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DIRECT RESEARCH

SUPPLY CHAIN, IN HOUSE OR OUTSOURCING?

IN THE CONTEXT OF THE MANUFACTURING INDUSTRY

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ABSTRACT

The following research paper address the question regarding whether a manufacturing company should manage his supply chain by themselves or if they should outsource it to an external supplier. Nowadays, outsourcing auxiliary activities like supply chain is commonly highlighted as a strategic decision for manufacturing firms.

This study addresses the issue of outsourcing or not from a theoretical and practical approach. Theoretical in the sense that literature is reviewed regarding the evolution of supply chain and the analysis of outsourcing by enumerating reasons both positive and negative. And practical because the research tries to reflect by a qualitative methodology the factors that may lead to a successful decision of outsourcing, this factors are ultimately tested in a multi criteria decision model to solve the question. A list of factors was identified and studied to came up with the mentioned model that affect the outsourcing decision.

KEYWORDS

Supply Chain, Outsourcing, Logistics, In-house.

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1. INTRODUCTION

1.1. Motives

The motivations that drove the realization of this research are directly related to the competitive and dynamic business environment in which manufacturing companies need to address challenges such as globalization, cost reductions and optimization of processes. In this scenario the supply chain is a key strategic factor in the success of a company due to the time and resources dedicated to this area; supply chain has the potential to be a competitive advantage not only if well managed, but also if outsourced successfully as alternative (Mentzer, 2007)

1.2. Overview

Many companies think, “why should I outsource to another company my supply chain or logistics, when I can do it myself?” Well, a well-managed logistics can save costs and a poorly managed one can cause resources to be wasted, but to reach a well-managed one we have to use many time and human resources for this purpose and this is something that many companies cannot afford not only at the economic level but, at a strategic level, because the more efforts are concentrated in auxiliary areas, the less companies will be dedicating efforts to their core business (Kalinzi, 2016). Auxiliary areas are equally important but not linked to the main strategies of the organization. Example: BMW, GM or Tesla, are companies that produce and manufacture automobile vehicles, their core business and efforts lay in the innovation of the process to produce vehicles and in the research and development to provide quality and tech automobiles.

It is at this time when a company has to decide which areas it wants to dedicate more efforts, and analyze if, dedicating that effort will achieve the expected results. Here is the moment when outsourcing becomes so important and interesting; outsourcing it is nothing more than hiring another company, which has as its main business the activity to be outsourced, to manage that

activity in the most optimal way possible and according to the specifications that are transferred through the company that subcontracts (the client) (Handfield, 2006).

1.3. Research question

The main objective of this research is to study, in the context of the manufacturing industry, the outsourcing of the supply chain as a competitive factor, the pros and cons, to finally be able to solve the following research questions:

RQ: What factors should be considered by a manufacturing company when deciding if their supply chain / logistics should be outsourced or realized within the company?

RQ: Which model could be use by the company to decide between in-house or outsource?

2. LITERATURE REVIEW

2.1. The evolution of supply chain

After 2ND. World War, the world entered into a Productivism era, where most manufacturing companies gave priority to economies of scale in order to allow mass production to minimize unit production cost as a key operative strategy (Tan, 2001). During these years (1950s-1960s) the concept of supply chain management was unknown, it was characterized by high inventory costs with huge investment in work in process (WIP) inventory to allow balance production flows (Tan, 2001). Logistics costs accounted approximately 15% of GDP for countries like the the United States and the United Kingdom (Ballou 2006). Increasing production was the main focus, and little emphasis was on cooperative buyer supplier partnership. According to Tan (2001), Sharing technology and expertise with customers or suppliers was considered too risky and unacceptable.

In the 1970s, management become aware of the huge WIP on manufacturing cost. The attention during this period changed, now the focus was performance instead of increasing production

through spreading the fixed cost to a bigger output (economies of scale). The introduction of IT (MRP Material Requirements Planning) in organizing the resources of the firm proves this.

It was until the 1980s, when the term supply chain or supply chain management was exposed. For example, in an interview conducted by Financial Time magazine in 1982, the consultant and logistics expert Keith Oliver, from the consulting company Booz Allen Hamilton, used publicly the term Supply Chain Management for 1st time on media.

Some authors have segmented the evolution of supply chain management into stages. Movahedi at al, (2009) segmented SCM evolution into three stages:

- Creation era (1980s): Stage when manufacturers understand the benefits that a cooperative relationship offers between buyer and suppliers. Many companies went more for a relationship oriented approach with their customers and supplier due to increase demands for a quick and cheap logistical service. They understood the benefits of cooperative relationship with the other firms in the different chain levels (Stank at al, 1999).
- Integration era (1990s): Stage where the IT system ERP (Enterprise Resource Planning) is introduced. ERP focus not only in managing the resources of the individual firm but also the resources of the integrated supply chain. Manufacturers now commonly exploit supplier strengths and technology in support of new product development, distribution channels, cost reduction, etc. (Morgan and Monczka, 1995).
- Globalization era (21st century): Stage that started with the internet revolution and the creation of the trade liberalization policies across the world, and the foundation of organizations that regulate trade such as the WTO (World Trade Organization). The focus is towards systems of supplier relations over national boundaries and into other continents (Movahedi at al, 2009). Global Supply Chain Management (GSCM) is the

newest concept introduced to the literature of SCM. This era is characterized of firms that grow faster and can reach new markets, they already have achieved economies of scale and now the focus is on internationalizing their businesses and finding the lowest sources of inputs to reduce costs and to grow markets to sell their product.

2.2. Supply chain concepts

Below, are presented some definitions of renowned authors on the supply chain management.

- Supply chain management encompasses all activities related to the flow and transformation of goods, from the raw material (extraction) stage to the end user, as well as related information flows. Materials and information flow up and down in the supply chain. In addition, it is the integration of these activities by improving the supply chain relationships to achieve a sustainable competitive advantage (Handfield & Nichols, 1999).
- Supply chain management is defined as the systematic and strategic coordination of traditional business functions and tactics through these business functions within a particular company, and through companies that participate in the supply chain. in order to improve the long-term performance of individual companies and the supply chain as a whole (Mentzer, et al., 2001).

Purpose of the supply chain

The supply chain has several actors and the objective to achieve the benefit of all of them is to increase the profitability of the entire chain; so it will not help us to evaluate the gain in each stage and in an isolated way since the goal is to maximize the total value generated. This total value is measured in terms of profitability. This will take into account the income, only generated by the customer who is the only one who delivers money to the chain for a product or service, and the costs incurred by all actors of this chain (Chopra & Meindl, 2008).

Levels of scope and decision of the supply chain

The administration of the supply chain raises three levels of scope and decision in the search for an adequate structuring of the same. These differ mainly in two aspects; the first is the period of time in which they develop and the second, the cost that implies a change in these levels. These levels are, design or also called strategy, planning or tactics and, operation or operative (Ballou, 2004).

- **Design of the supply chain:** The design allows to structure the supply chain in a global way and following the strategic objectives of the organization; thus, in this phase decisions are made regarding the configuration of the chain, the resources and processes that will be followed. Other decisions taken at this stage are the following: Location and production capacity of the plant, Storage facilities, Outsource or manufacture some component, Policies and means of transport.
- **Supply Chain Planning:** The planning stage corresponds to a period of time that can go from a quarter to a year, where this phase will be guided by the decisions and policies that were taken in the design stage. The highlights to touch in this period are the following: Demand forecasts, Inventory and operations policies, Markets to attend.
- **Supply Chain Operation:** In this last stage the decisions are taken in a period of time that can range from days, hours or minutes; that is, everyday actions, you will obey the guidelines established in the planning phase. The tasks corresponding to this stage are, for example, the following: Assignment of order to type of transport, Make supply requests

Guidelines and activities

There are two large groups of guidelines and activities in SCM: logistic and inter-functional. We will define each of them and their implication in the supply chain (Chopra & Meindl, 2008).

Logistics



Installations

Inventory

Transportation

Interfunctional



Information

Procurement

Logistics activities

Installations: Physical spaces where inventory is stored to be transformed (raw material or products in process) or waiting to be commercialized (final products). The importance of this guideline is based on the increase in cost efficiency or responsiveness. For example, having a centralized warehouse will increase efficiency as there will be better use of spaces and economies of scale may be applied; however, responsiveness will be lost since the product must be transported to reach the customer.

Inventory: Let us place ourselves in the hypothetical case that the demand is known exactly, you could know when we need to have the product ready for commercialize it and we would have an inventory that would approach zero units. Since this is not true because the demand usually has a degree of uncertainty, inventory is always needed to support the fluctuations that the demand presents. Like the previous guideline, having inventory will be useful if we want a high capacity to respond to our customers because we will have enough stock to meet orders, but that implies a cost that will reduce the efficiency of the supply chain; On the other hand, if we have little or no inventory, our efficiency will increase since we will not incur costs to maintain these, but our ability to respond to customers who demand our products will be reduced.

Transportation: It is the activity that acts as a face to face communicator as it travels through the different stages of the supply chain. Like the previous ones, it offers a very good response capacity or great efficiency, knowing how to balance it will give a competitive advantage that

the market will know how to value. For example, if we want to be efficient, economies of scale must be used to transport large volumes through economic (land, maritime or railway), but this will reduce our response capacity by the time it takes for these means; On the other hand, if we choose a means such as air transport, our efficiency will be reduced given the high cost of this, but the response time will increase categorically given the speed with which orders will arrive.

Interfunctional activities

Information: This is the most important guideline since it affects the other activities and directly to the supply chain. It primarily fulfills two functions; the first, connection between the different stages of the supply chain allowing to coordinate and maximize its profitability; and second, it helps the daily operations that are carried out at each stage. Unlike all guidelines, information is not exclusive between delivering a greater response capacity or providing greater efficiency, but having adequate information at the right time helps both objectives, achieve high responsiveness and great cost efficiency.

Procurement: This task explains the processes that we must define in the purchase or acquisition of goods or services. Involves deciding the policies for the choice of suppliers since it is a crucial issue in front of our clients, it directly affects our responsiveness and our efficiency.

2.3. Outsourcing literature

There are many opinions that, since the practice of outsourcing was extended, have arisen in this regard, since then there are many who favor this practice as well as refractors. According to Munir (2013) we can find the following arguments to support or not an outsourcing decision.

Reasons to outsource

One of the first and undoubtedly the most important is due to the economic issue, that is, outsourcing will allow us to convert fixed costs into variables, with the corresponding impact

on the company's balance sheet. Rates may vary depending on the type of mode we hire, we can hire depending on the level of production we have or through a fixed annual fee based on the forecast of the beginning of the year. There is also an improvement in the overall financial costs and an improvement in financial ratios in addition to expected benefits such as the transfer of risk or the improvement of the turnover rating per employee. Within the economic field, it must also be taken into account that subcontracting reduces the risks associated with investment in liabilities.

The second would be for reasons of technical capacity , that is, we cannot claim to have all the necessary knowledge to be able to execute all the processes with the necessary precision and optimization, that is, we cannot know enough of all the processes. This becomes a problem since it is currently necessary to have a greater knowledge in the great variety of processes that also gets bigger every day .

The third is obtaining flexibility in the event of variations in workload. Currently this is a reason with great importance because with the current economic environment, there are large variations in business activity, so having logistics outsourced allows greater flexibility, which is what companies demand today and what allows them in many occasions to survive.

The fourth would be due to reasons of legal order although this aspect is usually little mentioned. In the current business framework we find certain operations that are subject to specific regulation by law and that makes it difficult for a company to be trained in it.

Fifth we find reasons of sociolabor order. Subcontracting, generally labor intensive, can be used to reduce labor disputes arising from the internal execution of certain processes.

The sixth reason is included in the scope of the strategy with outsourcing, there is a reduction in the complexity of business management, losses of time and resources are avoided in areas

that do not belong to its main business, that is, the volume of core business must grow, the company remains as small and efficient as possible.

The seventh and final reason is the improved efficiency of operations and that delegating the execution of these tasks to a specialized company access is obtained to latest technological advances in these areas, without the need to generate additional costs.

Reasons why not outsource

These reasons why not outsource usually appear as internal resistances from certain areas of the company or after the analysis of bad experience of previous subcontracting.

The main reason is the loss of control over the process that may appear when outsourcing. This can give a certain feeling of distress by placing relevant processes in the external hands, or doubts about the capacity and willingness of the company hired for the service. Therefore it is clear that one of the things that it is not advisable to outsource are those processes that belong to the company's key processes .

Outsourcing come with risks driven by its inability to properly face those risks and respond to unforeseen events. The risks of outsourcing cover various areas from being operational risks to strategic risks. While operational risks affect the effectiveness of the company, strategic risks affect its direction, culture and shared information, among others. One of the most important risks of outsourcing is that the selected supplier does not have the capabilities to meet the objectives and standards that the company requires. Another risk is that by delegating a service to an external provider, companies are allowing it to realize how to take advantage of it and keep the profits. In addition, other problems occur, such as the loss of control of outsourced logistics management, the possibility of sharing the same logistics operator with competitors, which may lead us to think that information can be overlapped to a company of our competence.

3. METHODOLOGY & RESEARCH

3.1. Research procedure

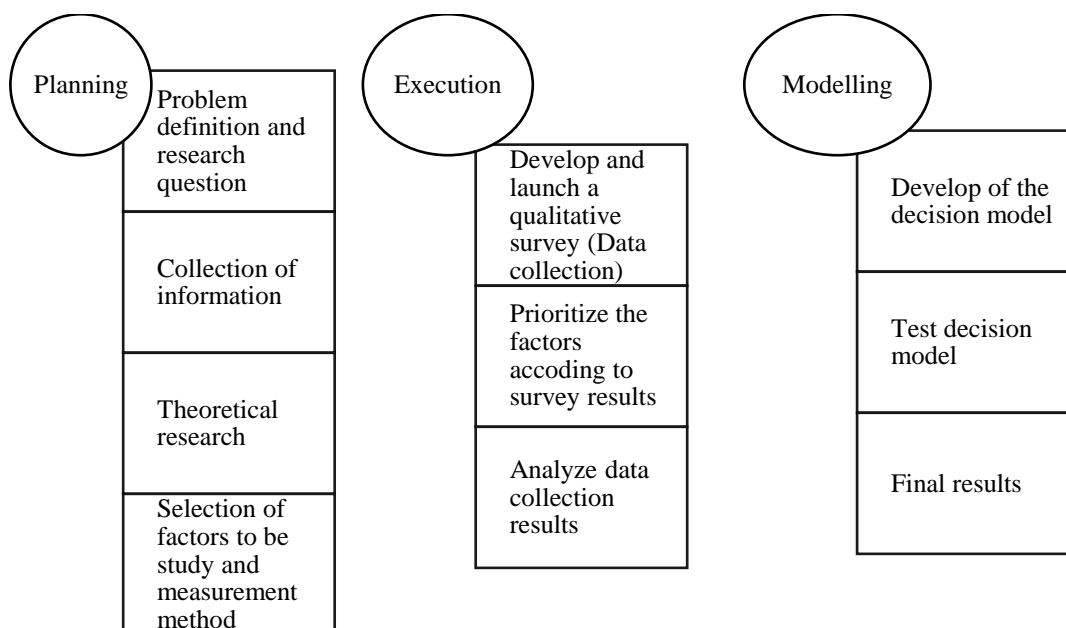
The research was conducted in the 3 phases according to decision model development: planning, execution and modelling.

Planning: Contains the steps of acquiring basic knowledge in the topic (theoretical insights), specifying the problem, identifying the critical factors in the problem and determining the appropriate methodology to conduct the study.

Executing: This phase is the study itself, where a qualitative methodology (survey) is used to perform the study, the factors are prioritized and given a weight to classify them as knockout criteria based on the survey results; also an evaluation of the factors was also made following a rating scale of 5 levels for both alternatives (outsourcing vs own management).

Modelling: Based on the previous analysis, a model of the outsourcing or not decision was established and tested. In this last phase, the decision model was validated and conducted following a Multi Criteria Decision Analysis approach.

(1) Decision model development



3.2. Planning

3.2.1. Problem definition

The aim of this research was stated:

- A. Identify the factors that are most relevant when deciding between outsourcing supply chain or do it in house.
- B. Develop a decision model to facilitate and respond the decision question of outsourcing or not the supply chain in a manufacturing context.

3.2.2. Selection of factors

As part of the 1st phase of the research which is planning, it was necessary to determine which factors affect the decision of outsourcing or not regarding supply chain activities. After reviewing the literature and theoretical framework which was presented before, the following parameters were identified as important and critical to consider in the decision problem, and also these factors are defined and decomposed for a proper measurement. In addition, as some of the factors are closely connected to each other, it was necessary to determine if any of them describe similar measurements and therefore can be combined. For example, cost and efficiency could be separated but for the purpose of this research they were combined. As Olhager (2000) states, efficiency is about making things in the right way, in order to achieve a low production costs per unit. Therefore, it is clear that efficiency connects closely to costs. This conclusion is also supported by OECD's (2015) definition of efficiency as "the comparison of what is actually produced and performed with what could be achieved with the same consumption of resources".

Factors:

- Customer service (time) and customer satisfaction
- Cost and efficiency
- Flexibility
- Quality
- Risks

Customer satisfaction: Customer service can be defined, in a broad sense, as the performance measure of the logistics system to provide a product or service in a timely manner. The concept of customer service is clearly connected to customer satisfaction, which is a broader concept, since it includes all the elements of the marketing mix: product, price, promotion and distribution. Clients expect great service to satisfy their needs to get a product on time and price. Customer service covers various activities that take place before, during and after the sale. From a logistic perspective, the following elements are part of it: availability of stocks, order management, accuracy of information, transportation, shipments and deliveries, etc. Oskarsson et al (2013) refers that lead time is the time from that a customer makes an order until the order is delivered. This involves a lot of many process from the time the order needs to be received and confirmed by sales and then communicated to the production operations until it is produced and sent to customer. All these sub times like the total assembly lead time and the transportation to the end customer contribute to the total lead time towards the end customer.

Cost: Oskarsson et al (2013) suggests that a total cost analysis should be used when a organization faces a change within its supply chain structure, as this approach evaluate the affected costs in the entire company, and not only the departments which are directly related to the change. Oskarsson et al (2013) suggest that the following factors should be considered when evaluating a supply chain change: warehousing costs, inventory carrying costs, transportation costs, administrative costs and extra additional logistic costs. Inventory carrying costs refers to the costs of having tied up capital. Warehousing costs are the ones associated with keeping the storage, as well as material handling costs; like the cost for receiving and inspecting the arriving goods. Transportation cost refers to the cost of transporting articles and materials to the firm and to the customer. Efficiency here is important because efficiency can all be measured as some sort of cost, either connected to material, labor or other kind of resources.

Flexibility: Flexibility is “the ability to change or react with little penalty in time, effort, cost or performance”, Scherrer- Rathje et al (2014). It can be divided into the 3 categories regarding supply chain according to Scherrer- Rathje et al (2014): product, volume and labor competence. Product flexibility is the ability to easily make changes in the offered product portfolio. Volume flexibility is the ability to change the production volume to handle variations in customer demand. Labor competence flexibility refers to how well the workforce can adapt with modifications in the product portfolio.

Quality: Meeting the quality requirements is mandatory for any company to survive in business, there is always a risk that the quality requirements are not met, logistics can affect quality by two main sub parameters: Mishandling material and damages to product. One way to detect or prevent quality risks is by regular inspections of incoming and outgoing goods, and by quality verification processes. Even they come at a cost, it will be less costly than a quality crisis scenario with clients.

Risks: According to Aron et al (2005), risks could be group in 4: strategic, operational, loss of knowledge and location risk. Arnold et al (2000) identify additional aspects of risk in outsourcing like being too dependent on supplier, imitation and minimized competitive advantage, loss of core competence, loss of value enhancing processes and limited ability to transform.

3.2.3. Methodology for measurement

The scientific method is a complex procedure that allows describing reality, designing scenarios of events and pointing out possible paths to establish some control over future situations (Cordón, 2008; Moselhi & Roofigari-Esfahan, 2012).

The methodology used to perform the research it is the qualitative approach. Qualitative research was used to uncover trends in thought and opinions, and dive deeper into our research

questions. The research follows an inductive reasoning where from particular findings a general model and conclusions were taken.

Part of the methodology consist of using the Multi Criteria Decision Analysis (MCDA) to plan, perform and develop a decision model. The MCDA method used was the Analytical Hierarchy Process (AHP). AHP is a method that identifies the components of a complex or unstructured problem, then fix the components (factors) in a hierarchical or structured order, assign numerical values (ranking level) to the subjective judgments coming from a research (in this case a survey was performed) situation on the relative preponderance of each component of the structure and synthesize these judgments estimating the weighting of each component. The best alternative to a problem is calculated taking in consideration the weights and ranking levels of the decision model.

Decision-making problems are complex processes in which multiple criteria are involved, so it is necessary to use tools that allow to discern between these to obtain a solution that satisfies in better degree the combination of possible alternatives. One of these tools is the AHP (Hierarchical Analysis Process). AHP was developed in the late 60s by Thomas Saaty, who from his investigations in the military field and his teaching experience formulated a tool simple to help the people responsible for the decision making. Its simplicity and its power have been evidenced in the hundreds of applications in which they have been obtained important results and today, it is the basis of many software packages designed for processes of complex decision making. In addition, it has been adopted by numerous companies for the support of complex and important decision-making processes.

3.3 Execution

3.3.1. Data collection

The data collection method used was a closed question survey with interval/ratio questions consisting on rating-scale and matrix questions (APENDIX)

The survey had a pre scanning questionnaire with a filter to get responses only from people that have working experience. The survey consisted of two parts (one for demographics and one for qualitative research questions). A total of 40 people participated in the research with the following demographics:

(2) Survey demographics

Sex ratio	Age group	Nationality	Work area	Company's business line
65% of respondents were male	42.5% (between 25 and 35 years), 30% (between 18 and 25 years), 27.5% (more than 35 years).	50% (Mexican), 17.5% (French), 15% (Portuguese), 10% (German), 7.5% (Other).	30% (Production & Operations), 20% (Logistics and supply chain), 17.5% (Quality and customer service), 12.5% (Finance and management), 20% (Others).	75% (Manufacturing), 25% (Services).

3.3.2. Survey results

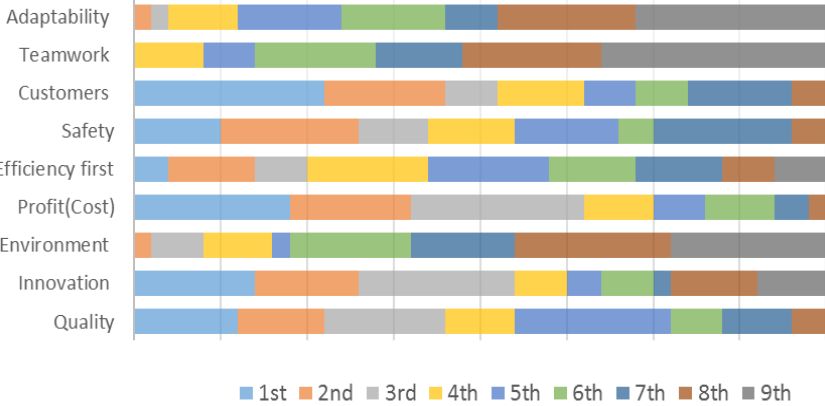
The survey consisted of 3 questions.

The 1st question was about ranking some critical factors (including the 5 factors of our research) in order of importance. The surveyed people were asked to position the factors according to the values and working culture of the companies they currently work. The results from the 40 participants were the following, where it can be seen the number of responses that got each

RANKING	Most Important -----> Less Important								
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Quality	6	5	7	4	9	3	4	2	0
Innovation	7	6	9	3	2	3	1	5	4
Environment	0	1	3	4	1	7	6	9	9
Profit(Cost)	9	7	10	4	3	4	2	1	
Efficiency first	2	5	3	7	7	5	5	3	3
Safety	5	8	4	5	6	2	8	2	0
Customers	11	7	3	5	3	3	6	2	0
Teamwork	0	0	0	4	3	7	5	8	13
Adaptability	0	1	1	4	6	6	3	8	11

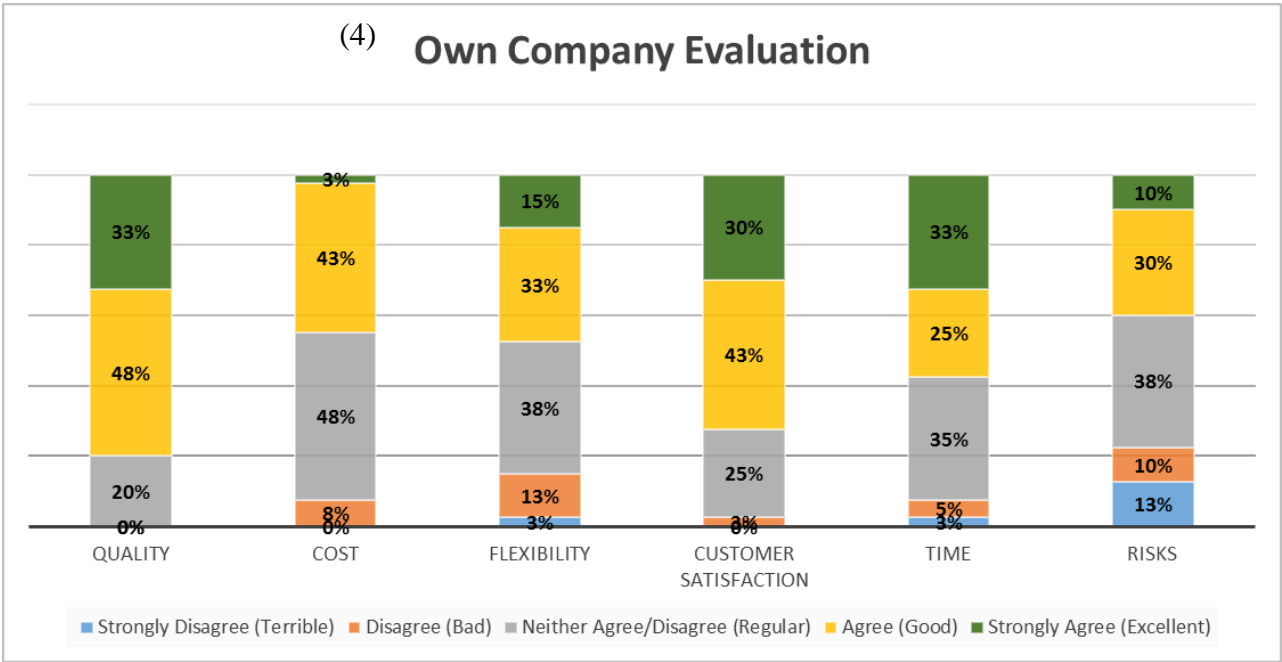
factor in each ranking level.

(3) MOST VALUABLE FACTORS



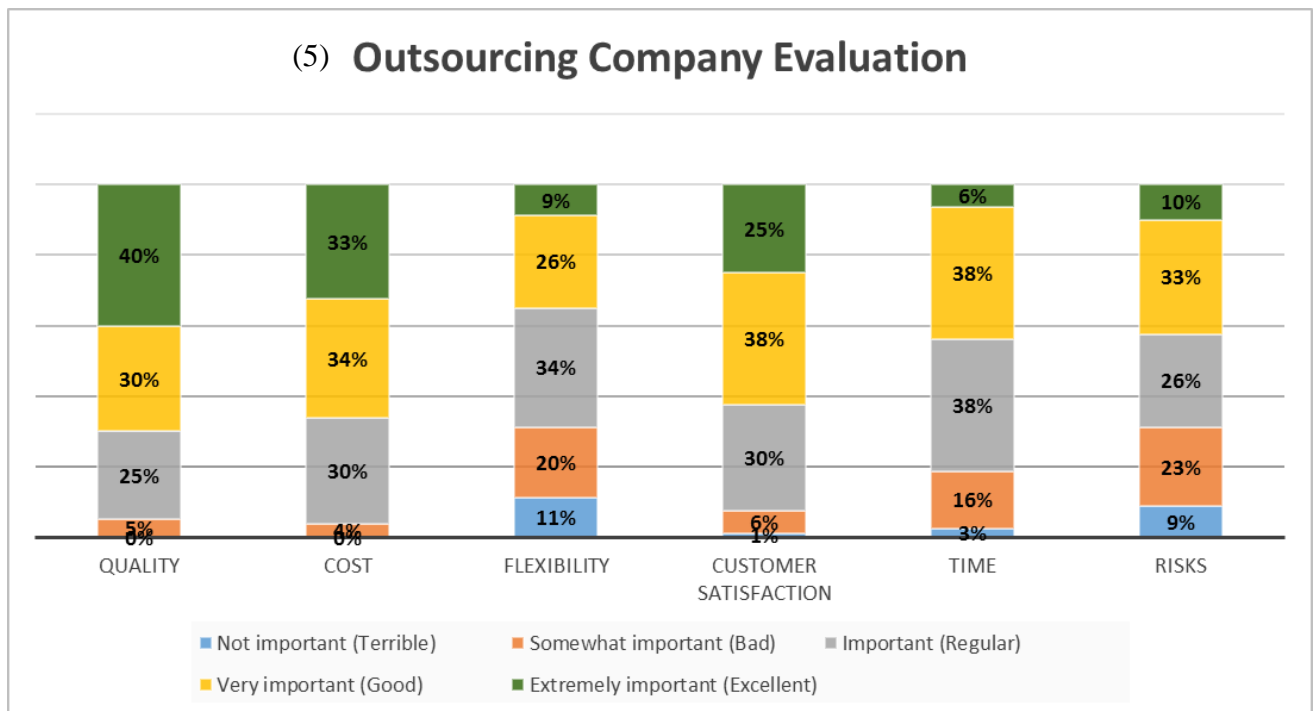
The 2nd question consisted of evaluate according to a 5 level ranking (Strongly disagree, disagree, neither agree or disagree, agree, strongly agree), how the companies (where the surveyed participants were working) were performing regarding the factors.

FACTOR	SURVEY QUESTION	Strongly Disagree	Disagree	Neither Agree/Disagree	Agree	Strongly Agree
Quality	Your organization considers quality as number one criterion in its activities and when selecting suppliers	0%	0%	20%	48%	33%
Cost	Your organization strive to establish long term relationships and cost saving strategies	0%	8%	48%	43%	3%
Flexibility	Your organization regularly solve problems jointly with its suppliers to adapt to new challenges	3%	13%	38%	33%	15%
Customer Satisfaction	Your organization frequently measures and evaluates customer satisfaction	0%	3%	25%	43%	30%
Time	Your organization pushes its own collaboratives and suppliers for shorter lead times	3%	5%	35%	25%	33%
Risks	Your organization share risks and rewards with its memebers and supply chain members	13%	10%	38%	30%	10%



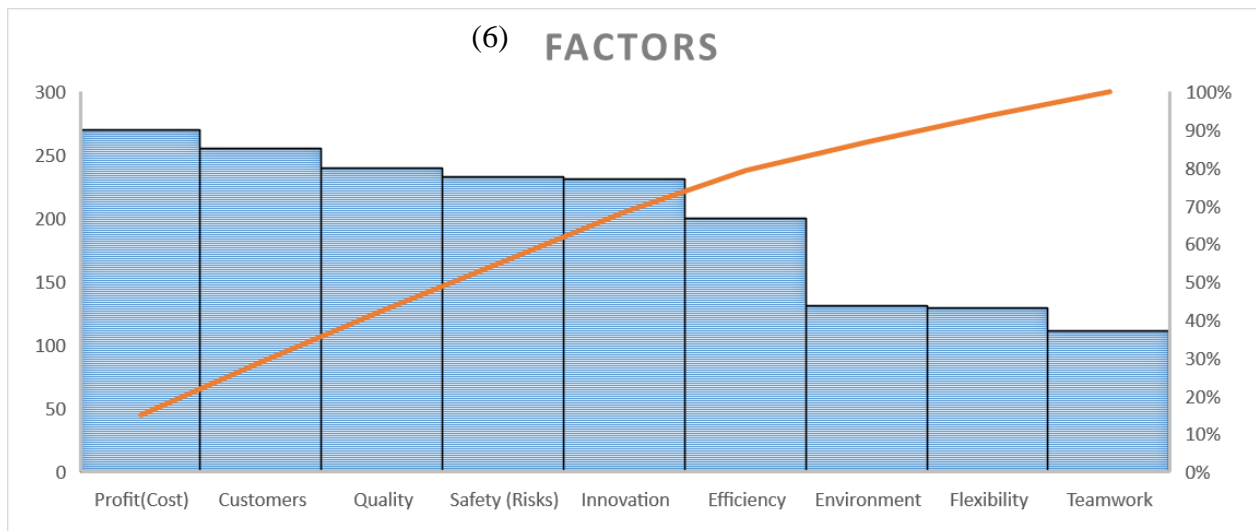
The 3rd question refers to an outsourcing possibility, it stated: “In the case that you hire a company to manage your logistics (including the purchase and delivery of raw materials, packaging, shipment, and transportation of goods to distributors, for example), and based on your previous experiences with outsourcing companies, please evaluate the importance of the following factors in your decision of the outsourcing company”. The results were the following

FACTOR	SURVEY QUESTION	Not important	Somewhat important	Important	Very important	Extremely important
Cost	Added value	0%	5%	43%	30%	23%
Cost	Opportunity for cost reductions	0%	3%	18%	38%	43%
Customer Satisfaction	Accurate order fulfillment	0%	0%	25%	45%	30%
Customer Satisfaction	Level and handling of complaint	3%	13%	35%	30%	20%
Efficiency	Simplifying the whole chain process	15%	30%	23%	18%	15%
Flexibility	Flexibility in accepting changes	10%	23%	20%	38%	10%
Flexibility	Capacity in case of demand increase	13%	18%	48%	15%	8%
Quality	Quality of service and materials	0%	5%	25%	30%	40%
Risks	Trust	3%	18%	23%	43%	15%
Risks	Top management support	15%	28%	30%	23%	5%
Time	Reliable delivery dates	0%	10%	33%	45%	13%
Time	Fast order cycle time	5%	23%	43%	30%	0%



3.3.3. Prioritizing and weighting factors

Next step was to prioritize the factors to choose which factors will be given more leverage in our AHP decision model. Firstly, based on the results from question 1, a weighted average was calculated, the ranking 1st, the most important was given higher punctuation (9 points) until the last ranking (9th) with 1 point; these points were multiplied by the number of respondents in each ranking for each factor. The results were the following:



Once with the weighted average we proceed to prioritize the factors in order to later use this priority level in our AHP model. We combined the 5 factors that of the study and excluded the factors not part of the study.

	FACTORS	Weights Average (Score)	Priority	Weighting for AHP Model
<i>Part of Study Model</i>	Profit(Cost) and Efficiency	470	1	0.35
<i>Part of Study Model</i>	Customers	255	2	0.20
<i>Part of Study Model</i>	Quality	240	3	0.18
<i>Part of Study Model</i>	Safety (Risks)	233	4	0.17
<i>Part of Study Model</i>	Flexibility	129	5	0.10
	Total score	1327		1.00
<i>Not Part of Study Model</i>	Innovation	231	6	
<i>Not Part of Study Model</i>	Environment	131	7	
<i>Not Part of Study Model</i>	Teamwork	111	8	
	Total score	1800		

3.4. Modelling

3.4.1. Determination of knockout criteria

Before creating our decision model, a knockout criterion was defined apart of our 5 factors. In order to determine this, the literature and academic findings were used. When reviewing the theoretical framework, the requisite of core competence is identified. So core competence was

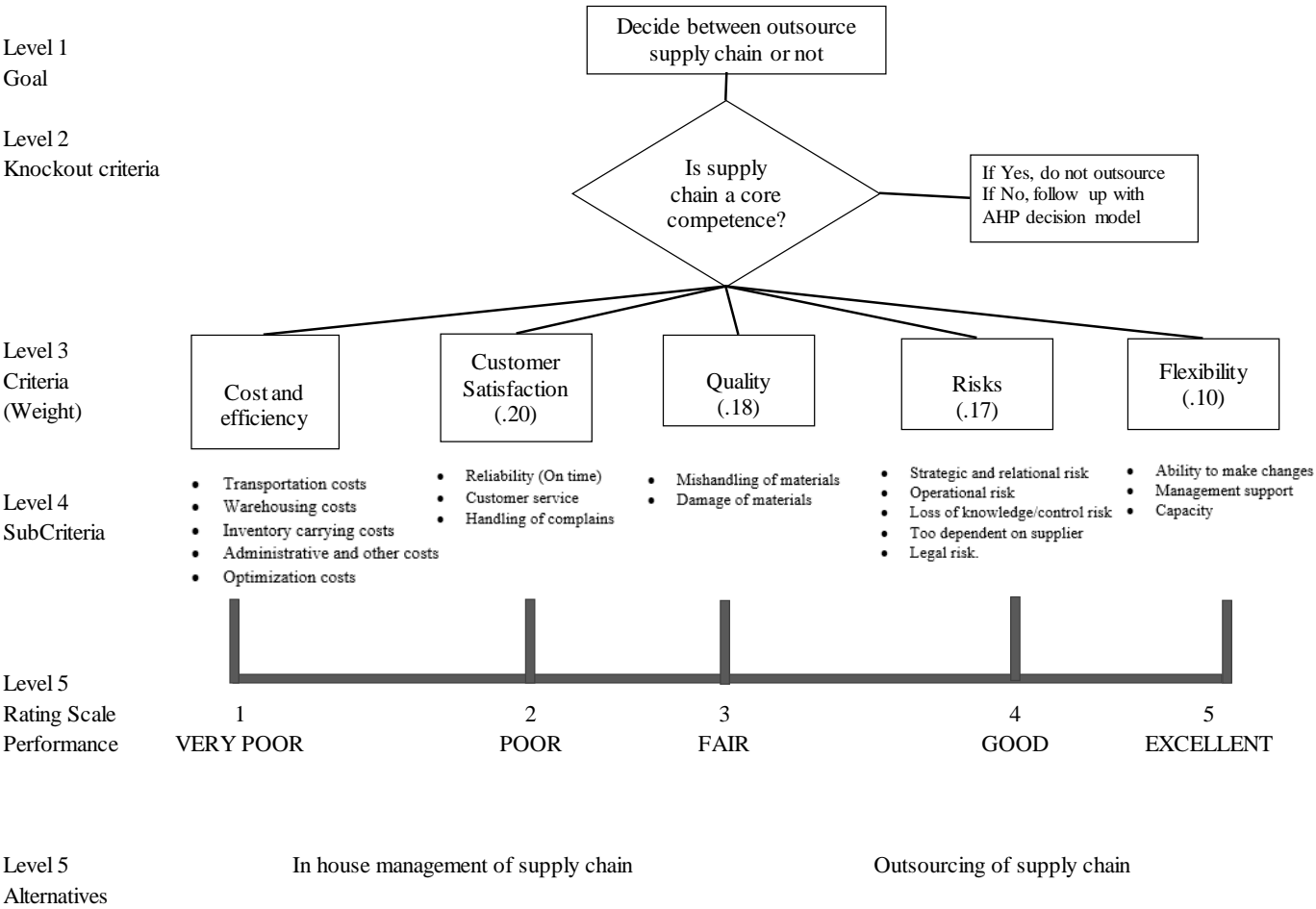
ranked as much more important than the rest of the factors and it will be used as knock out criteria to decide if the model is worth being tested or not.

3.4.2. MCDA Model > AHP

Next step is constructing a Multi Criteria Decision Model (MCDA) using the factors and their weights. Continuing with the list of prioritized factors, cost was identified as the parameter with highest score, followed by customer satisfaction-time in 2nd place.

In AHP model the alternatives (outsourcing vs managed in house) are ordered according to the Wj (final weight of the alternative) regarding all objectives in descending order, where the highest value indicates the most preferred alternative.

(7) Model (AHP)



3.4.3. Testing model and final results

Final step was to test the model to see which alternative resulted as the best option following the decision model in the previous step. In order to test the model, a matrix of points need to be calculated considering two things: 1) The factors and their relevance in the model (weights), and 2) The results/responses obtained in the survey regarding both alternatives. After the calculations (shown below), the alternative number 2 (outsourcing of supply chain) was concluded to be the best alternative for the research question.

ALTERNATIVE 1

In house management of supply chain

RESULTS	RATING SCALE				
FACTORS	Very poor (1)	Poor (2)	Fair (3)	Good (4)	Excellent (5)
Cost and efficiency (.35)	0%	8%	48%	43%	3%
Customer satisfaction-time (.20)	0%	3%	25%	43%	30%
Quality (.18)	0%	0%	20%	48%	33%
Risks (.17)	13%	10%	38%	30%	10%
Flexibility (.10)	3%	13%	38%	33%	15%

MATRIX OF POINTS	RATING SCALE				
FACTORS	Very poor	Poor	Fair	Good	Excellent
Cost and efficiency (.35)	0	5	50	60	4
Customer satisfaction-time (.20)	0	1	15	34	30
Quality (.18)	0	0	11	34	29
Risks (.17)	2	3	19	20	9
Flexibility (.10)	0	3	11	13	8

TOTAL POINTS FOR
ALTERNATIVE 1

361

ALTERNATIVE 2

Outsourcing of supply chain

RESULTS	RATING SCALE				
FACTORS	Very poor (1)	Poor (2)	Fair (3)	Good (4)	Excellent (5)
Cost and efficiency (.35)	0%	4%	30%	34%	33%
Customer satisfaction-time (.20)	1%	6%	30%	38%	25%
Quality (.18)	0%	5%	25%	30%	40%
Risks (.17)	9%	23%	26%	33%	10%

Flexibility (.10)	11%	20%	34%	26%	9%
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MATRIX OF POINTS	RATING SCALE				
FACTORS	Very poor	Poor	Fair	Good	Excellent
Cost and efficiency (.35)	0	3	32	47	57
Customer satisfaction-time (.20)	0	3	18	30	25
Quality (.18)	0	2	14	22	36
Risks (.17)	1	8	13	22	9
Flexibility (.10)	1	4	10	11	4

TOTAL POINTS FOR ALTERNATIVE 2	370
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4. LIMITATIONS AND FUTURE RESEARCH

When building the AHP decision model one limitation is that it takes into consideration some critical factors that drive the decision, however, is not an inclusive model covering all possible factors or scenarios. So it is important to mention that other parameters not mentioned could be used depending on the context of the firm, industry or degree of outsourcing desired.

Also one disadvantage of the model is that it takes mainly qualitative aspects, so for future research a quantitative research could be used to complement the model, especially regarding cost analysis. A cost estimation both for the implications and savings generated by the decision could be calculated to have numerical data to support the decision.

Finally, for future research one possible path in the planning of the factors is to follow a comprehensive approach with views of representatives of all major departments in the company with the aim of gaining a broad perspective of how different functions are affected by the outsourcing decision.

5. CONCLUSIONS

Supply chain is a living field of work, which is constantly changing and in need of updated processes and personnel. Sometimes companies cannot allocate enough resources to keep

updating its processes and personnel regarding logistics, which may lead them to lose the race of supply chain as competitive advantage. One solution obtained by this research is that outsourcing logistics could prove to be an efficient way to stay up to date in the field of supply chain without compromising efforts that could be better employed in the core business.

The evolution of logistics was reviewed and one conclusion is that the trends today are moving towards a more interconnected network where global suppliers and global clients share information and data to not only increase efficiency and save costs but to promptly satisfy the demands of customers for fast, competitive, sustainable and good quality products/services. This new stage of supply chain gives more room for outsourcing since companies are not anymore close mind business where everything is done and kept inside doors.

If a company intends to outsource the logistics department the first thing to analyze is whether it has the need or not, and whether if supply chain is part of its core business strategy or an auxiliary activity. After that, it comes the process to search in the market to see which logistics operator best resembles their need of some critical factors: quality, price, customer satisfaction, flexibility and risks coverage.

One of the main and most important conclusions that underlie this project comes from the factors involved in the Decision Model, specially about cost. Cost was retrieved as the most important parameter when choosing to outsource or not. Therefore, it should not be forgotten that companies must always analyze what costs they would have as their own in the internal realization of logistics and which of these they would save or transfer to the operator in case of outsourcing.

The AHP decision model is designed in order for the most critical factors to be reviewed first (Cost, then customer satisfaction, then quality, then risks, then flexibility). Companies can thus start evaluating the most critical factors in order to determine if it is useful to continue with the

rest of the investigation. Finally, despite there are some risks associated with outsourcing specially when it comes to flexibility of managerial decisions and operational risks regarding capacity and quality, or strategic risks regarding intellectual property; people tend to favor the decision of outsourcing logistics driven by two major forces that outpaces the risks: cost reduction and operation efficiency.

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APPENDIX

(Qualtrics Survey)



Q1. Please indicate your gender:

Male

Female

Q2. Please indicate your age group

Between 18 and 25

Between 25 and 35

More than 35

Q3. Please indicate your nationality:

Q4. Which of the following describes best the area you work in?

Finance

Logistics / Supply Chain

Human Resources

Sales & Marketing

Production & Operations

Quality & Customer Service

Other

Q5. Which of the following describes your company's line of business?

Manufacturing Automotive

Manufacturing (Other than automotive)

Banking & Financial Services

Consultancy

Food & Beverages

Retail

Healthcare

IT & Telecommunications

Transportation

Other

I don't currently work

Q6. Please rank the following aspects/values according to the importance they have in the company you work in, where 1 is the most important and 9 the least important

Customers first

Quality first

Innovation first

Environment first

Profit and growth first

Efficiency first

Safety first

Teamwork first

Adaptability first

Q7. Please indicate your level of agreement on the following statements based on your experience working in your company. The rating is from 1 (Strongly Disagree) to 5 (Strongly Agree)

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Your organization considers quality as number one criterion in its activities and when selecting suppliers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your organization strive to establish long term relationship with its suppliers and cost saving strategies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your organization includes its key suppliers in its planning and goal setting activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Your organization regularly solve problems jointly with its suppliers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your organization frequently measures and evaluates customer satisfaction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your organization pushes suppliers and collaboratives for shorter lead times	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your organization share risks and rewards with its members and supply chain members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q8. In the case that you hire a company to manage your logistics (including the purchase and delivery of raw materials, packaging, shipment, and transportation of goods to distributors, for example), please evaluate the importance of the following factors in your decision of the outsourcing company:

	Not important	Somewhat important	Important	Very important	Extremely important
Reliable delivery dates	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Accurate order fulfillment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Level and handling of complaints	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flexibility in accepting changes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fast order cycle time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Added value	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality of service and materials	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Trust	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Simplifying the whole chain process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capacity in case of demand increase	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Opportunity for cost reductions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Location of supplier	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Top management support	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Handling of complaints	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>