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COMPARING MANUFACTURING AND SERVICES SOURCING AGAINST R&D SOURCING

Marzieh ShahmariChatghieh*, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610,FI-90014, Finland
E-mail: negarshahmari@gmail.com

Harri Haapasalo, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610,FI-90014, Finland
E-mail: harri.haapasalo@oulu.fi

Anyanitha Distanont, Department of Industrial Engineering and Management, University of Oulu, P.O. Box 4610,FI-90014, Finland
E-mail: Anyanitha.Distanont@oulu.fi

ABSTRACT

Purpose *– The aim of this paper is to compare the critical issues (quality, cost, flexibility, competitiveness, resource utilization and innovation) of sourcing in manufacturing, service and R&D companies in order to explore the most crucial characteristics of R&D supply chain to define the most efficient strategy to source R&D.*
Design/methodology/approach *– The research was conducted with a qualitative approach through a literature analysis.*
Findings *– The final result is a comparison of the factors in manufacturing, service and R&D sourcing, to find out the framework to further analyze sourcing in R&D.*
Originality/value *– This research contributes to modifying the methods and strategies of sourcing in R&D sector, which have been used in manufacturing and services logistics.*

Keywords: Sourcing, R&D, supply chain
Paper type: Research paper

INTRODUCTION

Nowadays in competitive atmosphere of industries, all the companies try to produce the best product to gain customer satisfaction and market share. Companies which could survive in the *fiercely competitive marketplace must* work in accurate way, at accurate time and accurate place at all parts of their value chain. The efficiency and supreme productivity should come from all individual parts of the supply chain in order to match and control whole supply chain. Moreover, organizations have to use the most appropriate directions and procedures which come from proper strategies.

Moreover numerous researchers have investigated about different features of different supply chains. Some studies considered the manufacturing supply network characteristics (Feurer and

Chaharbaghi, 1994; Beaman, 1999; Harrison and Van Hoek, 2011), some of them focused on the service sector supply chain structures and influential factors (Fitzgerarld et al., 1991; Ellaram et al., 2004; Lehtonen and Salonen, 2006; Safizadeh, 2008). Additionally in last decades researchers are becoming more interested in R&D sector due to its essential role in competitiveness of organizations. There are various studies tried to point out its significant factors (Menke, 1991; Cooper and Kleinschmidt, 1994; Hagdoorn, 2002). Moreover there are some studies tried to modify manufacturing and service supply chain management models into the R&D supply network circumstance (e.g., Prajogo and Sohal, 2001).

According to the previous studies, it can be seen that there are many methods and procedures have been modified from manufacturing supply chain management to services sourcing network and most studies focused on manufacturing supply chain and services sourcing rather than on R&D sourcing. Moreover there is no research which tries to investigate the differences and similarities of R&D, manufacturing and services sourcing. Therefore this research tries to address this gap by investigating the significant factors of manufacturing and service supply networks in order to compare with R&D supply chain.

The purpose of the paper is to compare the critical issues of sourcing in manufacturing, service with R&D companies. In order to meet the objective of this study, the following research questions need to be answered:
RQ: What are the main differences and similarities of souring for tangible manufacturing and intangible services compared to R&D sourcing?

THE LOGIC OF THE PAPER

As mentioned in the introduction part, the purpose of the paper is to compare R&D sourcing with manufacturing and services supply chains. The manufacturing and services supply chains are more studied in the literature, thus their main characteristics are studied and compared to match with the same factors in R&D sourcing. To ease the comparing process and have a comprehensive insight, the supply chains are seen as systems with input, output and processor. Due to the effective role of inputs and products of each supply chains to make them different with each other, inputs and outputs of each of the systems_ manufacturing, services and R&D supply chains, are defined and compered in the 3rd chapter.

As the wideness of processor factors, some more bold issues should be compared in the processor part. Thus the performance dimensions of Fitzgerarld et al (1991): quality, cost, flexibility, competitiveness and resource utilization are seen as the most crucial issues in the area and compared in the 4th chapter. There are various other critical factors in supply chain, which could not be described in the paper. So the study as a scope belongs to only some factors that are considered as significant issues in sourcing. The logic of the comparison between the mentioned criteria was finding out the boldest similarities and differences from literatures in general view points. It is tried to find out the most common factors which could be belonged to all the industries but if there is any special example from special industries they are mentioned in the text. More over all the factors are seen from buyers view point.

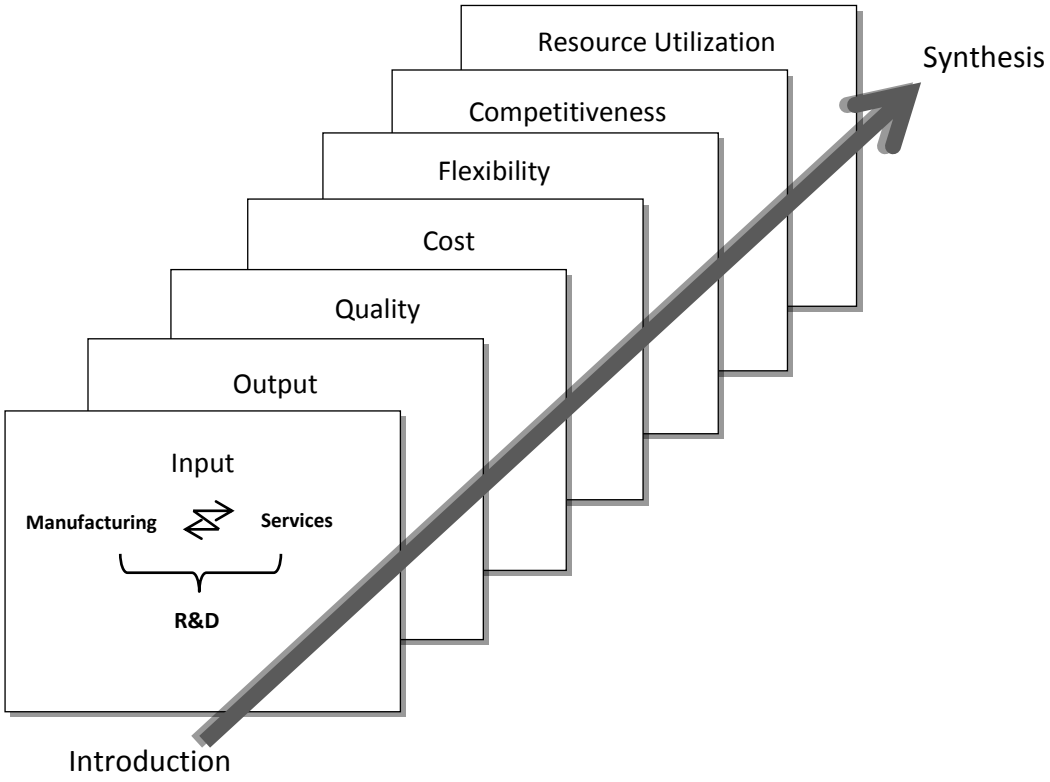

Fig. 1. Logic of the paper

1 Inputs and Outputs

Inputs are material, information, permissions and all properties which used in a process to gain required output which called product. The purpose of supply chain network players in any sector is to deliver products to customer. The characteristics of product determine the characteristics of supply chain and all of its drivers and activities

1.1 Manufacturing Supply chain

As Heshmati (2003) mentions inputs in manufacturing sector are material, capital, labor and energy to pass proper processes through add-value network, to be converted into outputs, which could be known either as physical objects or monetary values. Additionally, various authors try to classify the outputs of manufacturing by different features; as an example, Huang et al. (2002) classify the products in manufacturing sector to obtain appropriate supply chain management strategy; they introduce three groups of products: Functional, Innovative and Hybrid products. It is necessary to mention that the classification of products could be done by different industries and various purposes.

1.2 Services Supply Chain

Categorizing inputs in service companies is more or less the same as manufacturing companies, as Siegel and Grilichez (1992) represent, inputs of services companies are capital, labor, material, energy, exactly like manufacturing, moreover they add purchase of services besides the inputs of manufacturing sector. Heshmati (2003) points out that the costs which the company efforts for development could be known as an input. Classifying and evaluating inputs is totally easier than calculating and categorizing outputs, cause outputs of services sector include wide range of activities and products.

Lööf and Heshmati (2002) emphasize on the role of employees and assume that the output of service sector could be measured by value added per personnel, but the researches which study more detailed in various industries, illustrate more specific definitions, for example output of an educational institute is seen as registered student and for medical care centers the number of outpatients which checked in and inpatients which checked out are identified as outputs of the system (Rosko, 2001).

1.3 R&D Supply Chain

In current situation that the product life cycle is continuously becoming shorter, proper R&D and fast development could be the success factor of a company. Therefore, R&D process needs some supplementary inputs in compare with the service and manufacturing sectors, in R&D sector, in addition to labor and material the company needs specific data, information and knowledge. Labor is known as the people who participate in the process of research and development which could be referred to technicians and employees who are participating in prototype creation as well, material is the most obvious input of the processes which is needed for simulation, tests and prototype creation phase, but the knowledge, data and information is the base part of R&D inputs.

2 Performance dimensions of Supply chain comparison

2.1 Quality

Obviously the first priority of every company should be quality. There have been lots of companies which preferred cost reduction than quality, although studies depicted the outcome have been revenue reduction, one of the famous examples of this strategy is Toyota behavior which Cole (2011) investigated its reasons and characteristics. The quality is not only the right characteristics of product but the right activity of whole supply network. Therefore some researchers produce concept of SCQM (Supply Chain Quality Management) to transfer the process of quality evolution through all parts of supply chain (Carmignani, 2009). Moreover, Malhotra and Robinson (2005) suggest that quality approaches like ISO 9001 (2000) should assure quality from inside supply chain instead of separated methods to control supply chain and quality.

2.1.1 Quality in Manufacturing Supply Chain

To modify the old quality management system into SCQM, the companies should build a quality assurance system for the supply chain as a unify network, for instance Kuei et al. (2008) describe four steps for implementing SCQM in companies, Furthermore, Fish (2011) recommends some supportive activities to shift from traditional quality management in the supply chain into SCQM, which could promote the effectiveness of the efforts and ease the implementation of the approach.

2.1.2 Quality in Service sector supply chain

Bolton and Drew (1991) define service quality as the ratio of customer perception and company performance which is different from customer satisfaction. Lots of studies have done to find out the factors of service quality with various methods, Grönroos (1988) represents the customer observation of companies' activities into two groups: functional and technical. Parasuraman et al. (1985) study 22 factors which considered as effective elements of the quality of service and represent empathy, assurance, responsiveness, tangibles and reliability as the elements of customer perceptions of service quality and introduce SERVQUAL model.

Haywood-Farmer (1988) classifies possible factors which could be effective in the customers feedback from the services into: physical, behaviors of personnel and professional judgments; additionally furthermore, some other researchers like Santos (2003) and Dabholkar (1996) specify in particular industries for defining service quality factors and define models for e-commerce and self-service technologies.

Most of the researches have done only to measure and evolve technology in companies scale; although from supply chain management view point when the whole parts of chain are included in the quality assessment the process is more effective (Nix, 2001; Seth et al., 2005). Therefore researchers in the supply chain management field try to define service quality from network scale insight. In accordance with the definition of service quality the service quality in supply chain is defined as ratio of expectation to performance of each network player and whole add-value network (Seth et al, 2006).

Even though most of the studies in the area do not include requirements to harmonizing whole supply chain, the studies are illustrated that service quality programs lead to better performance of whole supply chain (Mentzer et al., 2000; Stanly & Wisner, 2002). Therefore Seth et al. (2006) try to modify service quality models to unify the whole network players in quality assurance programs by extending SERVQUAL model of Parasuraman et al. (1985), which is used by other researchers in empirical studies in various service companies like educational institute (Jacksen et al., 2011), health care centers (Fantazy et al., 2010) and management consultant (Giannakis, 2011).

Dale et al. (1997) demonstrate the differences between quality management in service provider organizations and manufacturing companies. They find out that quality in services sector is very

human factor centric, the behavior of personnel _ away from the technical performance of the service, could promote customer satisfaction or demote it.

2.1.3 Quality in R&D Supply chain

Menke (1991) mentions success factor of R&D as: working on the right project by proper people and appropriate process, so the framework which could illustrate "right" project, "proper" people and "appropriate" process is constructing quality. Subsequently he classifies the quality assessment stages. the first level is evaluation feasibility of the project according to market area, strategy of the company and lots of other statistical and qualitative data; which could be gained from strategy table, influence diagram, new product revenue forecast, sensitivity analysis and decision trees as suitable approaches for evaluation and prioritization of various R&D projects.

For the second and third stages of quality assurance, due to the similarity of these processes into manufacturing and services sectors, the approaches which have been implemented successfully in those sectors are mostly modified by various authors. For instance (Prajogo and Sohal, 2001) modify TQM for R&D sector, which is one of the most popular quality approaches in manufacturing and had been modified for service provider organizations too. In addition, Benner and Tushman (2003) argue that with mixture of process management and customer focus approach, company could make a quality structure that the process management approaches guarantee the quality part of processes and customer focus approaches carry the effectiveness of voice of customer in development and innovation process.

2.2 Cost

Simchi-Levi et al. (2007) classify cost as one of the features which customer evaluates each company's products with. Therefore, lower price is one of comprehensive competitive strategies and cost reduction is a factor which even in luxurious products is considered besides keeping high quality of products, to increase profitability of the company.

2.2.1 Cost in manufacturing supply chain

Beaman (1998) who studied about the performance of supply chain considers 4 approaches to promote profitability of a supply chain: minimizing costs, minimizing average inventory level, minimizing obsolete inventory and maximizing profit. Furthermore, other researches go beyond the details and suggest some methods to reduce costs, Camm et al. (1997) believe that the distribution centers allocation optimization and lower costs of transportation lead to less total costs. Moreover they give a stochastic based method to make efficient the numbers and locations of distribution centers; likewise, Lee and Feitzinger (1995) besides evaluating the number of distribution centers, calculate wide range of activities costs in supply chain from set up costs to inventory costs, to form whole integrated channel, cost efficiently.

From various viewpoints in supply chain studies, inventory level and allocation are crucial factors; Pyke and Cohen (1994) investigated about the inventory cost efficiency, they compute replenishments size and time, orders characteristics and amount of products in each batch to

prevent delays. Besides Lee et al. (1993) try to reduce inventory levels by production allocation. Furthermore, Altiok and Ranjan (1995) model attempts to lessen the inventory level by forecasting time and number of orders accurately. Towill and Del Vecchio (1994) by modifying filter model endeavor to minimize the number of inventories and their costs. Moreover, Ishii et al. (1988) suggest a method to reduce the inventories by identifying and eliminating obsolete products from them.

Several researches define models to cover all supply chain players in a unified cost efficient program. As Cohen and Lee (1988) create a model to increase supply chain profitability. According to their model all parts of supply chain are under control restrictedly. Besides, Jonrinaldi and Zhang (2013) optimize costs of whole supply chain with less restriction according to the demand forecast and products life cycle. Also Tzafestas and Kapsiotis (1994) introduce a procedure to improve entire network activities, thus they recommend three various approaches to evaluate supply chain players.

2.2.2 Cost in Service Sector Supply Chain

As described before, one of the customer preferences is lower cost in gaining appropriate services; simultaneously the company's target is to achieve both customer satisfaction and more profit. As Johnston and Glark (2008) represent high quality service delivery leads to absorbing more customers which brings better financial performance for the company. Therefore managers try to make supply chain efficient to provide high quality services with lower cost.
Frei (2006) recognizes various strategies to reduce cost beside keeping customer satisfied, he suggests some tips to make efficient supply chain as labor allocating view point, for instance: using cheap labor and outsourcing some activities to other countries with lower cost labors, try to automate the process as much as possible to eliminate human factors failure and make maintenance line cheaper, outsource customer contacts, ease tough processes in a way that they need less skilled employees. Although the entire decision making should be done carefully with all aspects and costs consideration, for example outsourcing labor could have some hidden cost for the company which should be taken into account (Ellaram et al., 2004).

2.2.3 Cost in R&D Supply Chain

In the beginning of every R&D project, one the most crucial concerns of stakeholders is the financial performance of the project result and suitability of the developed or innovative product with the situation of market, at the release time. Therefore a significant part of R&D project is financial estimation. Apparently known estimation methods for expected sale, revenue and other financial values are inadequate for a complete consideration of a R&D project. It is necessary to notify qualitative variables as well, these variables are illustrated situation of company, market and environment impressions against the new product release.

Additionally always there have been trade-offs between low cost innovation with high revenue, and costly researches to find out new infrastructures and build innovative products. Moreover time is another factor which makes R&D projects costly; as Dunk and Kilgore (2001) represent high competition on cost in short term projects, rather than innovation. Furthermore, Thoma and

O'Sullivan (2011) compare costly innovations in car industries of Germany and low cost built production lines in china.

Totally costs of R&D projects which gain from quantitative procedures like NPV (Net Present Value) and qualitative models like game theory lighten up the potential and future of each idea and project that the company should decide whether the potential goals, revenues, built infrastructures are in line with the company's strategies and invest on them.

2.3 Flexibility

Flexibility is capability of system to adjust with the changes which is made by the customer requirements, suppliers' feedings and any other environmental or internal factors, quickly and efficiently (Beaman, 1999). In accordance with the available uncertainty in all industries one of the success factors of any supply chain is high flexibility. Thus if the company wants to stay in competitive market should increase the flexibility as much as the level of uncertainty. Demand fluctuation, technology uncertainty, environmental problems like economic problems, contractual collapse in external sourcing and even natural contingencies like earthquake and tsunami can lead to high uncertainty in various occasions for manufacturers and manufacturer cannot remain in the market place without high level of flexibility.

2.3.1 Flexibility in manufacturing supply chain

Researches try to find out different kinds of flexibilities to gain the elements of them and solve the problem by finding its compositions. Hence, Slack (1991) identifies two different flexibilities in the manufacturing sector; Range flexibility which is the tolerance area that the operation can be adapted with changes, and respond flexibility, the value of changing operational direction (time, cost or both), it is necessary to mention that the extension of operational changes (range flexibility) is limited but it should be adjusted with level of uncertainty, which exist in the market circumstance.

In addition D'Souza and Williams (2000) represent volume, variety, process and material flexibilities as compounds of manufacturing supply chain flexibilities, that each of them has two subgroups of range and mobility. There are various categorizing of flexibilities from different viewpoints, for example Slack (1991) determines four distinct types of flexibilities in manufacturing network; volume, delivery, mix and new products flexibilities, which are represented to ease the classification of duties for finding out the gaps and increase flexibilities. Another interesting classification of flexibilities belongs to Koste and Malhorate (1999) that have a hierarchical approach and study all part of the supply chain which begins with the strategic flexibility and continues to individual personnel and contractors.

Subsequently, lots of investigations have done to determine the effective factors on flexibility and its measurement; Christopher (1992) describes flexibility measuring dimensions, as regular set up and product development time, economy of scope and the number of inventories. Moreover, Slack(1983) mentions that flexibility measurement is complicated due to various dimensions and facts _actually and potentially, that flexibility could be influenced by. Sethi &

Sethi (1990) realize 15 various dimensions of flexibility in manufacturing sector which encompass marketing, human factor and manufacturing criteria.

2.3.2 Flexibility in service sector supply chain

Any fluctuation in entering input or demanding output and technology of system cause uncertainty which leads to lower level of performance in absence of flexibility. Logically when high uncertainty situation occurs (e.g. variation in demand) the company would look for increasing numbers or variation of resources which not only is costly but also if the fluctuation would be temporary the company encounter useless provided inputs, therefore the company have to find out models to control such kinds of changeable conditions that is the concept of flexibility (Iravani et al. 2005).

But flexibility in services is even more complicated, the employees always are in close interaction with customers and one of the customer satisfaction factors is the officers behaviors which is almost unique for every customer, therefore in services companies customization is very common which is one of uncertainty factors (Aranda, 2003), thus flexibility known as high potential of company in customization (Iravani et al. 2005).

Different researches tried to find out different models for improving flexibility of companies in service sector, some researches emphasize on the resource or labor allocation and for each task or demand introduce two or more employee to reinforce the demand variations (Iravani et al, 2005) or some others study on the companies which provide product and services in the same time or provide service by using technological devices, prefer to use higher technological devices to evolve flexibility. Although Gupta and Somers (1996) believe that technology development does not cause better market share and competitive paramount. Therefore for gaining better flexibility in service supply chain, whole the adding value network should be flexible; as Chambers (1992) represents, the flexibility of supply chain is not possible without flexibility of all parts of the network.

Furthermore all parts of network should be prepared to adapt with environmental variations to guarantee the whole chains flexibility. Suarez et al. (1996) describe that from the design and introduction phase to the end of product life cycle, all the activities and duties should be flexible. Furthermore, resource management in addition to demand quality and quantity evaluation, should be adapted with all the variability and uncertainties which could happen, to prevent unutilized components and human factors or lack of resources.

2.3.3 Flexibility in R&D supply chain

Existence of uncertainty in all R&D projects is obvious, and negative effect of high uncertainty situation on the revenue of R&D projects is apparent as well. Therefore the whole chain structure should be flexible enough to triumph against at least some amounts of uncertainties. Furthermore it is necessary to mention that, due to some characteristics of R&D sector like output which is

almost vague in some R&D projects, lead time that could be floating and market situation in product introduction time which could be unknown, flexibility management in R&D is more complicated in compare with manufacturing and service sectors. Moreover, due to all unstable situations which named above the tolerance of flexibility in R&D should be wider.

Flexibility in R&D sector contains wide concept during various stages of development projects, which the project managers should decide whether to change the directions and plans. As mentioned, first phase of a R&D project is the evaluation or planning phase, that the company decides which idea could be more productive and efficient in accordance with the current information from customer demand, competitors' situation and market but in case of unstable condition, big fluctuations could destroy all plans of project. Moreover the whole chain structure should be prepared and flexible enough to react against the changes those are harmful or even useful for projects (Santiago & Vakili, 2005).

For the first phase of evaluation and concept studies, there are lots of models to evaluate various aspects of R&D potential projects like NPV (Net Present Value) or others which mentioned in the quality part, but most of them study current situation of company and disregard the uncertainty of the environment (Huchzemier & Loch, 2001). Schwartz and Trigeorgis (1997) adapted Real option theory which mostly used in corporate finance, to make the R&D projects more flexible by evaluating the process and effective environmental factors in each stage of the project. He gave 5 options in each stage to harness uncertainty like defer and abandonment.
Then Huchzemier & Loch (2001) expand his theory which contains more uncertainty factors in R&D like budget fluctuation, lead time delay, product characteristics and performance in addition to market factors, to make it more applicable in R&D flexibility measurement. Furthermore sequential model of Roberts & Weitzman (1981) is another effort to identify a method to restrain uncertainty in research and development projects.

2.4 Competitiveness

Recently, in the speedy developing technology area which leads to increasing customer requirements and shortening product life cycle, one of the most crucial considerations of managers and firms stakeholders is remained in the market and competition of industries by promoting competitiveness of their products and processes. Some authors like Cleveland et al. (1989), Kim and Arnold (1993) and Vickery et al. (1991), recognize strategy as the factor to remain in the competition between companies in industry and only mention competitiveness as a way to find out the level of production harmonization with strategic goals.
Feurer and Chaharbaghi (1994) define competitiveness as not only potential of knowledgeable employees and technological equipment to keep production activities synchronized with the strategic targets, but also capability of the company to manufacture and modify the manufacturing system with changing competitive environment. Away from various definitions details, all of them imply that competitiveness is a characteristic to stay in the market by having qualified products and capabilities, from customer viewpoints and following the strategic directions.

2.4.1 Competitiveness in manufacturing supply chain:

As the definitions are different, various studies distinguish various factors and criteria for this concept although they are similar and some of them are just repeated. Arze and Svensson (1997) emphasize on the level of equipment technological potentials and employee's knowledge on the degree of competitiveness; El Mhamedi and Binder (1992) argue about human factors effectiveness too. In addition, Gardiner and Gardiner (1997) constitute systematic management as another driver of the concept.

Consequently, researchers attempt to create methods and calculate the competitiveness of a manufacturing organization, for instance Feurer and Chaharbaghi (1994) consider people, technology, shareholders value, financial strength and customer value as the factors which the competitiveness could be evaluated by measuring their performance and mention that a sustainable competitiveness would be happened in the balance of all the factors.

Moreover, Chiang Kao and Shiang-Tai Liu (1999) assume that two dimensions of technology and management, that each of them contains various sub factors, are the base drivers of competitiveness. In accordance with the fact that some factors are not qualitative to be mentioned in mathematical statistics, they try to model competitiveness and all the drivers by fuzzy. They identify equipment quality and quantity, employees' knowledge and its appropriation to the level of automation, control level and technological capabilities as the sub factors of technology and try to convert the qualitative variations into fuzzy specifications. Furthermore they used from Amrine et al. (1993) description of effective components management.

2.4.2 Competitiveness in service sector supply chain

Porter (2000) besides defining service competition as a dynamic concept, which try to promote service strategies by innovation and development, argues that location is an effective factor in the service competitiveness that leads to increase productivity. So (2000) describes time and price as the most effective factors in competitiveness of service companies, moreover he emphasizes that time accuracy leads to more customer satisfaction. Moreover, Allon and Federguen (2007) classify competitiveness factors of service sector: price, time and other attributes. The last dimension which they describe is "other attributes" which refer to technical quality of company's core business that is the reason which customer is looking for the services.
Due to variation of "other attributes" factors in various industries, the researchers define "full price" concept, to find out unified structures for all the services companies competitiveness, which argue about competitiveness by functionalizing price and time with the assumption of the same rate of other attributes in all the services companies. Thus time and cost are implicit functions of each other from customer viewpoint. Additionally Carmonel et al. (1994) depict "full price" function is nonlinear. Moreover, Allon and Federguen (2007) according to constant level of "other attribute" in all the service provider companies, distinguish three various strategies for increasing competitiveness, first is improving capability to reduce both time and cost, second is trying to decrease customer waiting time and the third is price reduction strategy.

Apparently, core business of service provider organizations is the key point of competition. As mentioned, for evolving quality of service and product of the company the enterprise needs to have high technology development and innovation in the services and products but due to variation in the services core businesses and close relation between customer and employees situation and psychological factors, competitiveness in services is more complex in compare with manufacturing sector's competitiveness. Still, as described above price and quality are crucial competitive factors.

2.4.3 Competitiveness in R&D supply chain

Apparently, R&D known as the most fundamental company's solution to remain in the market competition and promoting its competitiveness features. In addition, the company identifies its competitive strategies to shape R&D and follow the plans, therefore all details of R&D projects are influenced by the company's competitive strategy from innovative topic selection and the projects budget to scheduling, in accordance with the companies capabilities (Cooper & Kleinschmidt, 1994). The competitive strategies could be seen from various aspects, moreover companies define different kinds of competitive strategies in various industries and environment, thus researchers have classified the competitive strategies from diverse insights, that each of them leads to gain special goals. Strategy could be identified as one of the success factors of R&D projects. Two various categorization of competitive strategy for R&D are describe below that first one is comprehensive for all industries and the second one is given especially for high tech industries.

Ulrich and Eppinger (2008) suggest a classification for competitive strategy which is applicable in various ranges of industries. They describe that companies could emphasize on technological development to introduce pure new technological products based on new technologies in industry, the most visible example in this area is the introduction of ipad by Apple company which is applicable by various customer segments (Wang et al., 2012).
Moreover, as the cost efficiency is one of competition features in various industries, they introduce cost leadership as another competitive strategy of a company which R&D projects try to make efficient processes by standardization, increase the economy of scale, develop production process and process planning to reduce production costs and offer cheaper high quality products or services to the customers, the known example of such development is Wal-Mart company distribution system (Harisson & Van Hoek, 2011).

The third competition strategy is finding out up-to-date customer requirements and keeping the products align with customer satisfaction level, by study voice of customer deeply, such customer focused methods mostly lead to developing new product lines and trying to implement total customer solution strategy, which bring customer loyalty for the company; It is necessary to mention that this method could be applied only for one or two customer segmentations.

In addition, imitative strategy is described as another competition plan which contains studying competitors' behaviors intensely to obtain their market share rate, customer perceptions, advantages, disadvantages and develop their successful or innovative product immediately. Important feature in this competitive strategy is performing the process rapidly before the satiate

of the market form the product. Furthermore the company should try to use its own innovative ideas in the product to not copying the product; the known example of Samsung tablets against apple ipads could illustrate this competitive strategy obviously (Sener & Davis, 2008).

Subsequently, Liao and Cheung (2002) classify competitive strategies in high tech industries with a customer segmentation focus and marketing insight, into five various strategies: first high added value, which company trying to develop a high value product which could be used widely in the industry and has high commercial value for almost all customer segments. Second is focus on one segment of customers and produce high value added product for them. Third is overall cost leadership as described in Ulrich and Eppinger's (2008) classification that the target of development is to reduce cost of products by various methods for all customer segments. The fourth competitive strategy is to differentiate the product; that the R&D team is seeking to acquire pure innovative idea to absorb almost all customer segmentations, and the last strategy which they describe is to develop innovative product for special customer segmentation.

2.5 Resource Utilization

Resource utilization is the level of used resources capacity like space, labor time and equipment, which illustrates how much the company currently used from its resources potential capabilities and how much of resource capacity is unused (Klassen & Mentor, 2007).

2.5.1 Resource utilization in manufacturing supply chain

Totally the amount of utilization should not be near 100% because it decreases the flexibility of a company; even repeated short term amount of high utilization rate known as a notification of low capacity of a company to keep the capability of resisting against uncertainties (olhager & Johansson, 2012). There are various models for capacity planning like waiting line, simulation and decision trees (Olhager et al., 2001). Consequently, ERP, MRP, BOM and all other resource planning methods and software are useful in this area for supply chain to keep the resource utilization in a balance which leads to neither unused resources nor low flexibilities against uncertainties.

2.5.2 Resource utilization in service sector supply chain

Resource utilization and planning structure in service is more or less the same as manufacturing most of the methods and software which used in manufacturing are modified for services, with some differences, in manufacturing the products according to the forecast should be on shelf or in inventories, whereas in service companies, the forecasts results should be practiced in the capacity of the company. Therefore lots of other concepts have different definition in service companies. All the ERP and MPS systems that were based on the BOM, in service sector are depend on Bill of Resources (BOS), furthermore, in service the role of human factor is very crucial so all the predictions should be done to cover human factors failures, like absence, holiday and other, additionally the utilization planners are mentioned that capacity utilization of human factors could be 100% rarely, and the quality would reduce with more utilization.

2.5.3 Resource utilization in R&D supply chain

Restricted amount of material, time, equipment and human resource, against high number of R&D projects make the companies to allocate resources efficiently, to maximize their utilization and have optimal number of high prioritized innovative projects in progress. Hendriks et al. (1999) emphasize on having unified resource and project pool in the environment to have more R&D projects with less costs.

Wheelwright and Clark (1992) try to allocate resources by "Aggregate Planning" from studying various aspects of project planning and resource allocation. Furthermore some other authors try to create methods to optimal number of in progress projects and their schedule, Platje et al. (1994) study single projects in a unified system of portfolios by "rough-cut-project-and-portfolio-planning" to optimize the number of portfolios based on available resources, moreover, Pillai and Tiwari (1995) suggest a long term procedure for prioritizing the portfolios by the strategic goals of the company, and put less significant projects in the future schedule of R&D teams.

Sometimes the company have to be enough flexible to redirect in accordance with the market fluctuation or competitors behaviors. Therefore, as Hendriks et al. (1999) suggest a model with short, medium and long term resource allocation planning that all these different schedule plans would related to each other by "resource dedication profile " and "project scatter factor", which illustrate situation of resources and projects during time.

3 Synthesis

Table 1. Comparison of R&D sourcing with manufacturing and services supply chains

	Manufacturing	**Services**	**R&D**
input	Capital, material, know-how and labor	capital, material, know-how, the role of labor could be more crucial	Capital, material, labor, but the role of knowledge and information is more critical
output	Finished products, physical or monetary values (like software)	services or additional service to manufactured products	new or developed product, process or activity
Quality	specified in the design of the product or known by quality management approaches	known from customer perceptions and customer expectations and service quality control approaches like SERVQUAL	Quality of concepts should be evaluated by companies policies, market conditions and the process of R&D should access with

	Manufacturing	Services	R&D
			modified Quality Control methods
Cost	cost reduction by efficient production, distribution and optimization whole supply chain	cheap labor, geographical allocation, technological equipment could reduce cost	Totally depends on the contract and strategies, concept and its revenue, which estimated by some methods before and after the beginning of project
Flexibility	Volume, delivery, mix, new product, range respond, flexibilities, some methods like JIT or other strategies like outsourcing could promote it	by allocating human factor and accurate capacity forecasting try to increase flexibility	flexibility of R&D project could be assured by continues evaluation of the project and market situation to continue, modify or abandon the project and avoiding more lost
competitiveness	manufacturing new technologies and best quality or cheap products with acceptable quality or both	more innovative, cheaper services, total customer solution, better employees behavior	technological capabilities, internal infrastructure and knowhow, customer potential and actual needs and market situation
resource utilization	utilization capacity should be synchronized with the production capacity; resource planning with ERP and MPS data bases	utilization capacity calculated with special recognition to the human factors potential; resource planning methods of manufacturing are modified for services	Projects should be prioritized according to the strategy of company, resource planning could be done by shifting or eliminating some project which company does not have enough resources for them.

The syntheses of all the described criteria are shown in table 2. As considered, in manufacturing sector inputs are material, capital, labor and know how. In services supply chain, the inputs are mostly the same with high effectiveness of labors due to more direct connection with customers. Moreover, in R&D supply chain, the inputs are the same with high emphasize on knowledge and information with was known as know-how in those supply chains.

Outputs of manufacturing companies are mostly finished product, not in meaning of ready to use but in the way that the product does not need any other work, although in case of after sale services the chain should be considered as a service supply chain. The outputs of service providers are the activities which are given to customers whether beside manufactured products or without any. In addition the outputs of R&D projects could be divided into two groups of totally new and developed products or services.

Quality is a concept which is defined in the design specification of products and could be assured by Quality management approaches in manufacturing sector. In service sector, quality more than the technical specification, depend on the customer perceptions and expectations which include employees' behavior as well and could be evaluated by some approaches like SERVQUAL. For R&D supply chain, the quality should be evaluated from the first phase of concept selection by strategies and policies of the company and should be followed in other steps as well.

Cost reduction could happen in manufacturing industry is known mostly by existence of efficiency in whole supply chain especially inventories and distribution centers or using from cheaper materials and labors, while in services geographical allocation, cheap labors and technological equipment. Moreover Cost efficiency in R&D project depends on the contracts and strategies of companies in addition to the estimated time and revenue of the projects.

Flexibility could be divided into various classifications to ease to promote by different methods like JIT. In service companies appropriate resource allocation and accurate capacity forecast could increase it. While in R&D supply chains, the project members should evaluate the project and market situations to continue, modify or abandon the project and avoid from more loos of the company.

Competitiveness strategies in manufacturing supply chain is mostly based on the cost, technology or both, therefore the company should represent the best quality, the cheapest product or combination of both. The situation in service company is more or less the same plus the bold role of employees and human factors behavior which could be paramount of a service provider, additionally in R&D sector the company could compete by best technological capabilities, cost leader ship strategy or customer focused developed product although combination of these strategies are possible as well.

Resource utilization and allocation are calculated by almost the same methods in manufacturing and services supply chains, but in R&D the projects should be prioritized be the strategic plans of the company.

CONCLUSION

In accordance with the mentioned difference and similarities of various sourcing networks, some approaches have been modified from one sectors supply chain to the other, while for more

accurate structures, more specifications should be studies. The usage of the study is mostly in those mentioned issued which give a brief landscape from different sectors supply chains.

Table. 1 could be the answer of research question in investigated criteria, inputs and outputs of R&D are almost the same as services and manufacturing with the difference of knowledge and date critical role in the R&D add value network. Quality in R&D should be defined from the first phase of concept selection and it should be assured during the other phases the same as two other sectors sourcing quality assurance approaches, although the whole concept of the project should be under continues evaluation.

Cost efficiency is more complex in R&D supply chain due to vague result of the process and the market situation in the future. Additionally the processes should be under assessment in all parts of the processes to keep the flexibility and avoid from loos in case of bad market situation or wrong direction of the R&D supply network players.

R&D is one of competitiveness tools in case of accuracy, the classification of high quality and low cost are the aim of R&D projects by using from innovation, supreme technologies or creative logistic methods for cost reduction. Resource allocation is defined the same in R&D sector and manufacturing and service companies with the difference on the prioritization policies which the company should define according to its strategies and market situation.

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