than 30%.



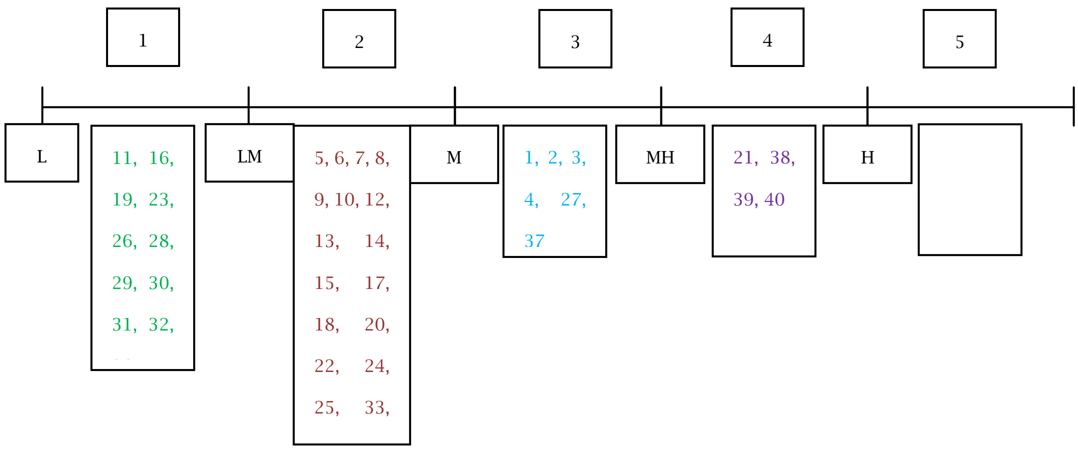
Competition level

Competition level affects the sourcing and manufacturing processes. A company intends to source the materials and operates the production abroad in order to lower the product's price. Therefore, considering the management could be more complex under the case of globalized sourcing and manufacturing, and higher cost has to be afforded by company, we consider that an increasing in competition level a firm is facing causes the increase in supply chain costs. This driver is measured on the basis of the investigated companies' financial reports and other documents. Therefore, the original value is represented based on five levels (i.e. from low to high), and converted to criticality value.



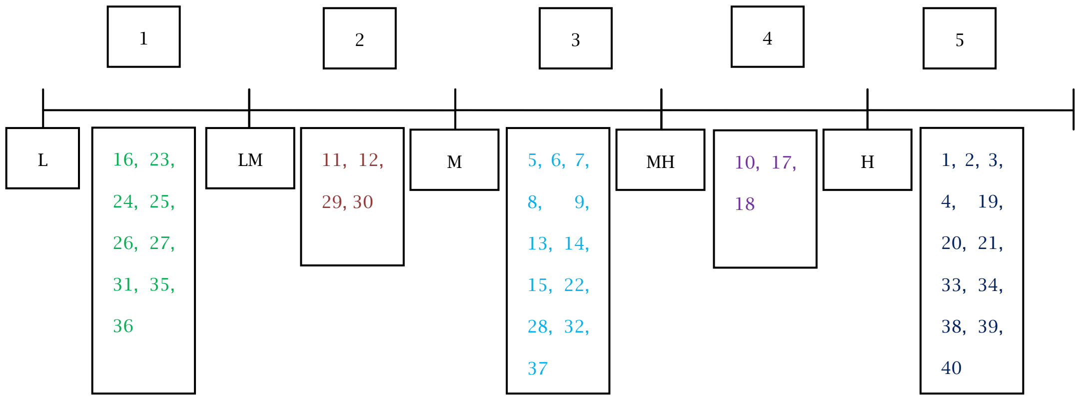
Handling requirements

Handling requirements have impacts on localization of distribution, since local strategy can reduce the possibility of damage due to the short transportation distance and less handling activities. In addition, an increasing in handling requirements direct causes the higher material handling cost. The original value of handling requirements is represented through five levels (i.e. low to high) and the criticality value is proportional to the five levels.



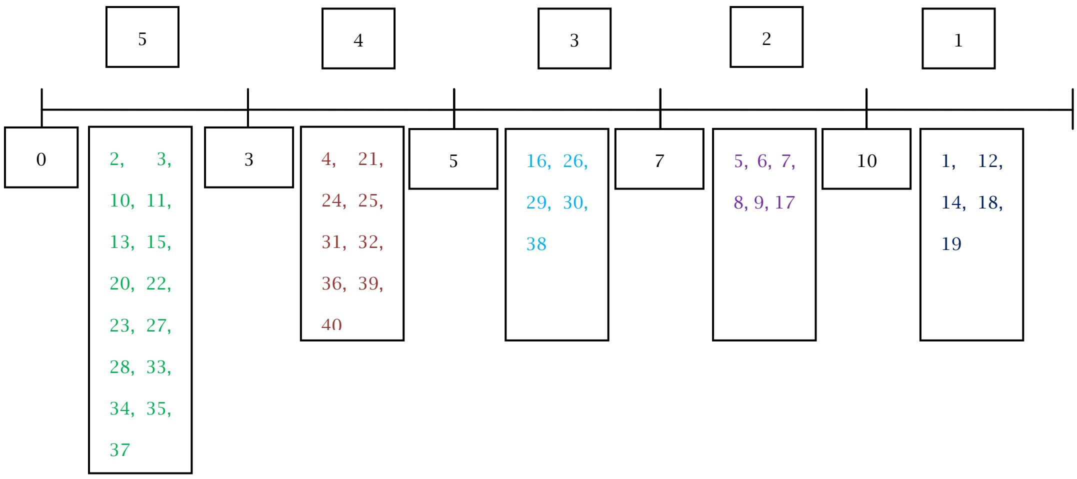
Technology level

Technology level affects the globalization of the strategic supply chain configuration. An increasing in technology level could lead to the increase in supply chain costs. The innovational products require the high quality, even scarce materials that could be sourced abroad in general nevertheless the high procurement cost. Moreover, the production should be operated by skilled labors that are charged higher than ordinary workers. The technology level is measured by taking into account the competition level of the whole industry sector a firm is involved and the market position of the firm. Therefore, the numerical scale is represented based on the five levels.



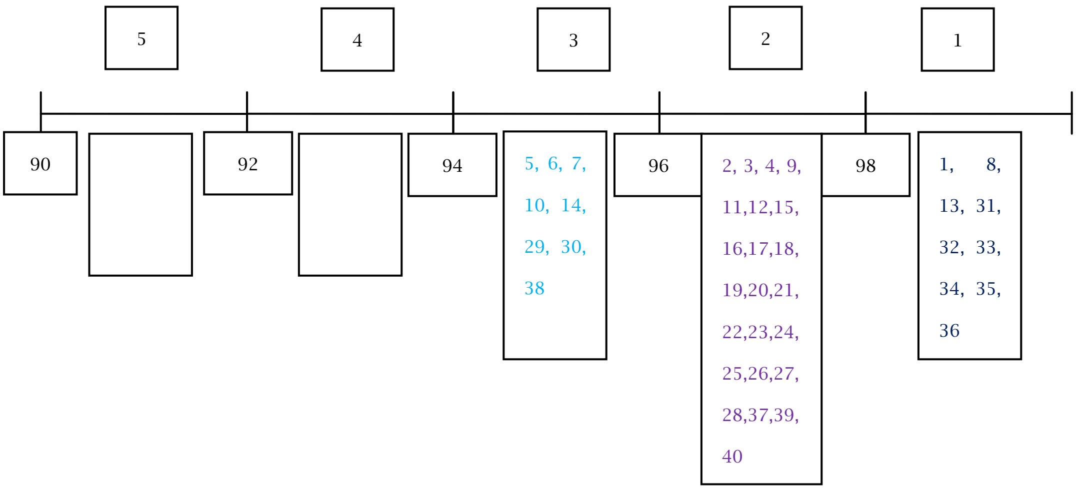
Cycle time

Cycle time affects the localization of manufacturing and distribution processes in a strategic supply chain configuration. The short delivery cycle time is able to improve the customer's satisfaction, therefore operating the production close to the market and local distribution is an effective way to reach this target. The longer the cycle lasts, the lower supply chain cost afforded. When the cycle time increases it is obtained a reduction in transportation costs, because a company does not need to choose fast transportation mode that are costly. On the basis of the case study, the cycle time is short for the companies that adopt local distribution, while the delivery period is longer under the case of global distribution.



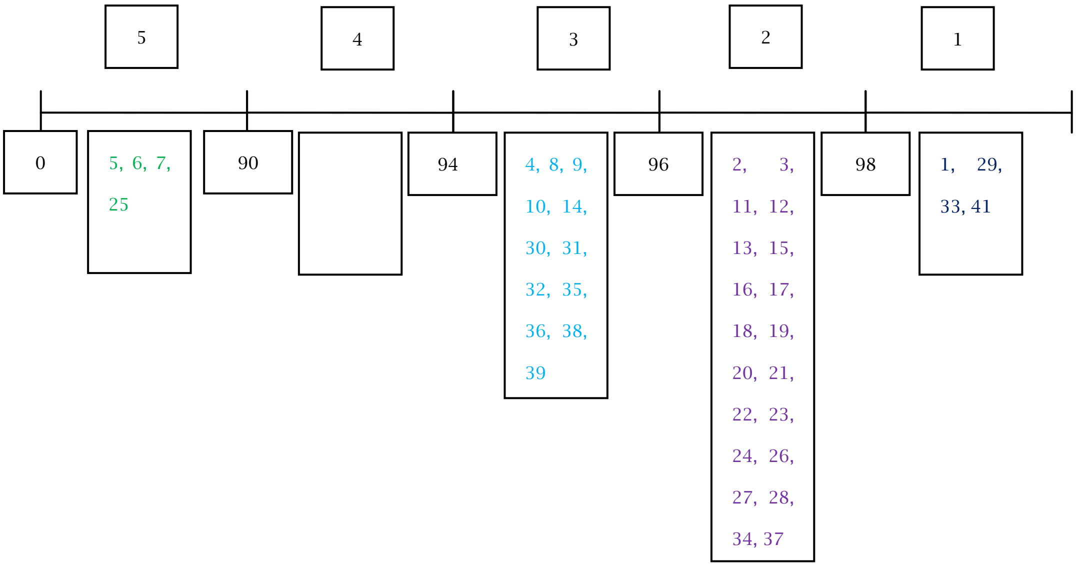
Completeness

Completeness (i.e. item fill rate) has the impacts on localization of manufacturing and distribution processes. When this performance increases, the supply chain costs would decrease. The transportation costs increases in case the completeness is reduced, since the level of saturation of the transportation mean cannot be fulfilled. What is more, with an increase in the completeness, the cost of lost sale is decreased. Considering the investigated companies are leading firms in their industry sectors. Therefore, every company performs well in completeness. The majority companies can reach at least 96% item fill rate.



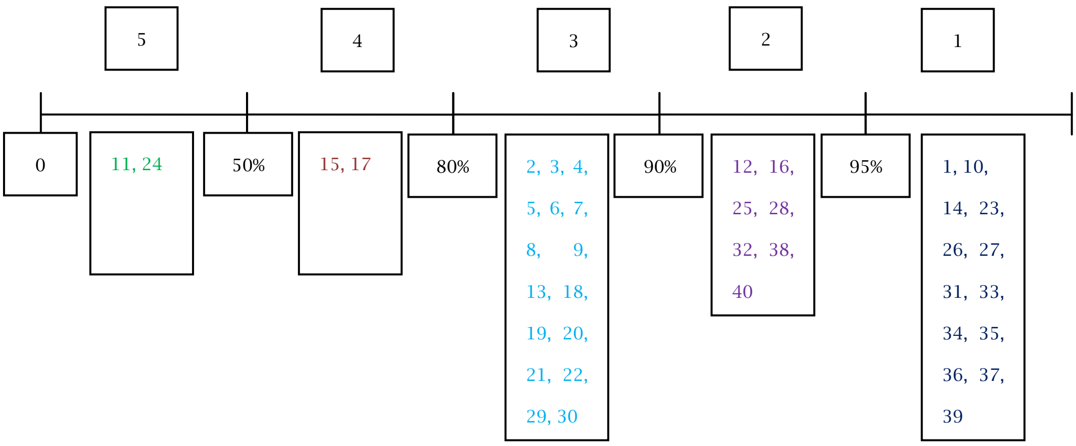
Delivery reliability

Delivery reliability influences the localization of products distribution. Accurate and timely delivery is in relation with the service level, and the short distribution pipeline could improve the distribution performance and mitigate the risk of delivery errors. An increasing in delivery reliability causes the decrease of supply chain costs, since it prevent from repeated delivery and punishment. In general, most of the investigated companies can deliver the products with a high reliability, while only a few firms cannot reach 96% in reliability. In addition, it seems that it is very difficult to reach 100% delivery reliability that may quite costly for a company.



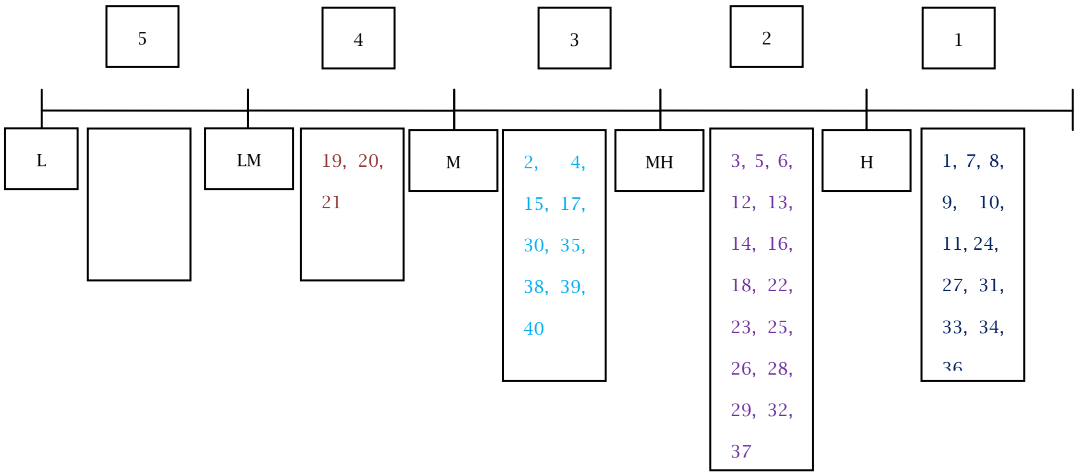
Dimension of order

Dimension of order affects the globalization of distribution. The long distance delivery, such as global distribution, could be used in case the dimension of the order is large enough to saturate the transport unit. The supply chain costs, particularly the transportation costs decreases with an augment in size of order. According to the case study, a few companies deliver the products with full truck load in order to decrease the total transportation costs and pursue the higher profit. On the other hand, most of the firms are not able to saturate the transportation unit because of the order's characteristics and service requirements.



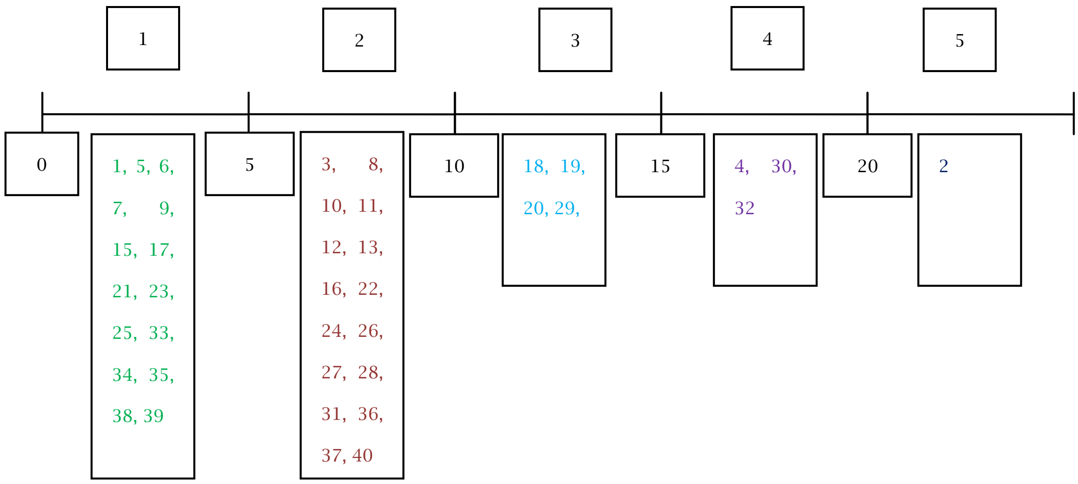
Demand predictability

Demand predictability has impacts on globalization of sourcing and distribution, since the advanced ability on demand predict can mitigate the risks on these two stages. A company spends less on supply chain cost in case the demand predictability is high. If the demand cannot be predicted in a correct way, additional unexpected deliveries have to be done in order to avoid stock out, and with an increasing in transportation costs. Likewise, the inventory costs would increase if a high level of uncertainty of future demand is presented, because inventory level tends to increase in order to cope with the unexpected demand. This driver should be measured on the basis of the average accuracy in demand forecast, but there is trouble on data collection as this method. Therefore, this variable is measured by considering the seasonality of the demand and the adoption of integrated information system in a company, and the original value and criticality scale are shown below.



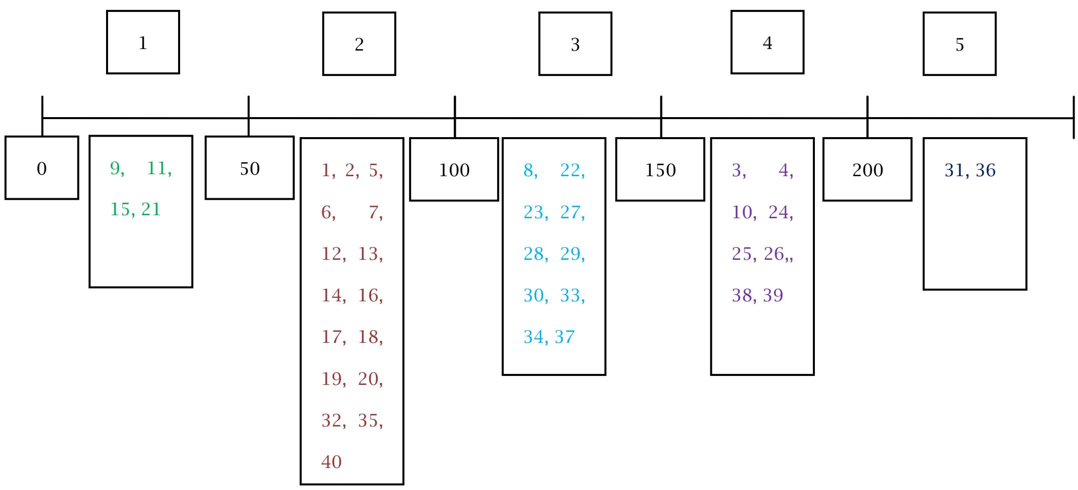
Demand volatility

Demand volatility influences the decision of localized strategic supply chain configuration, in particular on the sourcing and distribution processes. The products with high demand variability prefers the local procurement in order to mitigate the risk of late supply stemming from global sourcing whose delivery distance is quite long. Likewise, the distribution can be conducted on the local level in order to improve the quick response to the turbulent demand. An increasing in demand volatility results in the increase in supply chain costs. Firstly, the high demand volatility could bring the additional transportation costs due to the unexpected deliveries. Secondly, the inventory costs would be high because a company has to increase the inventory level in order to mitigate the risk of stock out. The investigation of demand volatility stemming from case study shows a very different result. The pharmaceutical industry and food industry exhibit a very stable demand, while the demand in fashion industry is comparatively turbulent.



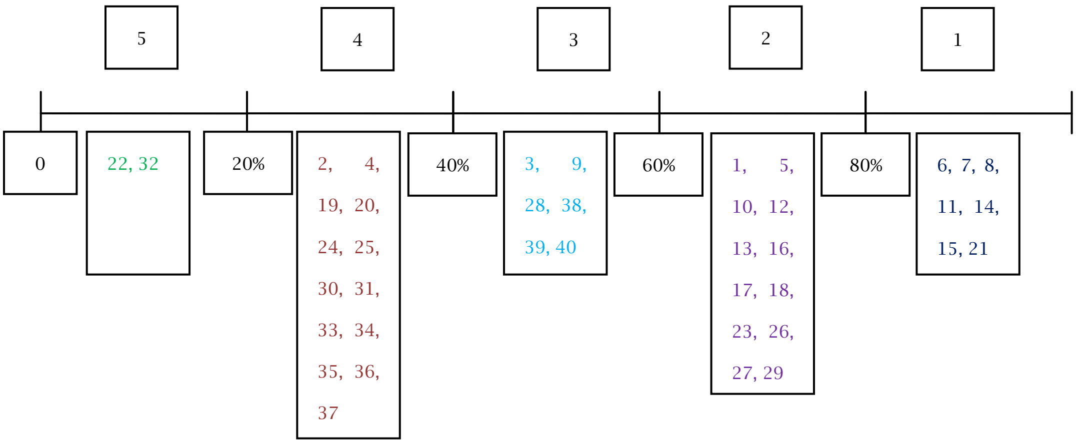
Dimension of market

Dimension of market motivates the globalization of sourcing and manufacturing. The strategic supply chain configuration becomes more complex when the dimension of market increases, because a company has to improve the management and control on the abroad suppliers and plants. Therefore, the supply chain costs increases with the augment of market dimension. According to the case study, the companies provide commodity goods have the highest market dimension (e.g. Coca-Cola Beverage, Colgate-Palmolive, etc.), while the most of remaining companies sold the products less than 100 countries.



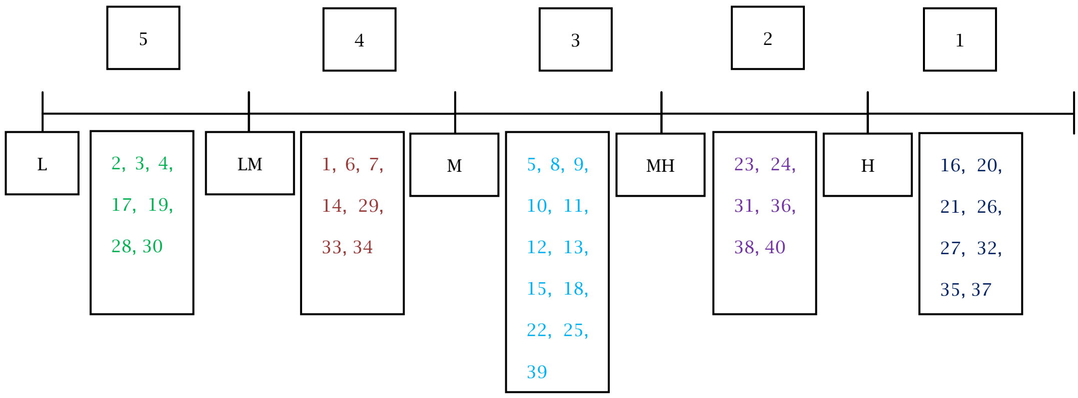
Strength of domestic demand

The strength of domestic demand has impact on the globalization of manufacturing. A company would like to operate abroad production if the demand of domestic market is weak while the overseas market is the main source of revenue. A company needs to improve the management and control when the production sites are located abroad in order to access the foreign market, and has to face the risk of loss of control, less skilled labors, the lack of staff training and so on. Therefore, the supply chain costs could be high if the domestic demand is weak, because a firm invests more on the global operation. On the basis of case study, the original value of strength of domestic demand in some companies is 100%, mainly due to the purely local strategic supply chain configuration (i.e. all the three supply chain processes are implemented on the local level in each region or all the products are only distributed to one region). On the other hand, the remaining firms show different original values on the basis different strategic supply chain configuration and company's strategy.



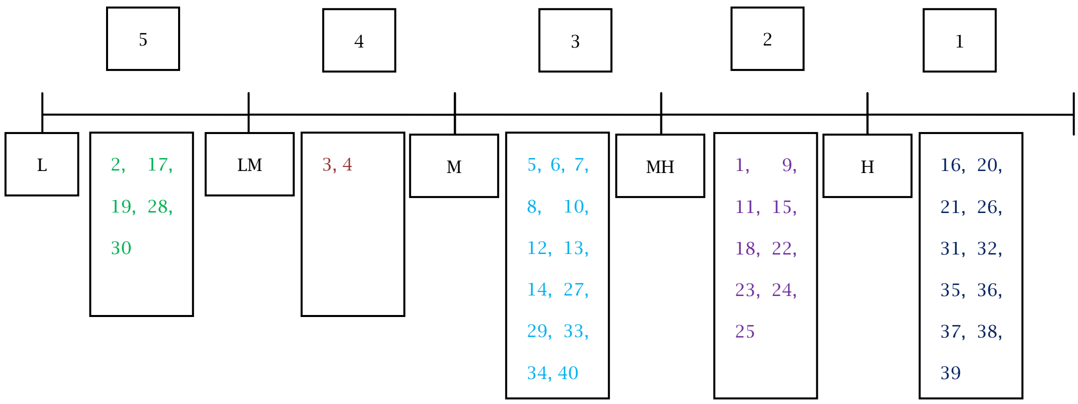
Competition of domestic suppliers

The level of domestic suppliers' competition has impact on the localization of material procurement. The fierce competition indicates the suppliers have to decrease the price in order to attract the buyers. Instead, if the number of suppliers is quite small that means the buyers would lose the power of bargain, and a company may search the abroad suppliers who can provide the purchased items with lower price. Therefore, an increasing in competition of domestic suppliers leads to the decrease of procurement costs and localized sourcing strategy. This driver should be measured based on the number of domestic suppliers that can provide items to focal company. However, it is hard to investigate the exact suppliers' quantity. Therefore, we use the five levels, from low to high, to indicate the number of domestic suppliers from small to large.



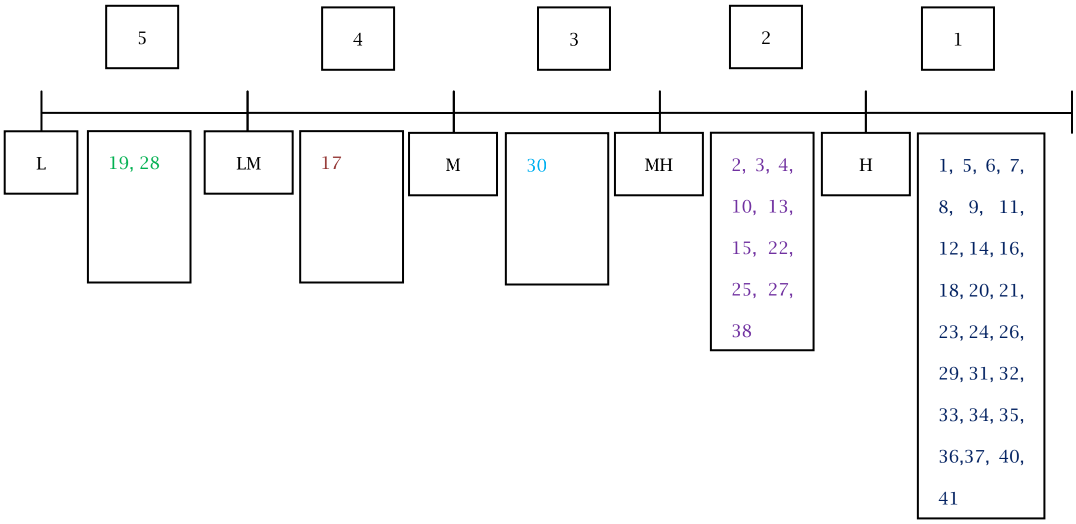
Availability of purchased items

The availability of purchased in home country of the focal company affects the localization of sourcing. A company has to conduct procurement abroad if the required items are not available in home country, even if the procurement costs could be high due to the increase in transportation costs. Therefore, the increase in availability of purchased items in home country causes decrease in supply chain costs. This variable is measured on the basis of the endowment of the domestic suppliers to the main purchased raw materials, and the company's documents involving the risk of procurement.



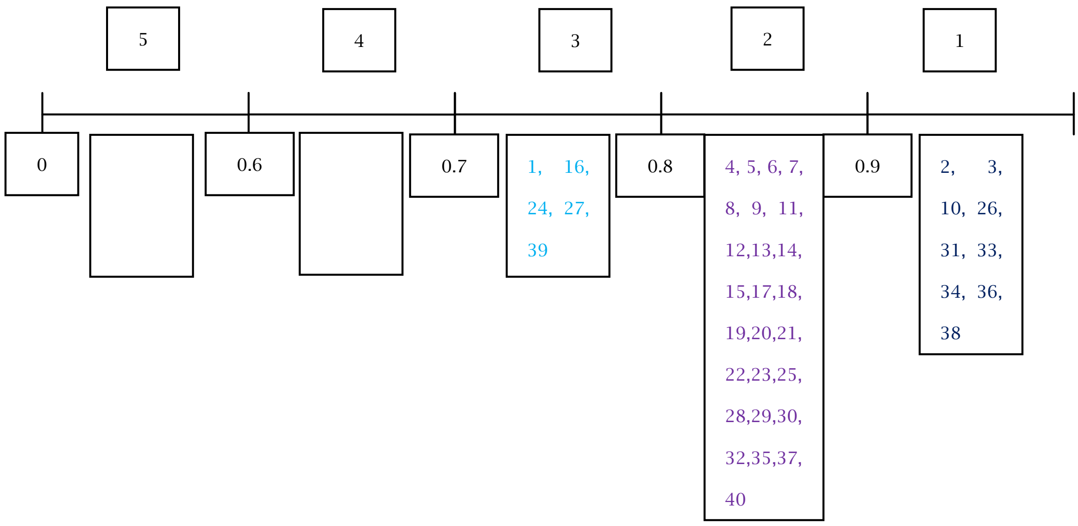
Quality of domestic sources

Quality of domestic sources has impact on localization of sourcing. The buyers would like to adopt local sourcing strategy in case the domestic suppliers provide high quality items. Instead, global sourcing has to be implemented despite higher procurement cost due to the increase in transportation costs. Therefore, an increasing in quality of domestic source causes the decrease in supply chain costs. This driver is measured on the basis of the company's financial report and other documents. The majority of the investigated companies can receive the required items with high quality in home country mainly results from those firms are headquartered in advanced countries that possess the advanced technology in different industry sectors.



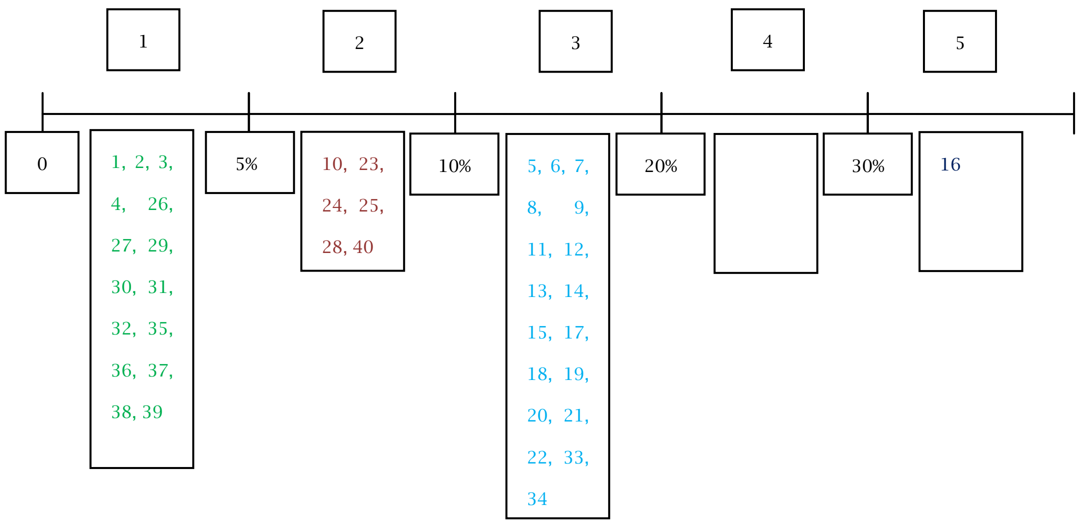
Strength of domestic currency

The strength of currency against the value of US dollar affects the globalization of manufacturing. By taken into account the US dollar is the most widely used currency in the global business nowadays, a company can mitigate the risk stemming from the loss of fluctuation on domestic currency that mean the unstable domestic currency value increases the financial loss in the global business. Instead, the stable currency's value can mitigate the loss, and decrease the supply chain costs. What is more, the stable currency facilitates a company to operate business abroad in order to pursue the low operation cost due to the less financial loss. In the investigated companies, the American firms have the currency advantage in nature because Breton Wood system endows US dollar the currency benefits, and the remaining companies headquartered in other countries have to exchange the domestic currency to US dollar for the global business payment.



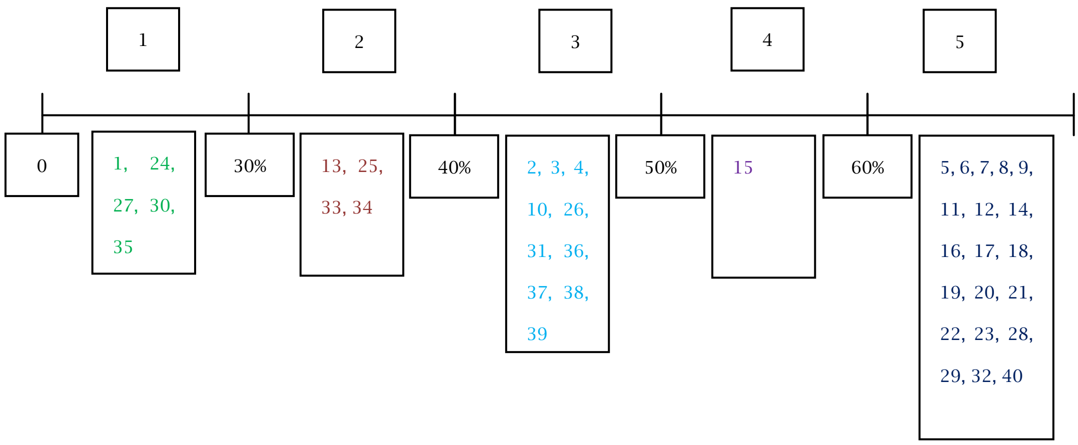
Import tariff

The import tariff affects sourcing and manufacturing processes. A company prefers the local strategy along with the increasing of import tariff charged by domestic government, because such strategy can avoid the addition cost stemming from the import of raw materials and finished products. Therefore, an increasing in import tariff brings the augment of supply chain costs. The import tariff is different according to the type of product and a country's policy. Whereas, the original value of import tax can be checked on the website of national customs or the relevant government department. Some countries launch the tax free policy for specific products imported abroad, while some products are imposed high trade tax in order to protect the domestic industry.



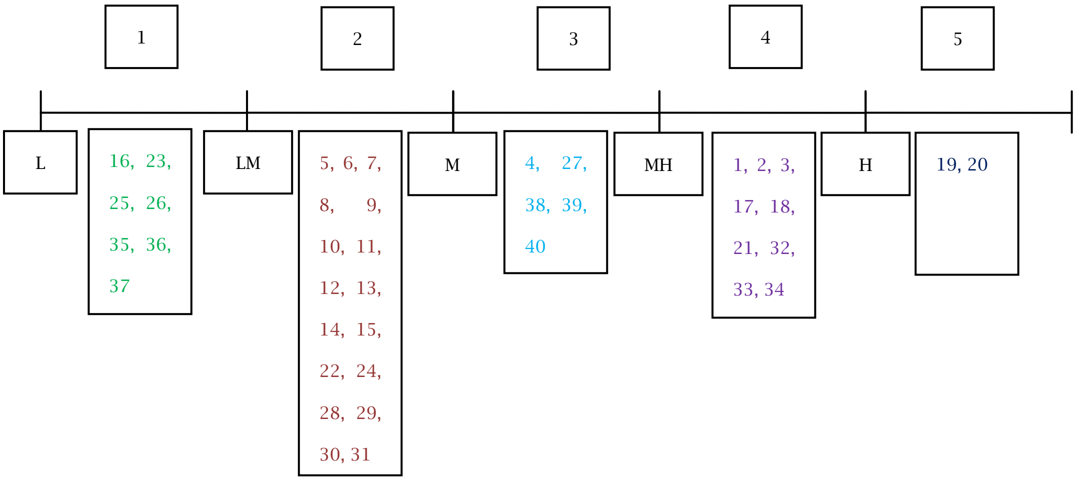
Tax incentives and benefits

Tax incentives and benefits indicate the total commercial tax rate in the home country of a company. This measure has impact on the globalization of manufacturing. The high tax rate compels a company to operate the business abroad in order to increase the after-tax profit. Therefore, an increasing in total commercial tax rate causes the increase in supply chain costs. The original value of total commercial tax rate is available in the World Bank indicators database. The commercial tax rate in Italy is quite high and reaches 68%, while the value is low in some countries such as Switzerland and Denmark.



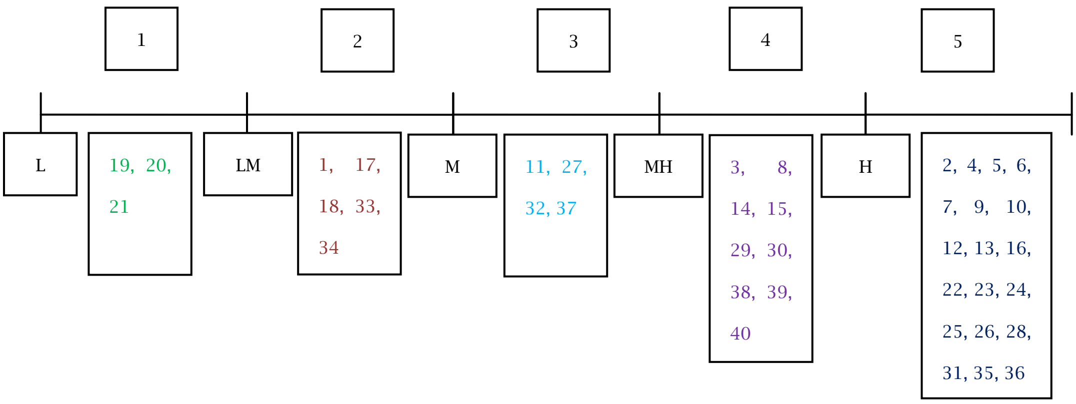
Importance of labor's quality

Importance of labor's quality affects the globalization of manufacturing. A company has to afford higher cost for the high qualified labors in order to manufacture the innovational production with high quality if they are available in homeland. Otherwise, the manufacturing has to be implemented in other countries where the skilled labors are available, but the firm needs to afford higher investment for the overseas operation. Therefore, the supply chain costs are increased along with an increasing on importance of labor's quality. This driver is measured on the basis of the type of finished products and the requirements of production process. In general, the innovation products need high skilled labors while the requirement is low for the commodity products.



Importance of labor's cost

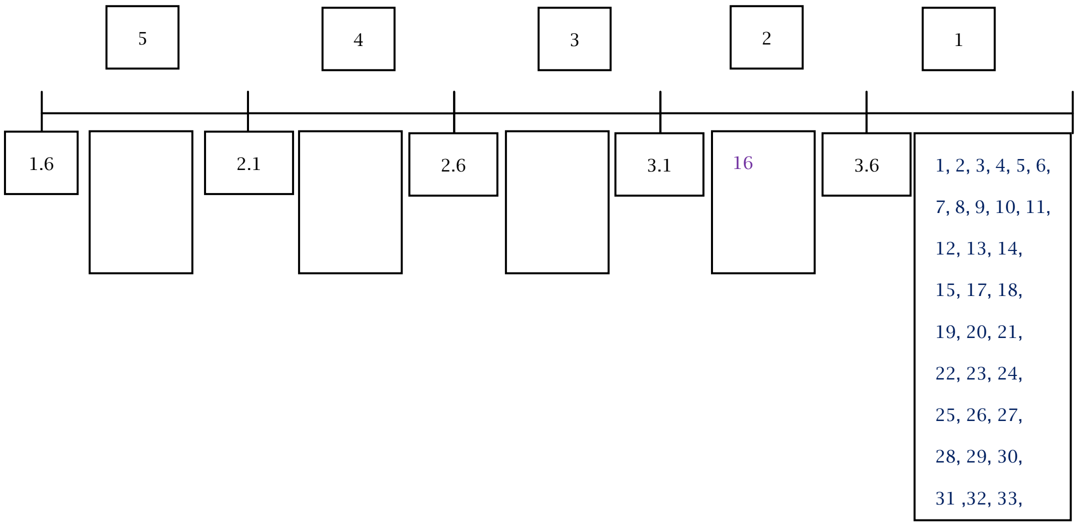
Labor's cost heavily affects the strategic manufacturing decision. A company prefers to operate the manufacturing in the country with low labor's cost. Global manufacturing could be conducted if the labor's cost is high in homeland. It is difficult to say if the importance of labor's cost stimulates an increasing in supply chain costs, whereas the total operating costs would be high in case the domestics labor's cost is high and the number of available labors is small, since a firm has to carry out the production abroad despite the high investment. According to the case study, the labor's cost is not extremely important if a company produces innovational products with high profit margin, while the labor's cost is a critical factor affecting the company's performance.



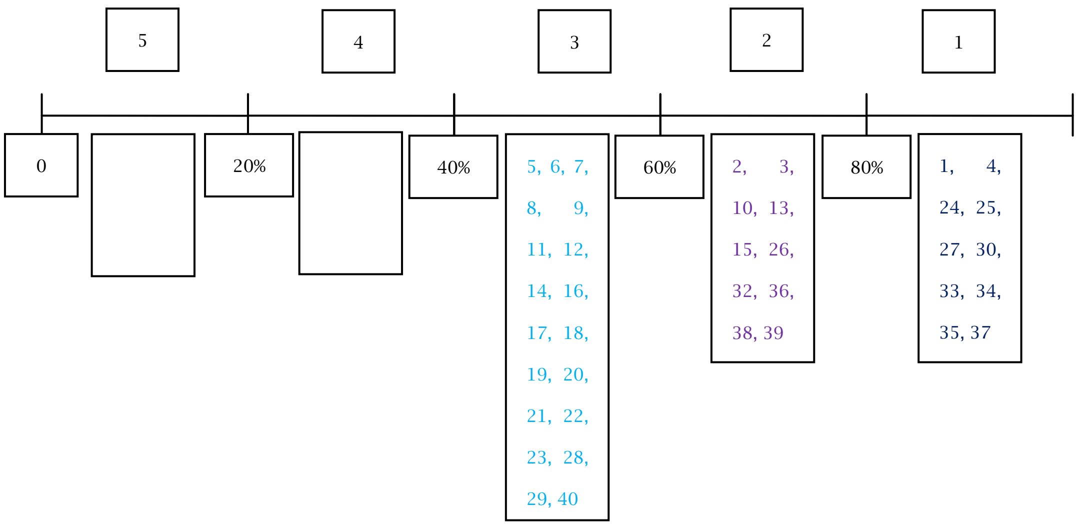
Quality of infrastructure

Quality of domestic infrastructure affects the localization of manufacturing. A firm is likely to conduct production in a country whose infrastructure is advanced. The local manufacturing could be adopted in case the quality of domestic infrastructure is high. Otherwise, the production site has to be moved abroad. In general, the investment on infrastructure is provided by government, while the cost of production movement should be afforded by the company. Therefore, the high quality of domestic infrastructure causes the decrease of total supply chain costs. The majority of the investigated companies are headquartered in advanced countries. Therefore the quality of infrastructure is satisfied by those firms. This measure is determined by two sub-indicators, i.e. Logistics Performance Index (LPI) and Internet users (per 100 people), all these two variables are provided by World Bank database. The criticality of this driver can be evaluated on the basis of the average original value of the two sub-indicators.

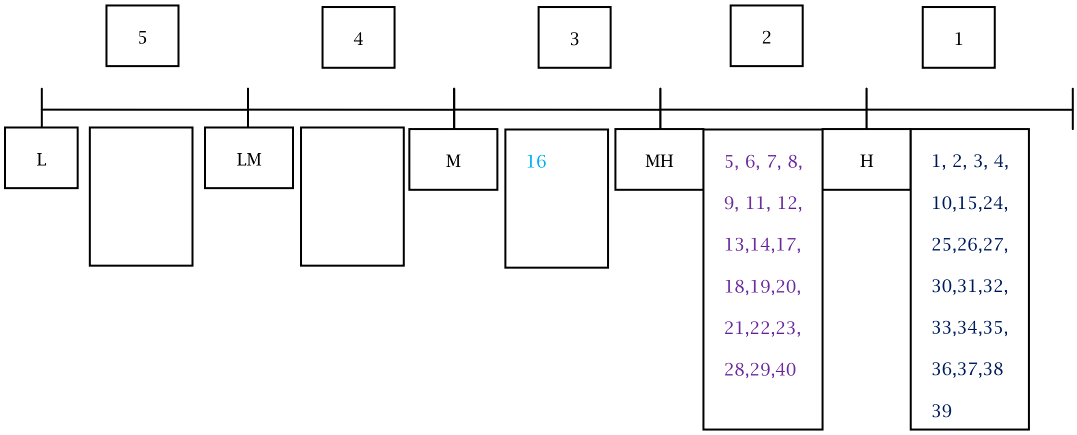
Logistics Performance Index:



Internet users (per 100 people):

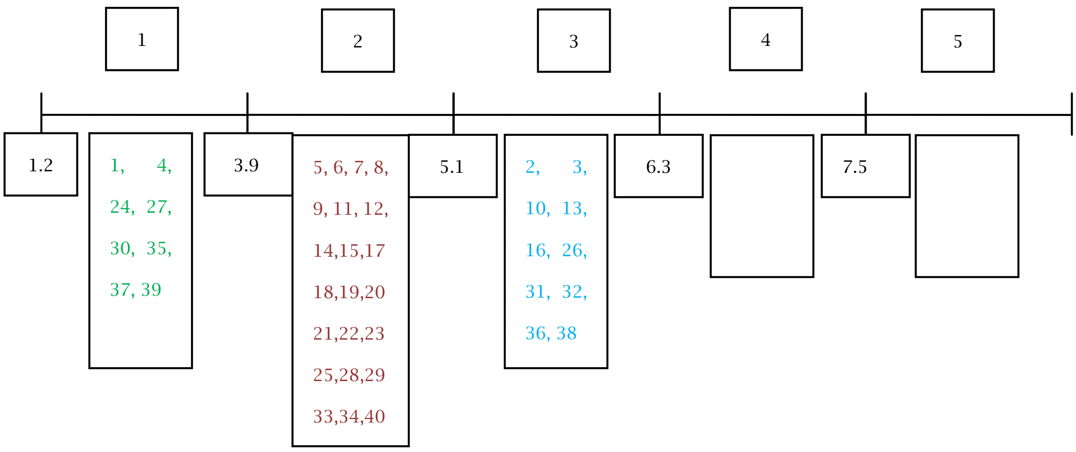


Overall value:



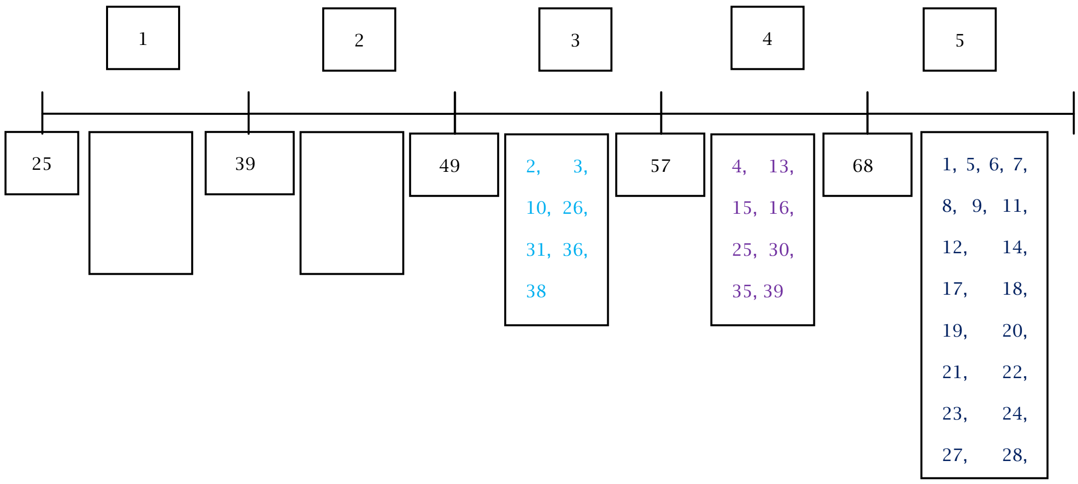
Political stability

The domestic political environment affects a firm to make decision about manufacturing in home country or abroad. The stable political environment is a motivator for local manufacturing. Otherwise, political instability increases the risks and costs for a company, and compels the firm to operate business abroad in order to avoid the unsatisfied domestic political issues. The original value of this driver is evaluated on the basis of Political Instability Index (PII), which evaluates 165 countries based on the score from 1.2 to 8.8. The less score of PII indicates the high stability of the political environment in a country. In general, all the advanced countries can provide a satisfied



Environment concern and regulation

Environment concern and regulation has direct impact on the strategic location decision about manufacturing. A company could afford less cost, and locate the manufacturing site in homeland if the domestic government provides moderate environment policy. Instead, a company has to invest more on the environment protection or move the manufacturing to the countries with weak requirements of environment issues. Therefore, an increasing in environment concern and regulation causes higher supply chain costs, mainly on the operations cost. This measure is evaluated on the basis of Environment Performance Index (EPI) that analyzes more than 130 countries which are scored from 25 to 77 and classified into five levels from weakest to strongest in order to describe the scale of a national government's environmental policy.



7. Data analysis

7.1. Data analysis process

The aim of quantitative analysis is threefold. The first purpose is data reduction that diminishes the number of affecting drivers depending on a series of statistical models (i.e. correlation analysis, factor analysis, and regression analysis), in order to obtain the most significant drivers. Data classification is the second purpose that aims to identify the context factors affecting strategic supply chain configurations. In fact, these two issues are closely bonded, because during the journey of data reduction, the number of the measured drivers is reduced based on the importance and reliability through a sequential quantitative analysis process (i.e. exploratory study, confirmatory study, and regression study), while the latent context factors can be classified based on the drivers' common characteristics as the intermediate output of the entire data analysis procedure. Another purpose of quantitative analysis is model development in which the decision matrix can be built based on the most significant drivers.

The quantitative analysis process is divided into two main parts when the research sub-objectives are considered. The first part consists of exploratory study and confirmatory study aiming to propose a theoretical model in which the number of the drivers is preliminary reduced, and the retained drivers are categorized into different factor groups based on their common characteristics through the statistical techniques of correlation analysis and factor analysis. In the second part, the third phase of the data analysis process (i.e. regression study) aims to identify the relationships between strategic supply chain configurations and supply chain problems, therefore, the number of drivers is further reduced in order to obtain the most significant drivers, which are employed to develop the decision matrix in the last phase (i.e. decision matrix study).

More in detailed, during the data analysis procedure, in order to minimize the problem of self-perceptual bias, several statistical approaches are employed to develop and evaluate the 27 drivers, including correlation analysis, exploratory factor analysis (EFA), and regression analysis. These techniques are useful in the early stage of empirical study, where the theoretical model do not exist, and, therefore, the exploratory of the model through exploratory factor analysis (EFA) is required. Furthermore, despite the theoretical model can be established on the basis of the exploratory technique, the unidimentionality and validity are not be assessed. Therefore, it is necessary to carry out confirmatory factor analysis (CFA) with a multiple-indicator measurement model to test the explored model. The linear regression analysis is implemented when strategic supply chain configurations are seen as dependent variables that are represented by the most critical drivers provided by developed theoretical model, in order to figure out the regression coefficients of those critical drivers in which the significant ones can be used to develop the decision matrix.

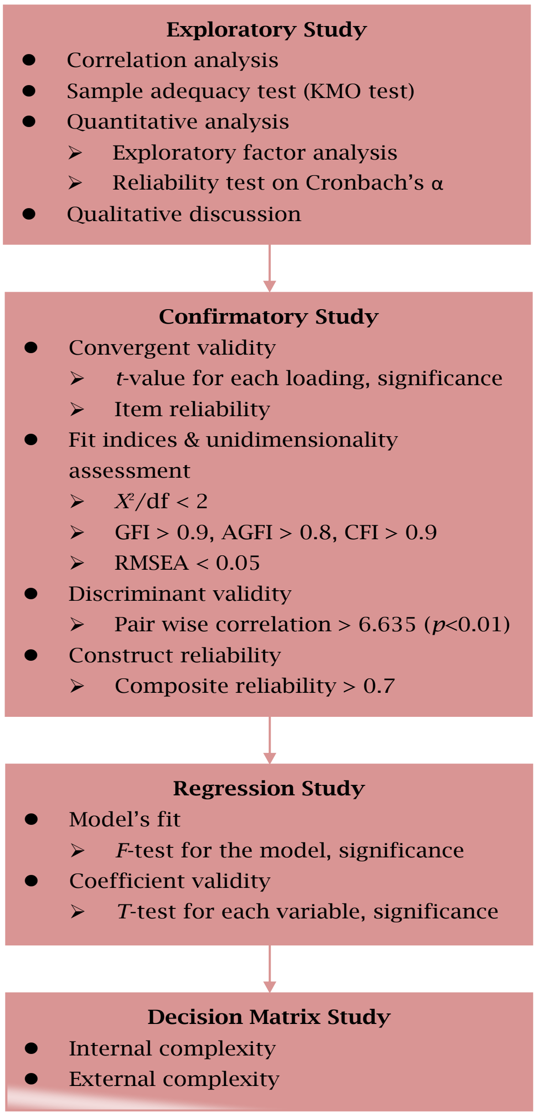


Figure 7.1 – Data analysis process

7.2. Exploratory study

7.2.1. Correlation analysis

Correlation analysis has been used extensively in the different field (e.g. psychology, marketing, and economics, etc). This statistical technique indicates that if the items (i.e. variables) in a measure are drawn from the domain of a single construct, responses to these items should be highly intercorrelated (Churchill, 1991). In order to avoid the multicollinearity in the 27 identified drivers, correlations between them are analyzed. The driver has to be dropped or combined when it is perfectly correlated to another one. The bivariate relationships between the separate variables are presented as Pearson correlation coefficients in the Table 7.1, where the bold numbers indicate the correlations are significant at 0.01 of *p*-value. Result reports that the prefect correlated relationship is absent between all the drivers, whereas there is a extremely high value of 0.843 at the 0.01 level of statistical significance existed between competition of domestic suppliers (V17) and availability of purchased items (V19). The former attribute is affected by the number of domestic suppliers, whereas the latter one represents the resource endowment of purchased items. Those two drivers indicate two separate dimensions. Therefore, this strong relationship is accepted.

	V1	**V2**	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**	**V9**	**V10**	**V11**	**V12**	**V13**	**V14**	**V15**	**V16**	**V17**	**V18**	**V19**	**V20**	**V21**	**V22**	**V23**	**V24**	**V25**	**V26**	**V27**
V1	1.00																										
V2	0.02	1.00																									
V3	0.06	**0.62**	1.00																								
V4	0.17	**0.65**	**0.61**	1.00																							
V5	0.13	0.16	0.08	0.09	1.00																						
V6	-0.3	0.27	0.23	0.10	**–0.4**	1.00																					
V7	-0.2	0.09	-0.0	-0.2	**–0.5**	**0.62**	1.00																				
V8	-0.3	0.37	0.18	-0.1	**–0.4**	**0.74**	**0.74**	1.00																			
V9	0.16	-0.1	-0.3	-0.3	0.30	-0.1	0.05	-0.1	1.00																		
V10	-0.2	0.08	0.31	0.14	-0.3	0.16	0.08	0.18	**–0.4**	1.00																	
V11	0.02	-0.3	**–0.4**	-0.2	-0.1	0.04	0.05	-0.0	-0.1	0.21	1.00																
V12	-0.0	0,19	0.28	**0.50**	0.01	-0.0	-0.1	-0.1	-0.1	0.19	-0.2	1.00															
V13	0.03	0.60	**0.47**	**0.68**	-0.2	0.43	0.22	0.30	**–0.4**	0.32	-0.1	0.33	1.00														
V14	-0.1	0.32	0.19	0.30	0.18	0.18	-0.0	0.01	-0.0	0.13	-0.0	0.22	0.34	1.00													
V15	0.10	-0.3	**–0.4**	**–0.5**	-0.0	-0.1	0.17	0.05	0.24	-0.1	0.32	-0.4	**–0.4**	-0.0	1.00												
V16	-0.0	-0.0	-0.2	-0.2	**0.41**	0.03	0.20	0.15	0.28	-0.3	0.23	-0.1	-0.1	0.31	**0.42**	1.00											
V17	-0.1	0.40	0.4	0.25	-0.1	0.12	-0.0	0.33	-0.2	0.28	-0.0	0.28	0.25	0.20	-0.0	-0.0	1.00										
V18	-0.1	0.37	0.40	0.20	-0.0	-0.0	-0.0	0.17	-0.2	0.22	-0.1	0.30	0.21	0.30	-0.1	-0.0	**0.84**	1.00									
V19	0.08	0.19	0.27	0.17	0.09	-0.3	-0.1	-0.1	-0.1	0.03	-0.0	0.21	0.26	0.19	0.02	0.16	**0.54**	**0.68**	1.00								
V20	0.03	-0.1	0.22	0.19	-0.0	-0.0	0.07	-0.2	-0.2	0.04	-0.1	0.20	0.13	-0.0	-0.3	-0.2	-0.1	-0.1	-0.0	1.00							
V21	-0.1	0.24	0.37	0.52	0.12	-0.0	-0.3	-0.1	-0.3	0.05	-0.2	0.35	0.19	-0.3	**–0.5**	-0.4	0.04	0.05	-0.0	0.19	1.00						
V22	-0.2	0.06	0.24	0.38	-0.0	0.01	-0.2	-0.0	**–0.5**	0.32	-0.1	0.30	**0.43**	-0.0	**–0.4**	-0.3	0.03	0.04	0.02	0.02	0.53	1.00					
V23	-0.0	0.78	0.45	0.35	0.03	0.40	0.33	**0.52**	-0.1	-0.0	-0.2	0.17	**0.61**	0.31	-0.2	0.18	0.30	0.29	0.24	-0.0	0.04	0.06	1.00				
V24	-0.1	-0.6	-0.3	-0.3	-0.2	-0.0	-0.0	-0.2	-0.0	0.12	**0.46**	-0.0	**–0.4**	-0.0	0.34	-0.0	0.01	-0.0	-0.1	-0.0	-0.1	-0.0	**–0.7**	1.00			
V25	-0.1	0.03	0.40	0.49	-0.0	0.01	-0.3	-0.2	**–0.5**	0.23	-0.2	0.33	0.29	-0.1	**–0.5**	**–0.4**	0.02	0.11	0.04	0.32	**0.76**	**0.77**	-0.0	-0.0	1.00		
V26	-0.0	0.01	-0.0	0.08	-0.0	0.04	-0.2	-0.0	-0.0	-0.0	0.08	-0.0	-0.0	0.03	0.13	-0.0	-0.0	-0.0	-0.0	**–0.6**	0.14	0.30	0.01	0.20	0.13	1.00	
V27	-0.1	0.17	0.31	0.16	0.18	-0.0	-0.1	-0.0	-0.2	0.04	-0.3	0.23	0.12	-0.1	**–0.5**	-0.1	0.03	0.11	-0.0	**0.54**	**0.46**	0.39	0.20	-0.4	0.51	-0.5	1.00

Table 7.1 – Result of correlation analysis

7.2.2. Exploratory factor analysis

7.2.2.1. Quantitative analysis

Factor analysis is a statistical approach that can be used to analyze interrelationships among a large number of variables and to explain these variables in terms of their common underlying dimensions (factor). The information contained in the original variables can be conducted into the smaller set of dimensions with minimum loss of information. Exploratory factor analysis (EFA) has been conducted on 27 drivers using principle component analysis with varimax rotation to extract the factor. All the drivers were conducted KMO test for sampling adequacy to determine the suitability of the data for factor analysis. The overall KMO measure is 0.5634 that is mainly affected by the limited sample size. However, it is above 0.5, which is the minimum cut off for factor analysis (Kohn, *et al.,* 2011). KMO result indicates the data are suitable for factor analysis. The initial EFA results reveal eight factors could be considered to represent all the drivers (see Table 7.2). However, by taking into consider the limitation on sample size, and the qualitative evaluation should be conducted as the further step in order to ensure the correctness of the result.

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
V1								-0.803
V2		0.820						
V3		0.480						
V4	0.509							
V5			-0.825					
V6			0.791					
V7			0.819					
V8			0.783					
V9	-0.751							
V10	0.433							
V11							-0.643	
V12						0.452		
V13		0.549						
V14						0.871		
V15	-0.572							
V16	-0.524							
V17				0.902				
V18				0.932				
V19				0.761				
V20					0.867			

V21	0.743							
V22	0.869							
V23		0.879						
V24		-0.895						
V25	0.902							
V26					-0.901			
V27					0.685			

Table 7.2 – Initial result of EFA

7.2.2.2. Qualitative discussion

The initial EFA result reports that 27 drivers can describe 8 latent factors. Each factor is composed by a set of drivers, but there are two exceptions, the seventh and eighth factors include only one driver respectively. In the theory, the delivery reliability (V11) is a variable measuring delivery performance, and represented as one of the requirements of customer service like cycle time and completeness, and therefore, this driver should be grouped into the first factor. Unfortunately, the reliability of the first factor is destroyed when the delivery reliability is fed into the first group. Therefore, in order to retain the reliability of the model, this driver could be deleted from the model. In addition and likewise, another driver - product variety (V1) - forms an individual factor. This driver should be assigned to the second factor representing the product physical and production features, since it influences the entire supply chain configuration in the theory. However, the reliability of the second factor group is reduced significantly. Therefore, this driver has to be dropped. As a result, the remaining 25 drivers are grouped into 6 factors (see Table 7.3).

Factor	**Item**	**Driver**	**Factor loading**	**Cumulative Variance Explained**	**Cronbach's alpha**
1	V4	Risk of obsolescence	0.509	0.172	0.817
	V9	Cycle time	0.751		
	V10	Completeness	0.433		
	V15	Dimension of market	0.572		
	V16	Strength of domestic market	0.524		
	V21	Import tariff	0.743		
	V22	Tax incentives and benefits	0.869		
	V25	Quality of infrastructure	0.902		

2	V2	Product value density	0.820	0.314	0.871
	V3	Physical density	0.480		
	V13	Demand predictability	0.549		
	V23	Importance of labor's quality	0.879		
	V24	Importance of labor's cost	0.895		
3	V5	Profit margin	0.825	0.440	0.845
	V6	Competition level	0.791		
	V7	Handling characteristics	0.819		
	V8	Technology level	0.783		
4	V17	Competition of domestic suppliers	0.902	0.547	0.868
	V18	Availability of purchased items	0.932		
	V19	Quality of domestic sources	0.761		
5	V20	Strength of domestic currency	0.867	0.632	0.786
	V26	Political stability	0.901		
	V27	Environment concern and regulation	0.685		
6	V12	Dimension of order	0.452	0.696	0.365
	V14	Demand volatility	0.871		

Table 7.3 – Intermediate result of EFA

A serious problem can be seen from the above table is that the cronbach's α of the sixth factor is 0.365, whereas a cronbach's α of 0.70 or higher is indicative of good reliability (Skipper and Hanna, 2009). Therefore, we should further discuss this factor. Dimension of order (V12) can determine the transportation mode, and thus could be moved to first group in which the drivers represent the transportation feature in general. Consequently, the construct reliability (i.e. cronbach's α) of this group is 0.8247, which is higher than the original value (0.817). With regard to the demand volatility (V14), it can be moved to second group indicating the product physical and production features. However, Cronbach's α of the second group is not increased. Therefore, we decide to delete this item from the list.

Factor	**Driver**	**Factor loading**	**Cumulative Variance Explained**	**Cronbach's Alpha**
Transportation requirements	Risk of obsolescence	0.509	0.172	0.825
	Cycle time	0.751		
	Completeness	0.433		
	Dimension of order	0.443		
	Dimension of market	0.572		
	Strength of domestic market	0.524		
	Import tariff	0.743		
	Tax incentives and benefits	0.869		
	Quality of infrastructure	0.902		
Product physical & production features	Product value density	0.820	0.314	0.871
	Physical density	0.480		
	Demand predictability	0.549		
	Importance of labor's quality	0.879		
	Importance of labor's cost	0.895		

Product economic & technology features	Profit margin	0.825	0.440	0.845
	Competition level	0.791		
	Handling characteristics	0.819		
	Technology level	0.783		
Supply characteristics	Competition of domestic suppliers	0.902	0.547	0.868
	Availability of purchased items	0.932		
	Quality of domestic sources	0.761		
External environment features	Strength of domestic currency	0.867	0.632	0.786
	Political stability	0.901		
	Environment concern and regulation	0.685		

Table 7.4 – Final result of EFA

Finally, the 5 factors including 24 drivers are labeled (see Table 7.4) and described below:

1) Factor 1 consists of nine drivers, namely, risk of obsolescence, cycle time, completeness, dimension of order, dimension of market, strength of domestic market, import tariff, tax incentives and benefits, and quality of infrastructure. These drivers are able to affect the decisions on transportation issue. Therefore, this factor is identified as a transportation factor.
2) Factor 2 consists of five drivers, namely, product value density, physical density, demand predictability, importance of labor's quality, and importance of labor's cost. These drivers indicates the product's physical property and production requirement, thus, this factor is identified as product physical and production factor.
3) Factor 3 comprises four drivers, namely, profit margin, competition level, handling characteristics, and technology level. These drivers are economy and technology related attributes, therefore, this factor is identified as product economic and technology factor.
4) Factor 4 consists of three drivers, namely, competition of domestic suppliers, availability of purchased items, and quality of domestic sources. They are related to procurement, thus, this factor is identified as a supply factor.
5) Factor 5 comprises three drivers, namely, strength of domestic currency, political stability, and environment concern and regulation. These drivers are related to the external environment and society, therefore, this factor is identified as external environment factor.

7.3. Confirmatory study

7.3.1. Confirmatory factor analysis

The confirmatory factor analysis (CFA) is a statistical approach involving the specification and estimation of one or more hypothesized models of factor structure, each of which proposes a set of factors to account for covariance among a set of observed variables (Koufteros, 1999). The path diagram (see Figure 0.4) implies a measurement model where there are five latent factors made up of their corresponding multiple observed variables. The five latent factors are represented by circles and labeled with the Greek letters ξ. Those latent factors are inter-related, as indicated by the two-headed arrows. The Greek letter Φ_{ij} represents the correlation between them. In addition, the 24 observed variables are enclosed in squares. Nine observed variables (X1-X9) are loaded onto transportation requirements; five observed variables (X10-X14) are loaded onto product physical & production features; four observed variables (X15-X18) are loaded onto product economics & technology features; three observed variables (X19-X21) are loaded onto supply characteristics and the same number of observed variables (X22-X24) are loaded onto external environment features. At the left of the path diagram, the Greek letters δ are seen as errors in observed variables. A straight arrow pointing from a latent variable to an observed variable indicates the causal effect of the latent variable on the observed variable, and the Greek letter λ coefficients are the factor loadings of the observed indicators on the latent variables.

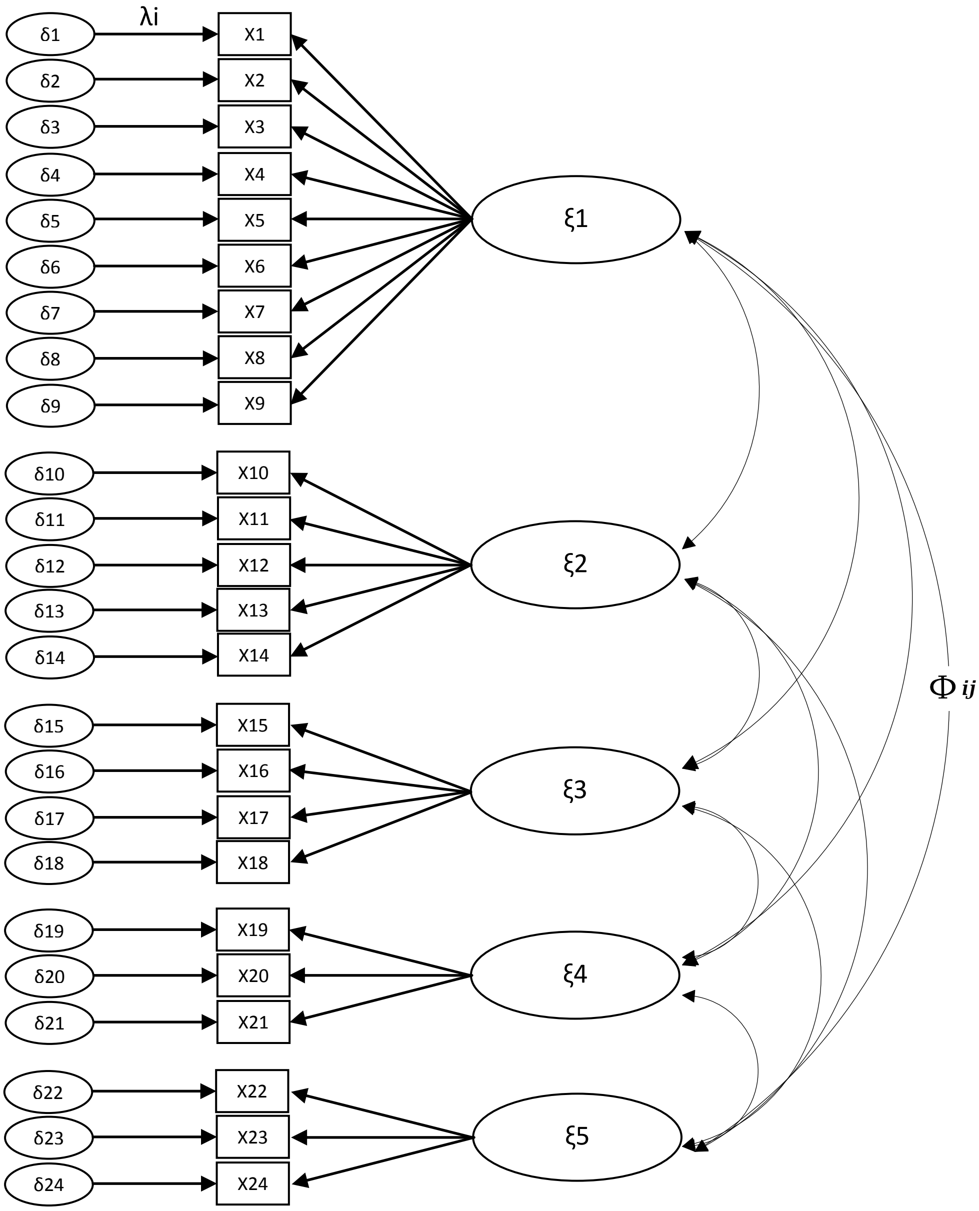


Figure 7.2 – Path diagram of CFA

In this research, LISREL8 software package was used to analyze the hypothesized model. The maximum likelihood estimation method was applied that has desirable asymptotic properties (e.g. minimum variance and unbiasedness) and is scale-free. This estimation method assumes multivariate normality of the observed variables (Wisner, 2003).

7.3.2. Assessment of factor loading and model's fit

The initial model's fit indices (e.g. X^2 (242) = 615.84, p = 0.000) of CFA suggested that improvement should be made. Examination of the factor loadings and modification indices suggested that four observed variables - X1, X3, X4, and X6 (i.e. risk of obsolescence, completeness, dimension of order, and strength of domestic market) - could be dropped from the model because of insignificant parameter estimates at $p < 0.01$. These drivers were considered less important to the model and thus were deleted. The modification indices also suggested observed variables are influenced each other between X13 (importance of labor's quality) and X14 (importance of labor's cost). This seems reasonable, because the quality and cost is the trade-off on the production in general. It was also found that X15 (profit margin) and X22 (strength of domestic currency) are correlated. This is not surprising, since the currency power is one of the factors to determine a firm's profit in the globalized business context. In addition, the observed item X16 (competition level) was suggested to establish the correlation link with X18 (technology level). It is reasonable to understand that the high-tech product is facing an increasing competition market. Finally, X22 (strength of domestic currency) was correlated with X24 (environment concern and regulation). The currency power indicates a country's economic advantage, which determines the other social-cultural facts, such as environment concern and regulation. The model was thus modified and the error covariance terms were added to link the appropriated sets of indicator variables.

The final model, consisted of 20 drivers and presented in Table 7.5, provides an adequate model fit (X^2 (158) = 185.53, $p = 0.388 > 0.05$), indicating that the proposed model is purified and acceptable. The tests of validity, reliability, and unidimensionality are discussed and described below.

Latent factor	**Driver**	**Standardized factor loading**	***T* – value**	**R^2**
ξ1	Cycle time	0.55	-	0.35
	Dimension of market	0.58	2.82	0.36
	Import tariff	0.74	3.30	0.62
	Tax incentives and benefits	0.74	3.29	0.63
	Quality of infrastructure	0.91	3.58	0.92
ξ2	Product value density	0.86	-	0.84
	Physical density	0.63	3.97	0.43
	Demand predictability	0.67	4.26	0.46
	Importance of labor's quality	0.78	5.09	0.70
	Importance of labor's cost	0.63	3.86	0.47
ξ3	Profit margin	0.57	-	0.30

	Competition level	0.60	3.14	0.32
	Handling characteristics	0.95	3.69	1.35
	Technology level	0.71	3.54	0.35
ξ4	Competition of domestic suppliers	0.80	-	0.76
	Availability of purchased items	0.94	5.19	0.94
	Quality of domestic sources	0.64	4.18	0.48
ξ5	Strength of domestic currency	0.84	-	0.67
	Political stability	0.57	2.89	0.81
	Environment concern and regulation	0.63	3.24	0.35
Goodness–of–fit statistics				
X^2 = 185.53 (p = 0.388); df = 158; X^2/df = 1.174; GFI = 0.90; AGFI = 0.80; CFI = 0.93; RMSEA = 0.027				

Table 7.5 – Parameter estimates, *t* – value, and R^2 for the proposed model

7.3.3. Convergent validity and item reliability

Convergent validity can be tested by *t* – value that is all statistically significant on the factor loading (Dunn *et al.,* 1994). The *t* –value greater than 1.96 or smaller than -1.96 implies statistical significance (Segar, 1997). The larger the factor loadings, the stronger is the evidence that the measured variables represent the underlying constructs (Bollen, 1998; Koufteros, 1999). Table 7.5 shows that all items exceed the required *t* – value at the 0.05 level of significance. Therefore, all indicators except deleted ones are significantly related to their specific constructs, verifying the posited relationships among the indicators and constructs.

Item reliability refers to the R^2 value in the observed variable that are accounted for by the latent variables influencing them, so R^2 can be used to measure the reliability of a particular observed item (Koufteros, 1999). The R^2 value typically above 0.3 provides evidence of acceptable reliability (Hair *et al.*, 1998). Table 7.5 also shows the R^2 value for all items are greater than 0.3. This reflects that the results are acceptable. Thus, the results of *t* – value and R^2 value provide sufficient evidence of convergent validity.

7.3.4. Assessment of the fit and unidimensionality

A number of goodness-of-fit indices recommended by many researchers were used to assess the fit and unidimensionality of the model (Bagozzi and Yi, 1988; Hu and Bentler, 1995; Kline, 1999; Koufteros, 1999). Table 7.5 shows that the *p* value of the Chi-square (X^2 = 185.53, df = 158) of 0.388, above minimum level of 0.05, indicates statistical nonsignificance. The result shows also some support for believing that differences in the predicted and actual matrices are nonsignificant, indicative of acceptable fit. Moreover, the goodness-of-fit index (GFI) and the adjusted goodness-of-fit (AGFI) are 0.90 and 0.80, respectively, reaching the recommended level perfectly. The Comparative Fit Index (CFI) is 0.93, which exceeds the recommended level of 0.90, further supporting acceptance of the model. The root-mean-square error of approximation (RMSEA) is 0.027. The normed Chi-square (X^2/df) obtains a value of 1.174, which falls well within the recommended range for conditional support to be given for model parsimony.

7.3.5. Discriminant validity

In order to assess discriminant validity, we built a constrained CFA model for every possible pair of latent constructs, in which the correlation between the paired constructs is fixed 1.0. This result is compared to the result of the unconstrained model, in which the correlations among constructs are freely estimated. If the difference between the chi-squares obtained from the original and the second CFA is greater than the chi-square value at the degree of freedom of 1 and significance level of $p < 0.01$ (i.e. 6.635), there is reasonable evidence of discriminant validity of the constructs (Ahire *et al.*, 1996). Table 7.6 reports the results for ten pair wise discriminant validity tests between the five latent constructs. The ΔX^2 values for all the tests confirm discriminant validity is satisfied.

Latent factors	**ξ1**	**ξ2**	**ξ3**	**ξ4**	**ξ5**
ξ1	-				
ξ2	6.94	-			
ξ3	9.62	9.61	-		
ξ4	35.19	31.43	7.07	-	
ξ5	12.48	10.28	21.87	27.94	-

Table 7.6 – Discriminant validity

7.3.6. Construct reliability

Construct reliability means that a set of latent variables of model are consistent in their measurement. This reliability is the degree to which a set of two or more indicators share the measurement of a construct. The high reliable constructs are those in which the indicators are highly intercorrelated, indicating that they are all measuring the same latent construct.

Composite reliability (CR) provides a measure of the internal consistency and homogeneity of items comprising a scale (Churchill, 1979). The range of values for composite reliability is between 0 and 1, and the value of greater than 0.7 expresses a satisfied level (Hair *et al.*, 1998). As presented in Table 7.7, indicates that the reliability of the constructs of Transportation requirements, Product Physical & Production features, Product Economics & Technology features, Supply characteristics, and External Environment features are 0.84, 0.84, 0.81, 0.85, and 0.76. All constructs exceed the recommended level.

A complementary measure to composite reliability is the average variance extracted (AVE). Higher variance value extracted value occurs when the indicators are truly representative of the latent construct. The recommended AVE value should exceed 0.50 for a construct (Fornell and Larcker, 1981). Table 7.7 also presents that among the AVEs of the measures, all constructs reach the recommended level except for External Environment (AVE = 0.48) closing to the minimum required value of 0.50. Thus, marginal acceptance can be given to this measure.

Measures	**CR**[a]	**AVE**[b]
$\xi 1$	0.84	0.51
$\xi 2$	0.84	0.51
$\xi 3$	0.81	0.52
$\xi 4$	0.85	0.76
$\xi 5$	0.76	0.48

Table 7.7 – Assessment of construct reliability

[a] Composite reliability (CR) = (sum of standardized loadings)^2/[(sum of standardized loadings)^2+(sum of indicator measurement error)].

[b] Average variance extracted (AVE) = (sum of squared standardized loadings)/[(sum of squared standardized loadings)+(sum of indicator measurement error)].

To summarize, it is found that the overall results of the goodness-of-fit of the model and the assessment of the model's validity and reliability substantial confirm the proposed theoretical model. The 20 critical drives and their effects on the supply chain system, and the 5 grouped context factors affecting strategic supply chain configuration are presented as Table 7.8

Factor	Driver	Effect on supply chain system		
		Sourcing	Manufacturing	Distribution
Transportation requirements	Cycle time		x	x
	Dimension of market	x	x	
	Import tariff	x	x	
	Tax incentives and benefits		x	
	Quality of infrastructure		x	
Product physical & production features	Product value density			x
	Physical density			x
	Demand predictability	x		x
	Importance of labor's quality		x	
	Importance of labor's cost		x	
Product economic & technology features	Profit margin	x		
	Competition level	x	x	
	Handling characteristics			x
	Technology level	x	x	
Supply characteristics	Competition of domestic suppliers	x		
	Availability of purchased items	x		
	Quality of domestic sources	x		
External environment features	Strength of domestic currency		x	
	Political stability		x	
	Environment concern and regulation		x	

Table 7.8 – Theoretical model

7.4. Regression study

The relationships of strategic supply chain configurations (i.e. local sourcing vs. global sourcing, local manufacturing vs. global manufacturing, and local distribution vs. global distribution) and the identified critical drivers given by theoretical model were examined by using regression analysis in which the strategic supply chain configuration of three operational processes (i.e. sourcing, manufacturing, and distribution) are seemed as dependent variable that are determined by a series of those critical drivers. Each process is analyzed individually through the regression model.

7.4.1. Regression model on sourcing stage

According to the theoretical model, it is reported that 9 critical drives affect the strategic location alternative on sourcing stage. Therefore, the fitted regression with strategic configuration of sourcing process as dependent variable (i.e. local sourcing or global sourcing) and those critical drivers as independent variables is presented as follows:

Y_s = β_0 +β_1(Profit Margin) +β_2(Competition Level) + β_3(Technology Level) + β_4(Demand Predictability) + β_5(Dimension of Market) + β_6(Competition of Domestic Suppliers) + β_7(Availability of Purchased Items) + β_8(Quality of Domestic Sources) + β_9(Import Tariff)

Where:

Y_s denotes the strategic supply chain configuration on sourcing process (i.e. local sourcing or global sourcing)

β_i denotes the coefficients of the constant and independent variables.

The result of regression model on sourcing stage shows the significant *F* –test value is 3.15, which is higher than 2.21 under the freedom of 9 and 30 (*p*–value is 0.0085). Among the 9 independent variables, 5 of them are significant influence the dependent variables. The reported coefficient of 0.509 on technology level is positive in the analysis and the reported *p*–value of 0.022 is significant at α level 0.05. Demand predictability shows the strong positive relation to the dependent variable with the coefficient of 0.685 and the *p*-value of 0.034, which is lower than 0.05. Another significant independent variable is competition of domestic suppliers whose value of coefficient is -0.309 and the reported *p*–value at required significance level is 0.022. The forth reported significant driver is availability of purchased items, which represents the significant coefficient of 0.638. In addition, quality of domestic sources reports the coefficient of -0.273 under the significant *p*–value of 0.003. Therefore, it is noticeable to conclude that those 5 drivers significant determine the strategic supply chain configuration on sourcing process (see Table 7.9).

Dependent variable: supply chain problems on sourcing stage				
F value				3.15
Significance of *F*- test				.009
R square				.4862
Variable	**Coefficient**	**Standardized Beta**	***T*–test**	**Significance of *P*–test**
Technology level	.509	.559	2.42	.022
Demand predictability	.685	.419	2.23	.034

Competition of domestic suppliers	-.309	-.347	-2.40	.022
Availability of purchased items	.638	.657	2.10	.045
Quality of domestic sources	-.273	-.206	-2.83	.003

Table 7.9 –Result of regression analysis on sourcing stage

7.4.2. Regression model on manufacturing stage

The number of the critical drivers affecting strategic supply chain configuration on manufacturing stage is 12 given by the theoretical model. Therefore, the regression model is constructed as following with the same rationale as the sourcing stage:

Y_m = β_0 +β_1(Competition Level) + β_2(Technology Level) + β_3(Cycle Time) + β_4(Dimension of Market) + β_5(Strength of Domestic Currency) + β_6(Import Tariff) + β_7(Tax Incentives and benefits) + β_8(Importance of Labor's Quality) +β_9(Importance of Labor's Cost) + β_{10}(Quality of Infrastructure) + β_{11}(Political Stability) + β_{12}(Environment Concern and Regulation)

Where:

Y_m denotes the strategic supply chain configuration on manufacturing process (i.e. local manufacturing or global manufacturing).

β_i denotes the coefficients of the constant and independent variables.

The result presents the *F*–test value is 4.35 under the freedom of 12 and 27, the *p*-value is 0.000, indicating the significant value. There are 5 variables show the significant relation with the dependent variable. In detailed, the coefficient of competition level is -0.613 and the *p*-value is 0.009. The technology level also show the strong relation with supply chain problems, and the reported coefficient of 0.476 is significant due to the *p*-value of 0.023. What is more, the strength of domestic currency determines the dependent variable obviously, its coefficient is -0.734 under the 0.05 significance level. Another significant variable is tax incentives and benefits whose coefficient is negative as well, shown -0.499, and reported *p*-value is 0.018. Lastly, the coefficient of 0.585 is obtained by importance of labor's cost, which is significant due to the *p*-value of 0.008 (see Table 7.10).

Dependent variable: supply chain problems on manufacturing stage				
F value				4.35
Significance of *F*- test				.000
R square				.6592
Variable	**Coefficient**	**Standardized Beta**	***T*–test**	**Significance of *P*–test**
Competition level	-.613	-.567	-2.83	.009
Technology level	.476	.524	2.41	.023
Strength of domestic currency	-.734	-.473	-2.51	.018
Tax incentives and benefits	-.499	-.596	-2.51	.018
Importance of labor's cost	.585	.665	2.85	.008

Table 7.10 –Result of regression analysis on manufacturing stage

7.4.3. Regression model on distribution stage

Based on the factor analysis, the theoretical model presents that 5 critical drivers affect strategic distribution network configuration. Therefore, the regression function is formulated as follow based on the defined model's principle:

$$Y_d = \beta_0 + \beta_1(\text{Product Value Density}) + \beta_2(\text{Physical Density}) + \beta_3(\text{Handling Characteristics}) + \beta_4(\text{Cycle Time}) + \beta_5(\text{Demand Predictability})$$

Where:

Y_d denotes the strategic supply chain configuration on distribution process (i.e. local distribution or global distribution).

β_i denotes the coefficients of the constant and independent variables.

The value of *F*-test of the model is 4.14 under the *p*-value of 0.0048, which reports the significant result. 3 independent variables present the significant relation with the dependent variable. First, the product value density positive influences the strategic distribution network configuration. The reported coefficient of 0.279 is significant due to the *p*-value of 0.007. Second, the value of coefficient of physical density is 0.334, which presents the strong positive relation under the *p*-value of 0.003. Lastly, cycle time is the third significant variable. Its coefficient is -0.098, and *p*-value of 0.049 (see Table 7.11).

Dependent variable: supply chain problems on distribution stage				
F value				4.14
Significance of *F*- test				.005
R square				.378
Variable	**Coefficient**	**Standardized Beta**	***T*–test**	**Significance of *P*–test**
Product value density	.279	.357	2.06	.007
Physical density	.334	.346	2.85	.003
Cycle time	-.098	-.112	-2.70	.049

Table 7.11 –Result of regression analysis on distribution stage

In summary, the number of the drivers affecting strategic supply chain configuration was reduced from 27 initially, through 20 on the basis of correlation analysis and factor analysis as intermediate stage, to 12 depending on the regression analysis finally by taking into consideration both the importance and reliability of each driver. Table 7.12 presents the identified 12 significant drivers and their statistical parameters.

Driver	**Coefficient**	**Standardized Beta**	***T*–test**	***P*–test**
Cycle time	-.098	-.112	-2.70	.049
Tax incentives and benefits	-.499	-.596	-2.51	.018
Product value density	.279	.357	2.06	.007
Physical density	.334	.346	2.85	.003
Demand predictability	.685	.419	2.23	.034
Importance of labor's cost	.585	.665	2.85	.008
Competition level	-.613	-.567	-2.83	.009
Technology level	.476	.524	2.41	.023
Competition of domestic suppliers	-.309	-.347	-2.40	.022
Availability of purchased items	.638	.657	2.10	.045
Quality of domestic sources	-.273	-.206	-2.83	.003
Strength of domestic currency	-.734	-.473	-2.51	.018

Table 7.12 – Significant drivers

7.5. Development of decision matrix

7.5.1. Strategic configuration model on sourcing stage

In order to describe the identified relationships for each supply chain stage, a decision matrix was developed and presented as graphic illustration. The decision matrix is consisted of two dimensions that imply different. On the one hand, as the horizon dimension, the internal complexity implies the aggregated value assessed by the significant drivers that mainly lies on the firm and product. On the other hand, those significant drivers dominated by the market and customer can determine the external complexity. Therefore, a supply chain problem is plotted on the decision matrix based on the value of two complexities, and represented as different symbols in order to understand the actual strategic supply chain configuration, more detailed, the green triangle indicates global strategy, and red square represents local strategy. In addition, a curve is drawn on the matrix in order to approximately distinguish the two divisions (i.e. global strategy and local strategy). Despite this curve cannot be considered as a proxy of the border between the divisions, it could indicate the existence of the two areas visually.

According to the 5 significant drivers (i.e. technology level, demand predictability, competition of domestic suppliers, availability of purchased items, and quality of domestic sources) affecting strategic configuration on sourcing stage, the value of internal complexity is determined by technology level and demand predictability, because they are the properties of product. Whereas, the other three drivers (i.e. competition of domestic suppliers, availability of purchased item, and quality of domestic sources) were assigned to one factor group – supply characteristics – that are determined by the external entities. Therefore, the internal complexity and external complexity on sourcing stage can be obtained through the equations:

Internal Complexity = Criticality value of technology level * 0.559 + Criticality value of demand predictability * 0.419

External Complexity = Criticality value of competition of domestic suppliers * -0.347 + Criticality value of Availability of purchased item * 0.657 + Criticality value of quality of domestic sources * -0.206

It is noting that value of each complexity depends on the criticality value of the corresponding significant drivers and their standardized beta because of two reasons. First, the two dimensions of the decision matrix are scaled with 5 discrete points due to a linear shift in order to normalize the matrix for three supply chain stages. Thus, the value of each driver should be discrete number when it is fed into the formulation. Second, the weight of each driver is defined as standardized beta rather than the regression coefficient, because the consideration of the constant element is not necessary.

The decision matrix on sourcing stage is presented as Figure 7.3, in which a curve (i.e. blue line) separates the supply chain problems based on the strategic location strategy, even though a few of exceptions are found in the two divisions.

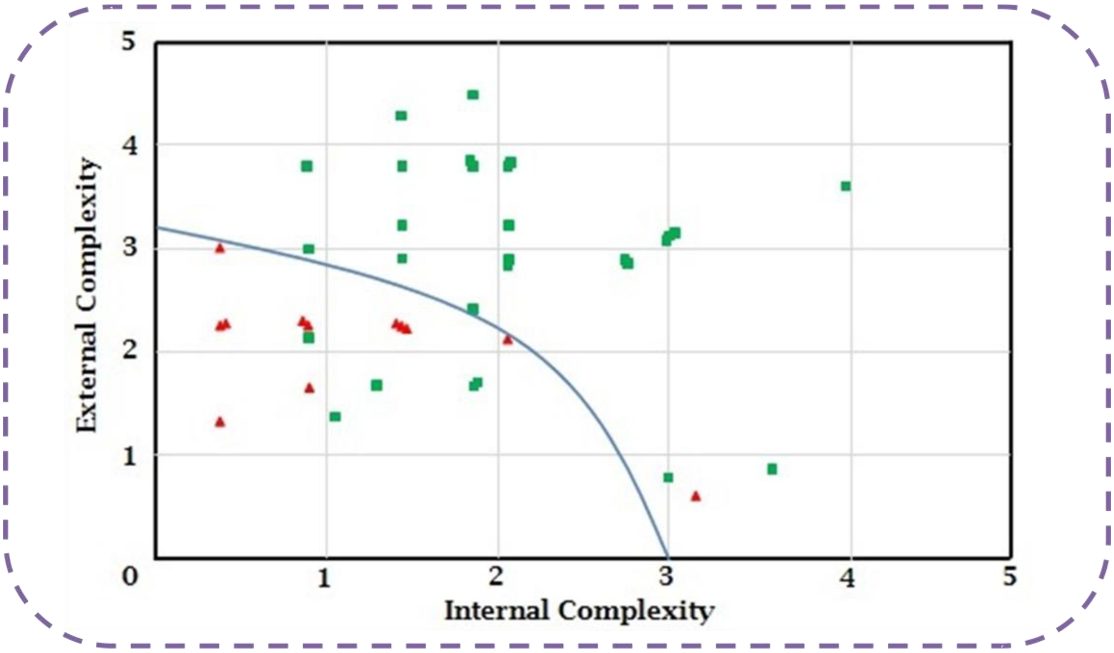


Figure 7.3 – Decision matrix on sourcing stage

The decision matrix of strategic supply chain configuration on sourcing stage highlights the following results:

1. Local sourcing (i.e. the division at left-down of the curve) is the preferred solution used for those supply chain problems in which the value of both two complexities are low (i.e. less than 3 generally) because the products are less innovation and the sourcing resources are abundant.

2. Global sourcing (i.e. the division at right-up of the curve) is the solution used for those supply chain problems when the external complexity is comparatively higher (i.e. approximate to or higher than 3) due to larger impact of the supply characteristics. This solution is also preferred when the internal complexity is obviously more complex (i.e. greater than or equal to 3) due to the highly innovation of the products, whereas the impact of demand predictability on the decision matrix is obscure, because all of the investigated firms are capable of predicating the demand superiorly.

In conclusion, the strategic location alternative on sourcing stage greater relies on three drivers - competition of domestic suppliers, availability of purchased item, and quality of domestic sources – who reveal the supply characteristics corresponding to the factor group, because despite some supply chain problems present similar internal complexity, most of the supply chain problems employing global strategy present more complex on the external dimension.

7.5.2. Strategic configuration model on manufacturing stage

On the manufacturing stage, the strategic configuration lies on 5 significant drivers (i.e. competition level, technology level, strength of domestic currency, tax incentives and benefits, and importance of labor's cost). Competition level, technology level, and importance of labor's cost determine the internal complexity, whereas the external complexity depends on the remaining 2 significant drivers. Therefore, the value of internal complexity and external complexity can be obtained through the following equations:

Internal Complexity = Criticality value of competition level * -0.567 + Criticality value of technology level * 0.524 + Criticality value of importance of labor's cost * 0.665

External Complexity = Criticality value of strength of domestic currency * -0.473 + Criticality value of tax incentives and benefits * -0.596

Figure 7.4 presents the decision matrix on manufacturing stage, it is shown the supply chain problems are divided into two separate areas by a curve (i.e. blue line), and only two supply chain problems are plotted in the opposite division.

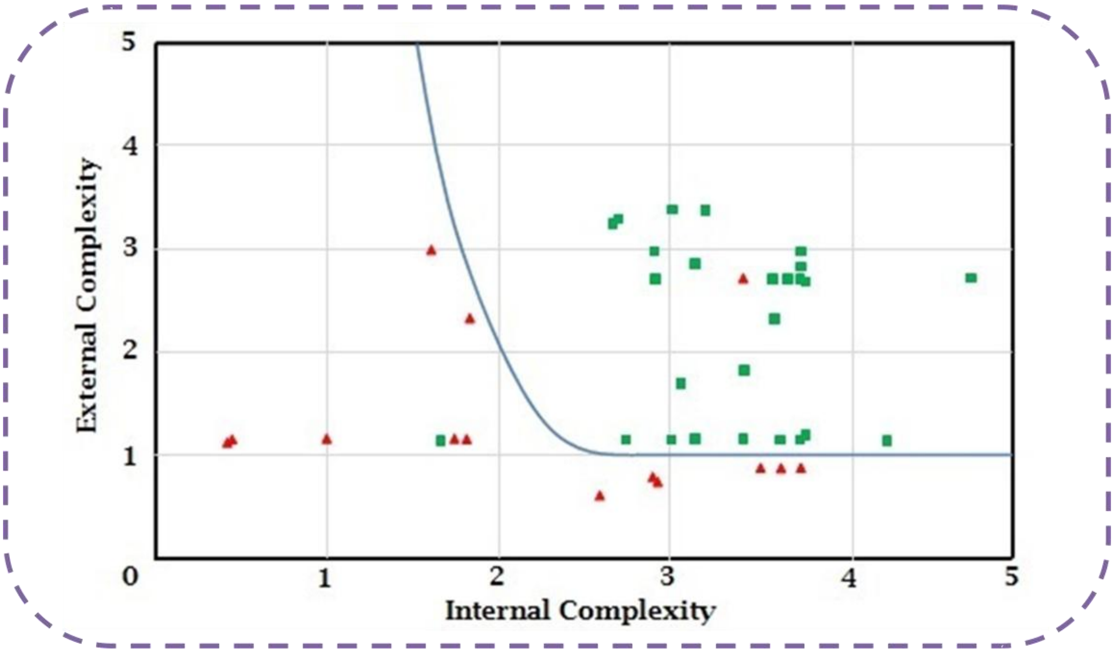


Figure 7.4 - Decision matrix on manufacturing stage

The plotted supply chain problems on manufacturing stage on the matrix demonstrate the following message:

1. Local manufacturing (i.e. the division under the curve) is the solution that is most frequently adopted by those supply chain problems in which the value of external complexity is obviously small (i.e. approximate to 1) due to the less impact on the currency power and commercial tax. It is also a popular solution for the supply chain problems whose internal complexity is small (i.e. less than 2) no matter how large the external complexity.

2. Global manufacturing (i.e. the division above the curve) is the preferred solution when the internal complexity is comparatively high (i.e. higher than 2), and the external complexity is more complex than local strategy (i.e. higher than 1), because this strategy is greater affected by the synthesized impact of internal and external complexities.

According to the presented characteristics of the decision matrix on manufacturing stage, the strategic location alternative of this process is not determined by single criterion, but rather a comprehensive evaluation of the 5 significant drivers. More in detail, it is inclined to produce globally when the synthesized effect of competition level, technology level, and importance of labor’s cost is increasing. Similarly, the strength of domestic currency and tax incentives and benefits are bonded to jointly impel the global strategy implementation.

7.5.3. Strategic configuration model on distribution stage

Taking into account there are only 3 significant drivers obtained through regression analysis, it is certain that product value density and physical density determine the internal complexity because they imply the product properties, whereas the external complexity lies on cycle time that indicates the customer requirement. Therefore, the value of internal complexity and external complexity is obtained through the following equations:

Internal Complexity = Criticality value of product value density * 0.357 + Criticality value of physical density * 0.346

External Complexity = Criticality value of cycle time * -0.112

Figure 7.5 shows that the decision matrix on distribution stage has a very similar shape as that described for sourcing stage, but with two main differences. On the one hand, the number of exceptions is quite small, because it is found only one supply chain problem is plotted in the conflicting division. On the other hand, the two divisions are mainly discriminated by the internal complexity.

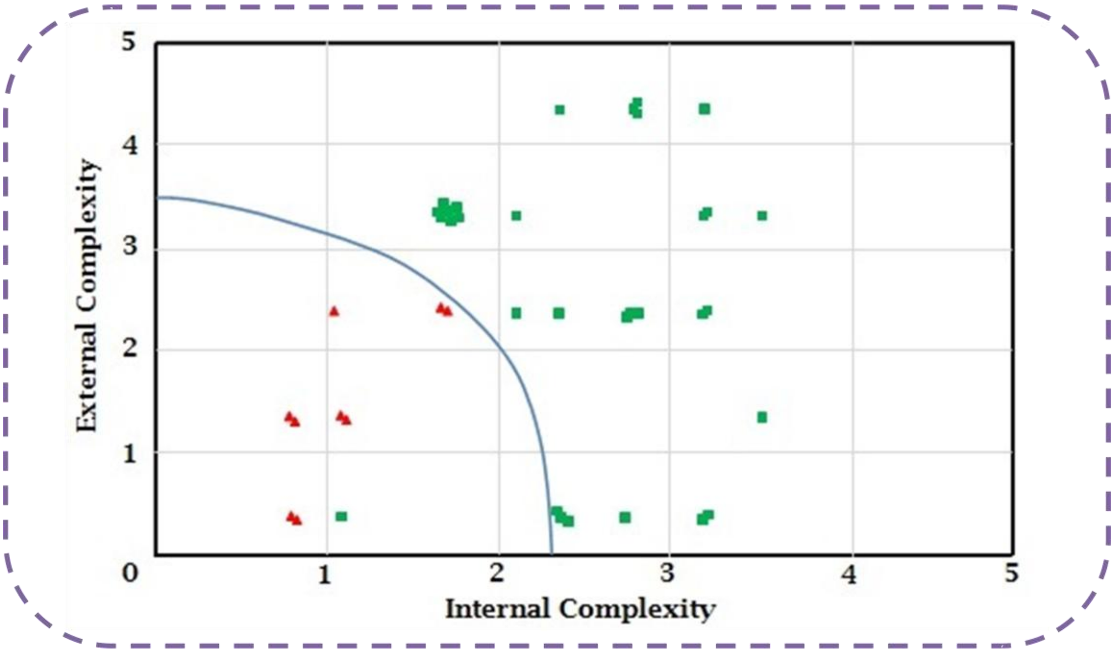


Figure 7.5 – Decision matrix on distribution stage

More in detail, according to the characteristics of the plotted supply chain problems, the decision matrix of distribution process is described as follow:

1. Local distribution (i.e. the division at left-down of the curve) is a favored solution for those supply chain problems in which the value of internal complexity is low (i.e. no more than 2) due to less product value density and physical density, and the external complexity is simple due to the rigid requirement on cycle time.

2. Global distribution (i.e. the division at right-up of the curve) is the preferred solution when the internal complexity is comparatively higher (i.e. approximate to or higher than 2), due to the larger impact on the physical property. At the same time, this solution is also suitable for the supply chain problems that are more complex on the external dimension due to the longer cycle time (i.e. at least one week in general) regardless of the internal complexity.

General speaking, the strategic supply chain configuration on distribution stage relies on two aspects. First, the internal complexity directly affects the implementation of global strategy due to the effects of product value density and physical density. Second, despite the internal complexity is weak, the strong external complexity also permits the firms employ global distribution due to the extensive response to cycle time.

8. Model validation

On the basis of the factor analysis and regression analysis, a theoretical model including 5 factors and 20 important drivers that affect strategic supply chain configuration design has been explored and confirmed, and the final decision matrixes in supporting strategic supply chain configuration for sourcing, manufacturing, and distribution have been developed. Therefore, the decision-making support model in this research is a set of toolset that consists of the numerical data measurement scales (i.e. transformation scale from original value to criticality value), the significant drivers and their parameters, and the three decision matrixes. However, the developed toolset need to be validated in order to check if it is reliable to provide support for the practitioners to design strategic supply chain configuration. Therefore, the remaining 5 investigated company case studies (i.e. Pirelli, H&M, Nike, PepsiCo Beverage, and Heineken) were applied to validate the reliability of the models based on a structured process: 1) original data investigation for the 12 significant drivers, 2) data transformation through the numerical scales, 3) identification of internal complexity and external complexity, 4) representation of the complexities on the decision matrix, 5) decision making.

First of all, the original value of the proposed 12 significant drivers was collected and listed in Table 7.13. The data was investigated as with the method applied on those previous 40 company cases in order to maintain the coherence in this research.

Driver	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5
Cycle time (days)	<3	<14	7-15	<5	2-3
Tax incentives and benefits	68%	50%	47%	47%	40%
Product value density (€/kg)	l-m	>20	medium	0.8-2	<5
Physical density	50-100	>50	>50	>300	>200
Demand predictability	m-h	m-h	high	high	medium
Importance of labor's cost	high	high	high	high	high
Competition level	l-m	l-m	l-m	l-m	medium
Technology level	m-h	low	medium	low	low
Competition of domestic suppliers	m-h	m-h	m-h	m-h	high
Availability of purchased items	m-h	high	high	high	high
Quality of domestic sources	high	m-h	high	high	high
Strength of domestic currency	0.82	0.89	1	1	0.82

Table 7.13 – Original data of drivers

On the second step, the actual value of each driver was transformed into criticality value (i.e. discrete number) on the basis of the developed 5-point numerical scales, and the result of data transformation is reported in Table 7.14.

Driver	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5
Cycle time (days)	5	1	1	4	5
Tax incentives and benefits	5	3	3	3	2
Product value density (€/kg)	2	3	3	1	1
Physical density	4	4	4	1	1
Demand predictability	2	2	1	1	3
Importance of labor's cost	5	5	5	5	5
Competition level	2	2	2	2	3
Technology level	3	1	3	1	1
Competition of domestic suppliers	2	2	2	2	1
Availability of purchased items	2	1	1	1	1
Quality of domestic sources	1	2	1	1	1
Strength of domestic currency	2	2	1	1	2

Table 7.14 – Criticality value of drivers

Third, the converted criticality value was fed into the developed formulations in order to assess the internal complexity and external complexity of each supply chain problem based on the needed significant drivers. Table 7.15 presents the complexities of the 5 supply chain problems for each firm.

Stage	**Complexity**	**Company**				
		Firm 1	**Firm 2**	**Firm 3**	**Firm 4**	**Firm 5**
Sourcing	Internal Complexity	2.5	1.4	2.1	1	1.8
	External Complexity	3	1	1.5	1.5	2.25
Manufacturing	Internal Complexity	3.8	2.7	3.8	2.7	2.1
	External Complexity	1.1	2.3	2.7	2.7	2.9
Distribution	Internal Complexity	2.1	2.5	2.5	0.7	0.7
	External Complexity	0.36	4.5	4.5	1.8	0.36

Table 7.15 – Complexities of supply chain problems

The recommended strategic supply chain configuration on each stage is obtained when the two complexities of the supply chain problem are plotted on the decision matrix. Therefore, the validation of the developed decision-making support model can be confirmed in case the proposed solution is coherence with the actual structure, because it is assumed that those best-in-class firms employ an optimal strategic supply chain configuration.

Sourcing process

As what Figure 7.6 shown, the plotted supply chain problems on the decision matrix for sourcing process suggest that the local sourcing should be a favored solution for four companies, because both their internal complexity and external complexity are weak (i.e. approximate to or less than 2), whereas global sourcing is an recommendation for one supply chain problem whose external complexity is more complex (i.e. approximate to 3). Therefore, it is found that all of the recommended strategic configurations on sourcing stage are coherence with the solutions those firms are using in practice.

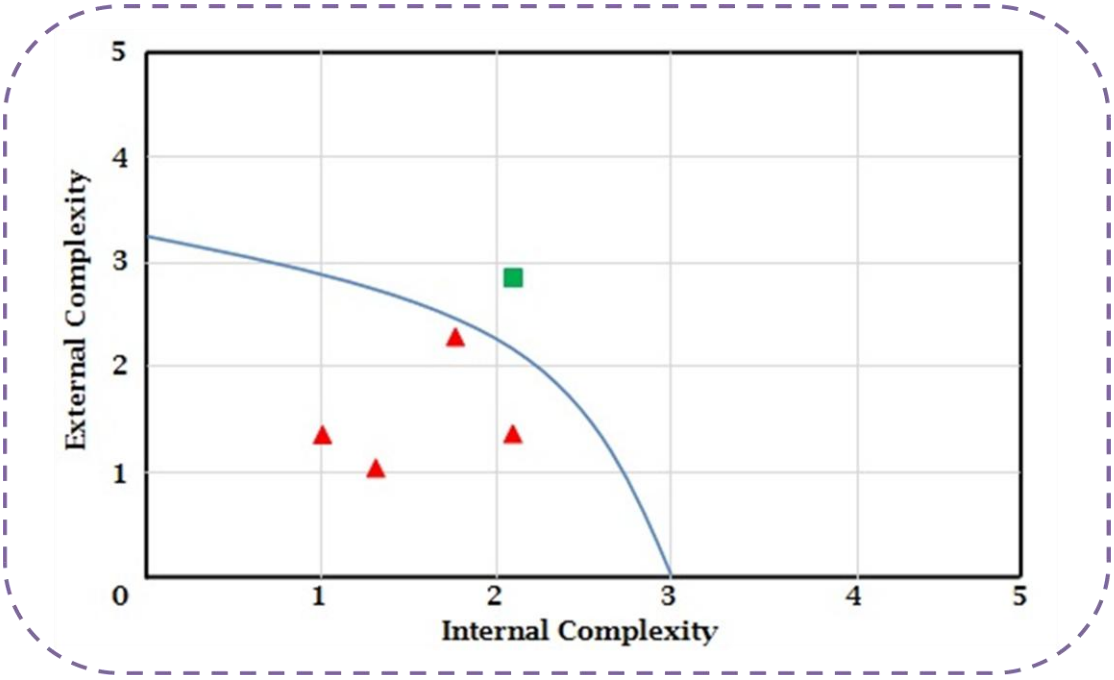


Figure 7.6 – Validation of decision matrix on sourcing stage

Manufacturing process

With regard to the validation of decision matrix on manufacturing stage, it is presented a satisfied result as shown in Figure 7.7, because the suggested strategic configurations are in line with the actual structure, when the supply chain problems of the 5 firms were plotted on the decision matrix based on the obtained value of two complexities. It is found that the supply chain problems comfort to the characteristics of the implementation of global manufacturing, because they presented a strong synthesized effect on both internal and external complexities (i.e. higher than 2 on internal complexity, and higher than 1 on external complexity simultaneously). Therefore, the 5 supply chain problems provide adequate evidence to verify the reliability.

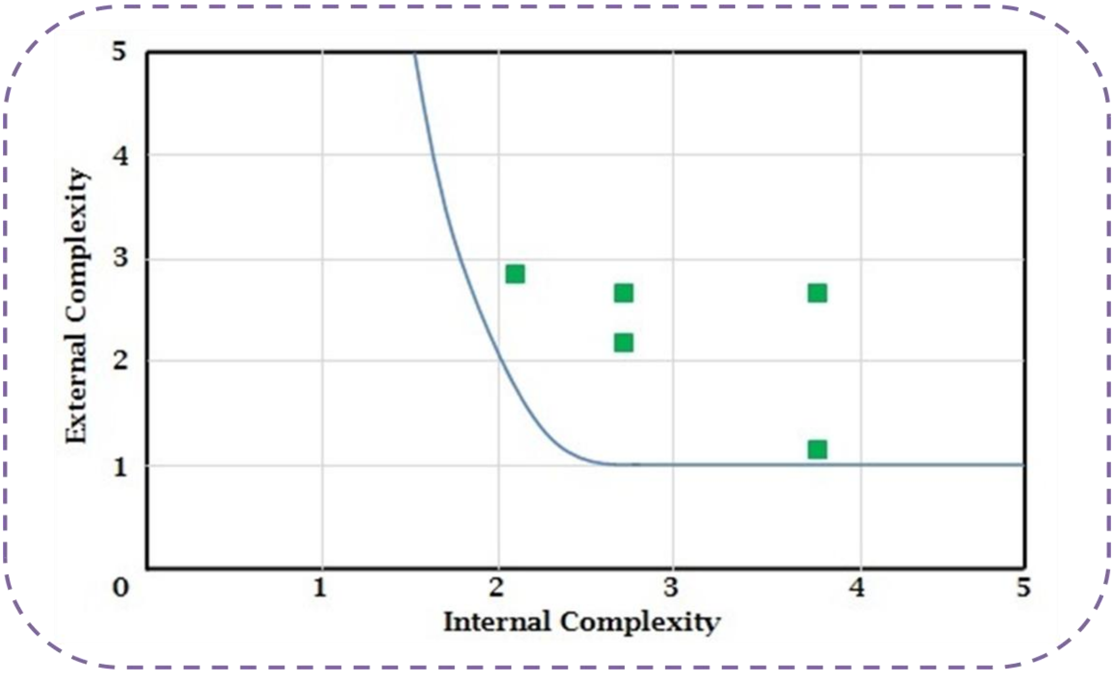


Figure 7.7 – Validation of decision matrix on manufacturing stage

Distribution process

Figure 7.8 presents the validation of the decision matrix on distribution stage for four firms are confirmed, because the proposed solution are coherence with the actual configuration, except one firm whose recommended structure is local distribution, whereas the global strategy is employed in practice. However, on the basis of an in-depth examination for this company, it is known that the manufacturing plants have been located in 13 countries in four main regions - 8 plants in Europe, 7 plants in Latin, 2 plants in NAFTA, and 3 plants in other regions (e.g. Asia-Pacific and MEAI). As the most important manufacturing site, the plants in Europe produce the completed product series and distribute them worldwide in order to fulfill overseas market, because the production capacity in other regions is limited, hence, those plants usually focus on specific product family. Therefore, Europe plants adopt global distribution strategy, whereas the plants in other regions only serve the local market. However, the investment for manufacturing plants in Asia and NAFTA is increasing in order to expand the production capacity to support the demand of the entire product series in their local market. In particular, the production capacity of in China would be increased more than double till 2014. It would mitigate the global distributed from

European plants, because the distribution strategy is changing to be more local incrementally. Therefore, it is proved that the validation of distribution process is acceptable.

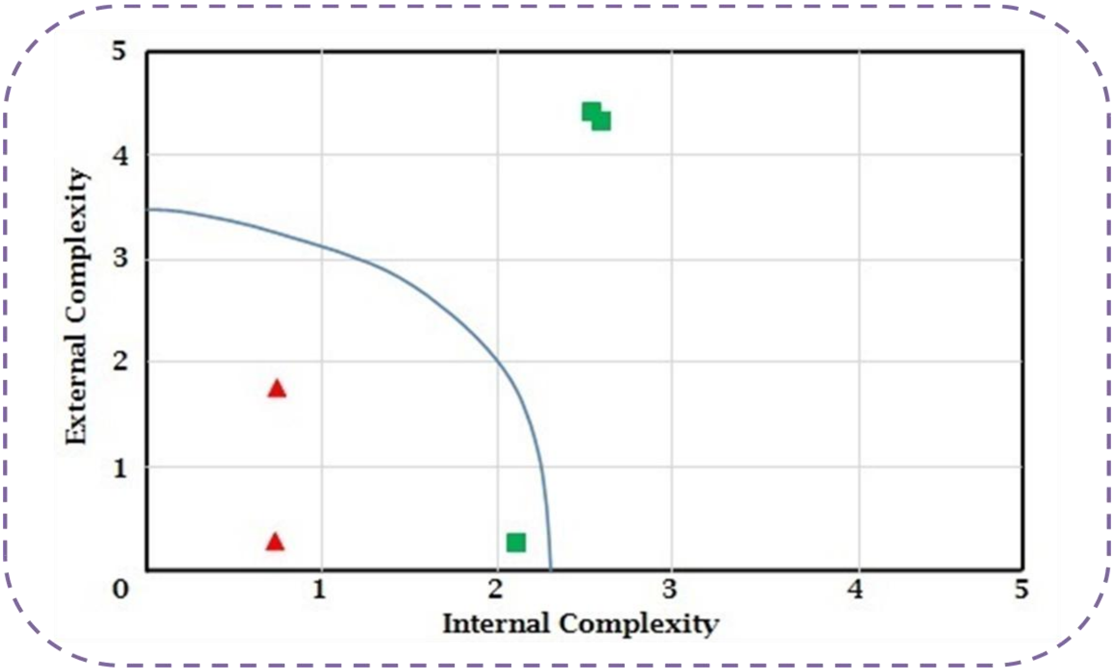


Figure 7.8 – Validation of decision matrix on distribution stage

In summary, the reliability of the proposed model consisted of 12 significant drivers, a series of data transformation scales, and three decision matrixes can be substantial accepted, because all of the recommended solutions of strategic supply chain configuration for each stage are reasonable. Therefore, the practitioners could use the proposed decision-making support model to design an optimal strategic supply chain configuration based on a 4-step sequential approach: 1) original data collection for the 12 significant drivers, 2) data transformation on the basis of the numerical scales, 3) evaluation of the two complexities, and 4) mapping the supply chain problem on the decision matrix and identifying the solution.

9. Conclusion and future research lines

In this research, a decision-making model including a set of toolset has been built based on empirical study integrating both qualitative and quantitative analyzes, in order to support the practitioners to make correct decision on strategic supply chain configuration design (i.e. the strategic location alternatives of sourcing, manufacturing, and distribution on the global or local scale). By identifying the drawbacks of existing supply chain design models, the integrated methodology adopted in this study considers comprehensive drivers no matter quantitative or qualitative ones affecting strategic supply chain design, and adopts statistical models through empirical investigation to avoid the unpractical assumptions usually involved in conventional optimization models. Depending on in-depth examination on 124 scientific papers, 8 strategic supply chain configurations have been proposed in a classification, and 27 drivers affecting strategic supply chain network design have been found and their effects on the entire supply chain system have been analyzed. On the basis of this, 45 company case studies have been conducted in order to investigate what kind of strategic supply chain configurations are adopted by the firms in practice, and collect the original value of each identified driver. Afterwards, a set of numerical measurement scales have been developed in order to transform the strategic supply chain configurations and original value of identified drivers into criticality value based on 1-5 discrete numbers that can be used in statistical models. In the first phase of quantitative analysis that is consisted of correlation analysis and factor analysis, 40 company cases were randomly selected to examine the importance and the characteristics of 27 identified drivers based on those statistical models. 3 identified drivers were dropped due to the weak statistics parameters, and therefore, a theoretical model in which 24 critical drivers are classified into 5 factor groups indicating different specific features of the drivers has been developed. Furthermore, given by the proposed theoretical model guiding strategic supply chain configuration design, the regression model was built in order to identify the relationships between strategic supply chain configurations and supply chain problems, and finally the decision matrixes for sourcing, manufacturing, and distribution processes of supply chain system were proposed based on the identified relationships in the second phase of quantitative analysis. In addition, the reliability of the developed toolset has been tested based on remaining 5 company cases, and showed a satisfied validation result. Despite the decision-making model in supporting users to select the appropriate strategic supply chain network configuration or check the coherence of an existing supply chain network configuration has been proposed and validated in this research, there are still some shortcomings that should be developed in greater detail.

1) The number of the investigated empirical cases is limited in this research.

In this study, 45 company case studies have been investigated in order to propose and validate the decision-making support model. Despite the quantitative analysis presented an accepted result based on the statistical indicators, it is encouraged to expand the samples in order to provide more evidences to support the reliability of the developed model. On the other hand, the leading manufacturing firms need to be studied in other industry sectors other than four sectors involved in this research, because the decision-making model should be applied in the manufacturing industry as a normative model.

2) The investigated information of company case study could be deeper.

The company case studies were conducted with the focus of strategic supply chain configuration. Therefore, the proposed decision-making model contributes to solve the strategic location alternative on the entire supply chain system on the global scale. However, it was found that many firms prefer hybrid strategic supply chain configuration, rather than the pure global or local strategy. Therefore, it is possible to provide more detailed segmentations on the strategic solution for the location issue based on the flow of goods, for example, the identified divisions on the decision matrix could be pure local, local-based, global-based, and pure global strategy on the basis of the level of globalization. Furthermore, the global supply chain network design involves not only network structure issue, but also the management policy including inventory and transportation decisions. It is indicated other strategic decisions relevant to strategic global supply chain network. Taking an example, the transportation mode is also a strategic decision issue affected by several drivers, the appropriate selection on the means of transport generates huge impact on the total supply chain cost. Therefore, the information relevant to strategic management policy (e.g. transportation and inventory issues) could be investigated in order to extend the scope of the decision-making model.

3) The decision–making model is developed based on two hypothesizes.

There are two assumptions in this research: 1) the main effects of each identified driver on the supply chain system are correct, and 2) those investigated best-in-class firms employ optimal supply chain structure. However, it has not found adequate empirical evidence to support all the proposed effects for each driver in literature, because most of the relevant research is qualitative and conceptual based study. Similarly, the examination of the supply chain performance to the strategic supply chain configuration for each firm is necessary, in order to prove those companies' capability on the supply chain management.

In order to fill these gaps, some potential research lines should be considered. First of all, more empirical studies could be conducted by increasing the number of case studies, in order to provide adequate empirical evidence to support the reliability of the decision-making support model. The expanded sample size not only improves the statistical indicators, but also provides more supply chain problems on the decision matrix in order to describe the border between the divisions. At the same time, based on the empirical investigation, on the one hand, the study could be extended to other manufacturing based industry sectors, because this decision-making model is developed as normative toolset for the practitioners in the manufacturing industry. On the other hand, the identified divisions on the decision matrix could be further segmented, when the strategic supply chain configuration is classified taking into account the hybrid structure. Secondly, the strategic decisions about management policy on strategic global supply chain network design, such as inventory policy and transportation mode, can be studied on the basis of the proposed methodology in this research, in order to support the users to make relevant decisions. Thirdly, regarding to the assumptions mentioned in this study, the effects of each identified driver on the supply chain system can be examined in order to confirm the proposed influences. In addition, the relationships between strategic supply chain configurations and supply chain performance can be identified to examine if the actual solutions adopted by the firms are optimal. Lastly, a theoretical model has been explored and confirmed through the statistical analysis as the intermediate output of the data reduction process. There is a potential direction of empirical research is to identify the effect of each factor on the strategic supply chain configuration on the basis of structured equation modeling, which is a popular technique used to identify the relationships between the unmeasured latent factors and a observed factor based on a specific factor structure.

Furthermore, this research offers valuable insights for practitioners as well, which can be summarized as follows:

1) A thorough understanding of the classification of strategic supply chain configurations and their characteristics.

The strategic supply chain configurations have been classified and explained, in order to uncover the characteristics and benefits of each structure. Therefore, the users can obtain a clear picture about the features of each strategic supply chain configuration.

2) A comprehensive and systematic understanding of the main drivers and factors that affect the strategic supply chain configuration.

On the basis of quantitative analysis, a structured theoretical model including 20 drivers and 5 relevant factor groups has been proposed. The identified theoretical model provides a systematic framework in order to help decision makers understand the nature of the supply chain problem they have to deal with.

3) A set of toolset that can be used to support decision-making on strategic supply chain configuration design.

The developed model in this research can help the users to design strategic supply chain configuration or check the coherence of existing supply chain network. A firm could adopt the proposed decision-making model, consisted of the significant drivers, data transformation scales, and decision matrix for each supply chain stage, to design an optimal strategic supply chain configuration based on a predefined sequential process.

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Appendix

Part A – Drivers affecting global supply chain design

	Supply Chain System	
Sourcing	**Manufacturing**	**Distribution**
Product variety, Profit margin, Competition level, Technology level Demand predictability, Demand volatility, Dimension of market Competition of domestic suppliers, Availability of purchased items, Quality of domestic sources Import tariff	Competition level, Technology level Cycle time, Item fill rate Dimension of market, Strength of domestic demand Strength of domestic currency, Import tariff, Tax rate, Labor's quality, Labor's cost, Quality of infrastructure, Political stability, Environment concern and regulation	Product variety, Product value density, Physical density, Risk of obsolescence, Handling characteristics Cycle time, Item fill rate, Delivery reliability Dimension of order, Demand predictability, Demand volatility

Table I – Drivers affecting strategic supply chain configuration

Driver	Definition
Product variety	Amount of products a firm provide
Product value density	Product value/weight
Physical density	Product weight/cubic volume
Risk of obsolescence	Product's life length offered in market
Profit margin	Production cost/value
Competition level	Firm's competitive position in its industry
Handling characteristics	Specific requirements of handling operations
Technology level	Functional or innovative product
Cycle time	Period from order launch to end of delivery
Item fill rate	Probability of holding required product in stock
Delivery reliability	Probability of a successful order delivery
Dimension of order	Level of delivered products quantity
Demand predictability	Error margin of demand forecast
Demand volatility	Overall variance ratio of demand
Dimension of market	Level of products penetration around the world
Strength of domestic demand	Domestic demand/total demand
Competition of domestic suppliers	Proxy of overall domestic purchasing cost
Availability of purchased items	Availability of required item in domestic country
Quality of domestic sources	Overall quality of items supplied in local country
Strength of domestic currency	Exchange rate of domestic currency/US dollar
Import tariff	Tax imposed by domestic government for import
Tax incentives and benefits	Total domestic commercial tax rate
Importance of labor's quality	Effect of labor's skill on final product
Importatnce of labor's cost	Effect of labor's cost on final product
Quality of infrastructure	Transportation availability and reliability
Political stability	Stability of investment and economic conditions
Enrionment concern and regulation	Degree of environment concern and legislation

Table II – Definition of drivers

Part B – Original data of 45 company case studies

Driver	Company				
	Parah	BasicNet	Zara	Sergio Tacchini	Levis Strauss EU
Product variety	800-1000	>1000	40000	>1000	>700
Product value density	medium-high	medium-high	>20€/kg	medium-high	medium
Physical density	50-100kg/m3	50-100kg/m3	50-100kg/m3	>50kg/m3	50-100kg/m3
Risk of obsolescence	60-90days	60-90days	7-30days	90days	90days
Profit margin	>15%	17%	23%	20-30%	15-20%
Competition level	medium	medium-high	medium-high	medium	low-medium
Handling requirements	low	low	low	low	low
Technology level	low-medium	low-medium	medium	medium	medium
Cycle time	2-3days	7-14days	1-2days	7-14days	2-3days
Completeness	97%	98%	100%	95-96%	98%
Delivery reliability	98%	98%	96-98%	95%	98%
Dimension of order	50%FTL	95% FTL	80-100%FTL	100% FTL	80%FTL
Demand predictability	high	medium-high	medium-high	medium-high	medium
Demand volatility	5-10%	8%	8-9%	N/A	Stable
Dimension of market	<50countries	72countries	82 countries	<100countries	<50countries
Strength of domestic demand	90%	68%	70%	85%	100%
Competition of domestic suppliers	medium	medium	medium	low-medium	medium
Availability of purchased items	medium-high	medium	medium	medium	medium-high
Quality of domestic sources	high	high	medium-high	high	medium-high
Strength of domestic currency	0.82	0.82	82%	0.82	0.82
Import tariff	12%	12%	12%	12%	12%
Tax incentives and benefits	68%	68%	39%	68%	58%
Importance of labor's quality	low-medium	low-medium	low-medium	low-medium	low-medium
Importatnce of labor's cost	medium	high	high	medium-high	medium-high
Quality of infrastructure	medium-high	medium-high	medium-high	medium-high	high
Political stability	low-medium	low-medium	medium	low-medium	low-medium
Enrionment concern and regulation	strongest	strongest	strong	strongest	strong

Driver	Company				
	Alpargatas	H&M	Nike	Ray-Ban	Barilla
Product variety	<200	>10000	high	>1000	1000
Product value density	low-medium	>20€/kg	medium	>50€/kg	<10€/kg
Physical density	20kg/m3	>50kg/m3	>50kg/m3	<50kg/m3	100-200kg/m3
Risk of obsolescence	90days	30days	180-270days	<90 days	>365days
Profit margin	9%	18%	19%	15-20%	10-13%
Competition level	medium-high	low-medium	meidum-low	mdium-low	low-medium
Handling requirements	low	low	meidum-low	low-medium	low
Technology level	low	low	medium-high	low-medium	low
Cycle time	<7days	<14days	7-15days	<3days	1-3days
Completeness	98%	<96%	99%	98%	98%
Delivery reliability	98%	<96%	99%	98%	98%
Dimension of order	>90%FTL	FTL	>90%FCL	80-90%FTL	100%FTL
Demand predictability	medium-high	medium-high	very high	medium-high	medium-high
Demand volatility	8.00%	11%	10-15%	7%	2%
Dimension of market	80countries	54countries	170countries	130countries	>100countries
Strength of domestic demand	72%	80%	40-50%	19%	>60%
Competition of domestic suppliers	high	medium-high	low	medium	medium-high
Availability of purchased items	high	high	low	medium-high	medium-high
Quality of domestic sources	high	medium-high	low	medium-high	high
Strength of domestic currency	0.8	0.89	1	0.82	82%
Import tariff	35%	12%	28%	12%	9%
Tax incentives and benefits	69%	50%	47%	68%	68%
Importance of labor's quality	low	low	low-medium	low-medium	low
Importatnce of labor's cost	high	high	high	high	high
Quality of infrastructure	medium	high	high	medium-high	medium-high
Political stability	medium	high	medium	low-medium	low-medium
Enrionment concern and regulation	strong	high	modest	strongest	strongest

Driver	Company				
	Nestlé	Unilever Food	Kellogg's Cereal	Lindt & Sprüngli	IllyCaffè
Product variety	3100	>500	>1000	800-1000	<200
Product value density	10€/kg	7.5€/kg	<10€/kg	30-50€/kg	5-8€/kg
Physical density	230kg/m3	>150kg/m3	>150kg/m3	50-80kg/m3	50-80kg/m3
Risk of obsolescence	>365days	>365days	>365days	>365days	>365days
Profit margin	15%	17%	14%	10-15%	>10%
Competition level	low-medium	low-medium	medium.-low	low-medium	low-medium
Handling requirements	low-medium	low-medium	low	medium	low
Technology level	low	low	low	low	low
Cycle time	<5days	<5days	<7days	3-5days	<3days
Completeness	98%	98%	98%	98%	98%
Delivery reliability	96-98%	90%	>96%	98%	98%
Dimension of order	50%FTL	90-100%FTL	98%FTL	>95%FTL	>90%FTL
Demand predictability	high	medium-high	medium-high	high	medium-high
Demand volatility	5-6%	3-5%	8.00%	6-8%	5-10%
Dimension of market	>150countries	>190countries	>180countries	>120countries	140countries
Strength of domestic demand	29%	27%	62%	63%	44%
Competition of domestic suppliers	medium-high	medium	high	high	low
Availability of purchased items	medium-high	medium-high	high	medium	low
Quality of domestic sources	high	medium-high	high	medium-high	low
Strength of domestic currency	0.74	0.82	1	0.74	0.82
Import tariff	8%	8%	0%	0%	9%
Tax incentives and benefits	30%	40%	47%	30%	68%
Importance of labor's quality	low-medium	low	low	medium	low-medium
Importatnce of labor's cost	high	high	high	medium	high
Quality of infrastructure	high	high	high	high	medium-high
Political stability	low	low-medium	medium	low	low-medium
Enrionment concern and regulation	strongest	strong	modest	strongest	strongest

Driver	Company				
	Carlsberg	Coca-Cola	Absolut Vodka	Pepsico Beverage	Heineken
Product variety	>1000	>1000	<200	<200	>1000
Product value density	<5€/kg	0.8-2€/kg	<20€/kg	0.8-2€/kg	<5€/kg
Physical density	200-400kg/m3	496kg/m3	>200kg/m3	>300kg/m3	>200kg/m3
Risk of obsolescence	>365days	>365days	>365days	365days	>365days
Profit margin	14%	21%	25%	16%	16%
Competition level	medium	low-medium	medium	low-medium	medium
Handling requirements	low-medium	low	low-medium	low	low-medium
Technology level	low	low	low-medium	low	low
Cycle time	1day	2-4days	<3days	<5days	2-3days
Completeness	99%	>98%	98%	99%	>98%
Delivery reliability	96%	96%	98%	99%	95-96%
Dimension of order	100%FTL	100%FTL	>95%FCL	FTL	FTL
Demand predictability	medium	high	medium-high	high	medium
Demand volatility	1%	6-7%	6%	5%	5-8%
Dimension of market	53countries	>200countries	130countries	>200countries	178countries
Strength of domestic demand	26%	22%	28%	59%	60%
Competition of domestic suppliers	high	medium-high	high	medium-high	high
Availability of purchased items	high	high	high	high	high
Quality of domestic sources	high	high	high	high	high
Strength of domestic currency	0.89	1	0.89	1	0.82
Import tariff	<3%	0%	0%	0%	0%
Tax incentives and benefits	28%	47%	50%	47%	40%
Importance of labor’s quality	low	low	low	low	low
Importatnce of labor’s cost	high	high	medium	high	high
Quality of infrastructure	high	high	high	high	high
Political stability	low	medium	low	medium	low-medium
Enrionment concern and regulation	strong	modest	strongest	modest	strong

Driver	Company				
	Chicco	LEGO	Colgate Palmolive	GSK	Astra Zeneca
Product variety	256	>1000	>1000	216	>200
Product value density	10-20€/kg	20-30€/kg	<2€/kg	high	high
Physical density	low	50kg/m3	500kg/m3	50-80kg/m3	100kg/m3
Risk of obsolescence	270-365days	270-365days	>365days	>365days	>365days
Profit margin	21%	24%	21%	>30%	38%
Competition level	medium	medium	medium-	medium-high	medium-high
Handling requirements	low	low	low	low-medium	low-medium
Technology level	low-medium	low-medium	low	high	high
Cycle time	6days	5-7days	2-4days	3days	2-3days
Completeness	95%	96%	>98%	100%	100%
Delivery reliability	99%	96%	96%	99%	98%
Dimension of order	>80% FTL	>80%FTL	100%FTL	100%FTL	100%FTL
Demand predictability	medium-high	medium	high	high	high
Demand volatility	14%	20%	6-7%	1%	2%
Dimension of market	>100countries	130countries	>200countries	>100countries	>100countries
Strength of domestic demand	65%	20-30%	27%	23%	25%
Competition of domestic suppliers	low-medium	low	medium-high	low-medium	low-medium
Availability of purchased items	medium	low	high	medium	medium
Quality of domestic sources	high	medium	high	high	high
Strength of domestic currency	0.82	0.89	1	0.94	0.94
Import tariff	5%	0%	0%	13%	13%
Tax incentives and benefits	68%	28%	47%	35%	35%
Importance of labor's quality	low-medium	low-medium	low-medium	medium-high	medium-high
Importatnce of labor's cost	medium-high	medium-high	high	low-medium	low-medium
Quality of infrastructure	medium-high	high	high	high	high
Political stability	low-medium	low	medium	low-medium	low-medium
Enrionment concern and regulation	strongest	strong	modest	strongest	strongest

Driver	Company				
	HP	Apple Hardware	Dell Hardware	Nokia Mobile	Candy Washing
Product variety	>1000	60-70	>1000	<200	17
Product value density	>100€/kg	high	150-200€/kg	50-100€/kg	8-13€/kg
Physical density	50kg/m3	100-150kg/m3	<50kg/m3	>100kg/m3	100-150kg/m^3
Risk of obsolescence	120-180days	120-180days	120-180days	120-180days	365days
Profit margin	24%	44%	20%	23%	10-15%
Competition level	high	high	high	high	medium-high
Handling requirements	medium	medium	medium	medium	low-medium
Technology level	high	high	high	high	medium
Cycle time	15days	<5days	2-3days	<5days	10 days
Completeness	100%	98%	98%	98%	96%
Delivery reliability	100%	98%	98%	96%	90%
Dimension of order	100%FTL	80-100%FCL	80-100%FCL	>80%FTL	80-100% FTL
Demand predictability	high	medium	medium-high	medium	medium-high
Demand volatility	5%	>20%	8-10%	20%	5%
Dimension of market	<100countries	<100countries	>180countries	>150countries	50-70countries
Strength of domestic demand	>60%	37%	49%	29%	80%
Competition of domestic suppliers	low-medium	low	low	low	medium
Availability of purchased items	medium-high	low	low	low-medium	medium
Quality of domestic sources	high	medium-high	medium-high	medium-high	high
Strength of domestic currency	0.74	1	1	0.82	0.82
Import tariff	<2%	0%	0%	0%	20%
Tax incentives and benefits	30%	47%	47%	41%	68%
Importance of labor's quality	medium-high	medium-high	medium-high	medium	low-medium
Importatnce of labor's cost	low-medium	high	medium-high	high	high
Quality of infrastructure	high	high	high	high	medium-high
Political stability	low	medium	medium	low	low-medium
Enrionment concern and regulation	strongest	modest	modest	strong	strongest

Driver	Company				
	Candy Cooling	Candy Cooking	Whirlpool EU	Indesit	Black&Decker
Product variety	30	120	300-400	200-300	500-700
Product value density	6-15€/kg	15-20€/kg	10-15€/kg	10-20€/kg	<50€/kg
Physical density	150-200kg/m³	100-150kg/m³	>100kg/m³	medium	100-200kg/m3
Risk of obsolescence	365days	365days	270-365days	medium-high	>365days
Profit margin	20-30%	10-15%	15-20%	<10%	15%
Competition level	medium-high	medium-high	medium-high	medium-high	low-medium
Handling requirements	low-medium	low-medium	low-medium	low-medium	low-medium
Technology level	medium	medium	medium	medium	medium
Cycle time	10 days	10 days	5-10days	5-10days	<3days
Completeness	96%	96%	100%	98%	96%
Delivery reliability	90%	90%	96%	95-96%	96%
Dimension of order	80-100% FTL	80-100% FTL	80-100%FTL	80-100%FTL	FCL
Demand predictability	medium-high	medium-high	high	high	high
Demand volatility	5%	5%	5-7%	<5%	8%
Dimension of market	50-70countries	50-70countries	>100countries	<50countries	>170countries
Strength of domestic demand	80%+	80%+	85%	60%	65%
Competition of domestic suppliers	low-medium	low-medium	medium	medium	medium
Availability of purchased items	medium	medium	medium	high	medium
Quality of domestic sources	high	high	high	high	medium-high
Strength of domestic currency	0.82	0.82	0.82	0.82	1
Import tariff	20%	20%	20%	20%	6%
Tax incentives and benefits	68%	68%	68%	68%	47%
Importance of labor's quality	low-medium	low-medium	low-medium	low-medium	low-medium
Importatnce of labor's cost	high	high	medium-high	high	high
Quality of infrastructure	medium-high	medium-high	medium-high	medium-high	high
Political stability	low-medium	low-medium	low-medium	low-medium	medium
Enrionment concern and regulation	strongest	strongest	strongest	strongest	modest

Driver	Company				
	Mantero	Patrizia Pepe	Ermenegildo Zegna	Gucci Leather	The Bridge
Product variety	>1000	>1000	>1000	700	700
Product value density	high	medium-high	high	high	high
Physical density	<100kg/m3	50-100kg/m3	50-100kg/m3	50-100kg/m3	>50kg/m3
Risk of obsolescence	<60days	<90days	<90days	<90days	90-180days
Profit margin	>30%	20-30%	>30%	>30%	30%
Competition level	low	medium	medium	medium-high	medium-high
Handling requirements	low	low	low	low-medium	low-medium
Technology level	medium-high	medium-high	high	high	high
Cycle time	10 days	7-14days	7-14days	1-2days	3-5days
Completeness	98%	98%	98%	98%	98%
Delivery reliability	98%	98%	98%	98%	98%
Dimension of order	70%FTL	90% FTL	90% FTL	90%FTL	90%FTL
Demand predictability	medium	medium-high	medium-high	low-medium	medium-high
Demand volatility	stable	10-15%	10-15%	10-15%	<5%
Dimension of market	low-medium	50-80countries	<80countries	60-80countries	<50countries
Strength of domestic demand	77%	60%+	38%	27%	90%
Competition of domestic suppliers	low	medium	low	high	high
Availability of purchased items	low	medium-high	low	high	high
Quality of domestic sources	low-medium	high	low	high	high
Strength of domestic currency	0.82	0.82	0.82	0.82	0.82
Import tariff	12%	12%	12%	12%	12%
Tax incentives and benefits	68%	68%	68%	68%	68%
Importance of labor's quality	medium-high	medium-high	high	high	medium-high
Importatnce of labor's cost	low-medium	low-medium	low	low	low
Quality of infrastructure	medium-high	medium-high	medium-high	medium-high	medium-high
Political stability	low-medium	low-medium	low-medium	low-medium	low-medium
Enrionment concern and regulation	strongest	strongest	strongest	strongest	strongest

Driver	Company				
	L'occitane en Provence	General Motor	Toyota Motor	Fiat Automobiles	Pirelli Tire
Product variety	500-700	<1000	<1000	<1000	300-400
Product value density	50-60€/kg	11-16€/kg	15-23€/kg	10-15€/kg	low-medium
Physical density	>100kg/m3	>100kg/m3	>100kg/m3	>100kg/m3	50-100kg/m3
Risk of obsolescence	>365days	>365days	>365days	>365days	>365days
Profit margin	14.00%	3-5%	5%	4%	10-15%
Competition level	medium-high	high	high	high	low-medium
Handling requirements	low-medium	medium-high	medium-high	medium-high	low-medium
Technology level	medium	high	high	high	medium-high
Cycle time	<5days	7days	<5days	3-5days	<3day
Completeness	>98%	96%	98%	98%	98%
Delivery reliability	96%	96%	96%	>98%	>98%
Dimension of order	92-95%FTL	90%FTL	100%FCL	>90%FTL	80-100%FTL
Demand predictability	medium-high	medium	medium	medium	medium-high
Demand volatility	18%	<3%	3-5%	8-10%	15%
Dimension of market	90countries	157countries	>160countries	61countries	>160countries
Strength of domestic demand	15%	59%	46%	60%	40%
Competition of domestic suppliers	high	medium-high	medium	medium-high	medium
Availability of purchased items	high	medium	high	medium	medium-high
Quality of domestic sources	high	medium-high	high	high	high
Strength of domestic currency	0.82	1	0.75	0.82	0.82
Import tariff	0%	2.5%	0%	10%	5%
Tax incentives and benefits	65.00%	47%	50%	68%	68%
Importance of labor's quality	medium-high	medium	medium	medium	low-medium
Importatnce of labor's cost	medium	medium-high	medium-high	medium-high	high
Quality of infrastructure	high	high	high	medium-high	medium-high
Political stability	medium	medium	low	low-medium	low-medium
Enrionment concern and regulation	strongest	modest	strong	strongest	strongest

Part C – Criticality value of driver's data for the randomly selected 40 firms

Driver	Company				
	HP	Apple Hardware	Dell Hardware	Nokia Mobile	Candy Washing
Product variety	5	1	4	1	1
Product value density	5	5	5	4	2
Physical density	5	3	5	3	3
Risk of obsolescence	4	4	4	4	2
Profit margin	2	3	2	2	2
Competition level	5	5	5	5	4
Handling requirements	3	3	3	3	2
Technology level	4	4	4	4	3
Cycle time	2	3	4	3	2
Completeness	2	3	3	3	5
Delivery reliability	2	3	3	5	5
Dimension of order	1	3	3	3	3
Demand predictability	3	3	3	3	2
Demand volatility	2	5	2	5	1
Dimension of market	2	2	4	4	2
Strength of domestic demand	2	4	3	4	2
Competition of domestic suppliers	4	5	5	5	3
Availability of purchased items	2	5	4	4	3
Quality of domestic sources	1	2	2	2	1
Strength of domestic currency	3	1	1	2	2
Import tariff	1	1	1	1	3
Tax incentives and benefits	1	3	3	3	5
Importance of labor's quality	4	4	4	3	2
Importatnce of labor's cost	2	5	4	5	5
Quality of infrastructure	1	1	1	1	2
Political stability	1	3	3	1	2
Enrionment concern and regulation	5	3	3	4	5
Sourcing structure	3	3	4	4	5
Manufacturing structure	1	1	2	4	2
Distribution structure	3	3	1	4	1

Driver	Company				
	Candy Cooling	Candy Cooking	Whirlpool EU	Indesit	Black&Decker
Product variety	1	1	2	2	2
Product value density	2	2	2	2	4
Physical density	3	3	3	3	2
Risk of obsolescence	2	2	2	2	1
Profit margin	2	2	2	2	2
Competition level	4	4	4	4	2
Handling requirements	2	2	2	2	2
Technology level	3	3	3	3	3
Cycle time	2	2	2	2	2
Completeness	5	5	1	3	5
Delivery reliability	5	5	1	5	5
Dimension of order	3	3	3	3	1
Demand predictability	2	2	2	2	2
Demand volatility	1	1	2	1	2
Dimension of market	2	2	3	1	4
Strength of domestic demand	1	1	1	3	2
Competition of domestic suppliers	4	4	3	3	3
Availability of purchased items	3	3	3	2	3
Quality of domestic sources	1	1	1	1	2
Strength of domestic currency	2	2	2	2	1
Import tariff	3	3	3	3	2
Tax incentives and benefits	5	5	5	5	3
Importance of labor's quality	2	2	2	2	2
Importatnce of labor's cost	5	5	4	5	5
Quality of infrastructure	2	2	2	2	1
Political stability	2	2	2	2	3
Enrionment concern and regulation	5	5	5	5	3
Sourcing structure	3	3	3	1	4
Manufacturing structure	1	1	1	4	5
Distribution structure	3	3	3	4	5

Driver	Company				
	Parah	BasicNet	Zara	Sergio Tacchini	Levi Strauss EU
Product variety	4	5	5	5	5
Product value density	4	4	3	4	3
Physical density	4	4	4	4	4
Risk of obsolescence	5	5	5	5	5
Profit margin	3	3	3	3	4
Competition level	3	4	4	3	2
Handling requirements	1	1	1	1	1
Technology level	1	2	1	2	1
Cycle time	5	1	5	1	5
Completeness	4	3	1	5	3
Delivery reliability	2	5	4	5	1
Dimension of order	5	2	3	1	4
Demand predictability	2	3	2	3	3
Demand volatility	2	2	2	N/A	2
Dimension of market	1	2	2	2	1
Strength of domestic demand	1	2	2	1	1
Competition of domestic suppliers	3	3	3	4	3
Availability of purchased items	2	3	3	3	2
Quality of domestic sources	1	1	2	1	2
Strength of domestic currency	2	2	2	2	2
Import tariff	3	3	3	3	3
Tax incentives and benefits	5	5	2	5	4
Importance of labor's quality	2	2	2	2	2
Importatnce of labor's cost	3	5	5	4	4
Quality of infrastructure	2	2	2	2	1
Political stability	2	2	3	2	2
Enrionment concern and regulation	5	5	4	5	4
Sourcing structure	3	2	4	3	1
Manufacturing structure	1	4	5	1	3
Distribution structure	3	4	5	3	2

Driver	Company				
	Alpargatas	Mantero	Patrizia Pepe	Ermenegildo Zegna	Gucci Leather
Product variety	1	5	5	5	3
Product value density	2	5	4	5	5
Physical density	5	4	4	4	4
Risk of obsolescence	5	5	5	5	5
Profit margin	4	4	3	4	4
Competition level	4	1	3	3	4
Handling requirements	1	1	1	1	2
Technology level	1	2	2	2	2
Cycle time	1	1	1	2	3
Completeness	3	2	5	2	2
Delivery reliability	3	3	3	3	3
Dimension of order	2	4	3	3	3
Demand predictability	2	3	3	4	4
Demand volatility	2	1	3	3	3
Dimension of market	2	2	2	2	2
Strength of domestic demand	2	2	2	4	4
Competition of domestic suppliers	1	5	3	5	1
Availability of purchased items	1	5	2	5	1
Quality of domestic sources	1	4	1	5	1
Strength of domestic currency	3	2	2	2	2
Import tariff	5	3	3	3	3
Tax incentives and benefits	5	5	5	5	5
Importance of labor's quality	1	4	4	5	5
Importatnce of labor's cost	5	2	2	1	1
Quality of infrastructure	3	2	2	2	2
Political stability	3	2	2	2	2
Enrionment concern and regulation	4	5	5	5	5
Sourcing structure	1	2	4	3	1
Manufacturing structure	1	4	4	1	1
Distribution structure	3	4	4	3	3

Driver	Company				
	The Bridge	Ray-Ban	Barilla	Nestlé	Unilever Food
Product variety	3	3	5	5	3
Product value density	5	4	1	1	1
Physical density	4	5	2	1	2
Risk of obsolescence	5	5	1	1	1
Profit margin	4	5	4	4	3
Competition level	4	2	2	2	2
Handling requirements	2	2	1	2	2
Technology level	2	2	1	1	1
Cycle time	3	2	3	4	4
Completeness	2	3	1	1	1
Delivery reliability	3	3	3	4	5
Dimension of order	3	3	1	5	2
Demand predictability	4	2	1	1	1
Demand volatility	2	2	1	2	1
Dimension of market	1	3	3	4	4
Strength of domestic demand	1	5	2	4	4
Competition of domestic suppliers	1	3	2	2	3
Availability of purchased items	1	2	2	2	2
Quality of domestic sources	1	2	1	1	2
Strength of domestic currency	2	2	2	3	2
Import tariff	3	3	2	2	2
Tax incentives and benefits	5	5	5	1	2
Importance of labor's quality	4	2	1	2	1
Importatnce of labor's cost	1	5	5	5	5
Quality of infrastructure	2	2	2	1	1
Political stability	2	2	2	1	2
Enrionment concern and regulation	5	5	5	5	4
Sourcing structure	1	4	4	1	5
Manufacturing structure	1	4	4	2	2
Distribution structure	3	5	4	1	1

Driver	Company				
	Kellogg's	Lindt & Sprüngli	IllyCaffè	Chicco	LEGO
Product variety	5	4	1	2	5
Product value density	1	3	1	2	3
Physical density	2	4	4	5	5
Risk of obsolescence	1	1	1	2	2
Profit margin	3	3	3	4	5
Competition level	2	2	2	3	3
Handling requirements	1	3	1	1	1
Technology level	1	1	1	2	2
Cycle time	4	5	2	3	3
Completeness	1	3	3	5	5
Delivery reliability	4	3	3	2	5
Dimension of order	1	1	2	3	3
Demand predictability	1	1	2	2	2
Demand volatility	2	2	2	3	4
Dimension of market	4	3	3	3	3
Strength of domestic demand	2	2	3	2	4
Competition of domestic suppliers	1	1	5	4	5
Availability of purchased items	1	3	5	3	5
Quality of domestic sources	1	2	5	1	3
Strength of domestic currency	1	3	2	2	2
Import tariff	1	1	2	1	1
Tax incentives and benefits	3	1	5	5	1
Importance of labor's quality	1	3	2	2	2
Importatnce of labor's cost	5	3	5	4	4
Quality of infrastructure	1	1	2	2	1
Political stability	3	1	2	2	1
Enrionment concern and regulation	3	5	5	5	4
Sourcing structure	1	5	3	4	2
Manufacturing structure	2	4	1	4	4
Distribution structure	1	4	3	4	4

Driver	Company				
	Colgate Palmolive	L'occitane en Provence	GSK	Astra Zeneca	Carlsberg
CarProduct variety	5	2	2	2	5
Product value density	1	3	5	5	1
Physical density	1	3	4	4	1
Risk of obsolescence	1	1	1	1	1
Profit margin	4	5	5	5	4
Competition level	3	4	4	4	3
Handling requirements	1	2	2	2	2
Technology level	1	3	5	5	1
Cycle time	4	3	5	5	5
Completeness	2	2	1	1	1
Delivery reliability	5	5	2	3	5
Dimension of order	1	2	1	1	1
Demand predictability	1	2	1	1	1
Demand volatility	2	4	1	1	1
Dimension of market	5	2	3	3	2
Strength of domestic demand	4	5	4	4	4
Competition of domestic suppliers	2	1	4	4	1
Availability of purchased items	1	1	3	3	1
Quality of domestic sources	1	1	1	1	1
Strength of domestic currency	1	2	1	1	2
Import tariff	1	1	3	3	1
Tax incentives and benefits	3	5	2	2	1
Importance of labor's quality	2	4	4	4	1
Importatnce of labor's cost	5	3	2	2	5
Quality of infrastructure	1	1	1	1	1
Political stability	3	3	2	2	1
Enrionment concern and regulation	3	5	5	5	4
Sourcing structure	4	1	4	5	1
Manufacturing structure	2	1	4	5	2
Distribution structure	1	3	4	5	1

Driver	Company				
	Coca-Cola	Absolut Vodka	General Motor	Toyota Motor	Fiat Automobiles
CarProduct variety	5	1	4	4	4
Product value density	1	2	2	2	2
Physical density	1	1	3	3	3
Risk of obsolescence	1	1	1	1	1
Profit margin	4	4	1	1	1
Competition level	2	3	5	5	5
Handling requirements	1	2	4	4	4
Technology level	1	2	5	5	5
Cycle time	5	5	2	3	3
Completeness	1	3	5	3	3
Delivery reliability	5	3	5	5	2
Dimension of order	1	1	2	1	2
Demand predictability	1	2	3	3	3
Demand volatility	2	2	1	1	2
Dimension of market	5	3	4	4	2
Strength of domestic demand	4	4	3	3	3
Competition of domestic suppliers	2	1	2	3	2
Availability of purchased items	1	1	1	1	3
Quality of domestic sources	1	1	2	1	1
Strength of domestic currency	1	2	1	3	2
Import tariff	1	1	1	1	2
Tax incentives and benefits	3	3	3	3	5
Importance of labor's quality	1	1	3	3	3
Importatnce of labor's cost	5	3	4	4	4
Quality of infrastructure	1	1	1	1	2
Political stability	3	1	3	1	2
Enrionment concern and regulation	3	5	3	4	5
Sourcing structure	1	1	5	1	5
Manufacturing structure	2	1	4	2	2
Distribution structure	1	3	5	1	1