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**Developing a SCM Model for Improving
Leadership Role of STPs in Knowledge and
Technology Transfer from Research and
Innovation Centers**

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Executive Summary

Scientific society such as universities, research and innovation centers, have an important role between the social, political and economical factors, which have a valuable effect on the economical and technological development in a society. The process begins from creation and developing knowledge and technology, which usually starts from universities and research centers and continues with a practical and commercialization approach in establishing and developing firms and industries with their Services and products. This process could be seen as a chain with universities, research & innovation centers as suppliers in one side, and companies and industries as users in the other side. For the connection between two sides of this chain, an important link is needed to transfer the knowledge and developed technology from research centers to industries practically. In this paper, we are going to show that how the Science and Technology Parks (STPs) play the leadership role in this chain with using the Supply Chain Management (SCM) model and strategy to make an integrated network between this chain parts and processes.

Keywords: Science and Technology Parks (STPs), Research and Innovation Centers, Commercialization, Supply Chain Management (SCM), Industry, Knowledge and Technology Transfer, Leadership Role

1. Introduction

The increasing importance of knowledge and technology and its impact on development of the countries is an obvious issue. Great advances in knowledge and technology in recent decades is caused a competitive strategic factor. Creation and transferring knowledge and technology in the effective manner, lead to a company or organization to achieve its ideal goals in the shorter way. In our paper this route is defined from supply chain management processes and its strategies, which has been modified for the knowledge and technology transfer on the base of its parts and members. These parts have been gathered in a network that if their connection to each other be defined correctly as links in the chain, we could have integrated chain for the main purpose of this paper topic. On one side of this chain, we have the suppliers of the knowledge or technologies owners called upstream chain, and on the other side, we have the customers and users of those knowledge and technology products or services called downstream chain. For the connection between two sides of this chain, an important link is needed to transfer the knowledge and developed technology from upstream to downstream chain as it is called internal supply chain. Refer to our research, one of the best links in this position could be STPs, which bring about an appropriate environment for the companies and researchers to work and cooperate with the universities and research & innovation centers as the suppliers, on the basis of the industries requirements as the customers. This chain could be seen as a system to converge all the links and elements which playing a role in. In such a system, we should apply a model to manage this chain and its elements as a whole system to attain its goals.

A supply chain is a set of organizations directly linked by one or more upstream and downstream flows of products, services, finances, or information from a source to a customer. SCM is the active management of supply chain activities to maximize customer value and achieve a sustainable competitive advantage. It has been defined as the design, planning, execution, control, and monitoring of supply chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand and measuring performance globally. Effective and optimal supply chain management initiatives, use the most pertinent business community processes and organizational concepts as well as the technology, information systems, and communication infrastructures, to establish a competitive edge and maintain staying power. SCM is the comprehensive integration of all sub-processes that enable the exchange of information and movement of goods and services between suppliers and end customers, including manufacturers, distributors, retailers, research centers, government agencies and service firms or any other enterprise within the extended supply chain. In a networked and extended supply chain, each supplier and partner can securely access key business information, which is empowered to make informed decisions for the best serve customers according to their needs. To perform a good supply chain management in the way of a knowledge base enterprise's goals, some important strategies are needed: configuration components strategy, channel strategy, outsourcing strategy, customer service strategy and asset network. These are the fundamental building blocks of the supply chain strategy. Supply chain strategies require a total system's view for the links in the chain that work together efficiently to create customer satisfaction at the end point of delivery to the consumer. Consequently, costs must be lowered throughout the chain by driving out unnecessary expenses, movements, and handling. The main focus is turned to efficiency and added value, or the end-user's perception of value. Efficiency must be increased and bottlenecks removed. The measurement of performance focuses on total system efficiency and the equitable monetary reward distribution to those within the supply chain. The supply chain system must be responsive to customer requirements.

In a short description for the role of the science and technology parks in leadership of developing innovation and commercialization process, they generally represent a kind of Public private partnerships that are designed to foster and support knowledge flows. This process especially performs among science parks firms, as well as between these firms and external enterprise and companies to improve regional economic growth. In general, these knowledge and technology base firms have inventions or practical innovations, which want to commercialize them with support of STPs in the way of the customer demands. Among common denominators, it can be highlighted that science and technology parks facilitate access for the firms to key factors, such as Research & Development, innovation, infrastructures, venture capitalists, human capital, technological capital, and social capital. These factors are related to the capacity to adapt to technological, economic, and social changes in markets. Therefore, STPs have emerged based on new institutional

arrangements that facilitate interactive relations between universities, researchers, industries and government.

This paper attempts to investigate the knowledge and technology development from a SCM perspective, with a practical and commercialization approach to industries. It tries to identify the role of the STPs as an important interface in knowledge and technology transfer from universities as well as research & innovation centers to industry and society as the customers, according to their needs and problems. The main objective of this model processes is to empower the STPs, to play a significant leadership role, which has been confirmed before, in other cases as a managerial interface in varied fields of industry.

2. Conceptual issues in knowledge and technology transfer from universities and research centers

Recent work in both macroeconomic theory and technology policy has focused renewed attention on the role of spillovers in general and on university research & innovation in particular, in driving economic growth. University and research centers can be beneficial to industrial firms by providing them with a number of relationship alternatives that facilitate the advancement of knowledge and new technologies.

Collaboration between industry and universities faces significant challenges including the fact that these organizations are driven by different incentive systems. Universities are primarily driven to create new knowledge and to educate, whereas private firms are focused on capturing valuable knowledge that can be leveraged for competitive advantage. In addition, universities are becoming increasingly proactive managers of their collaborations with industry, seeking to create valuable Intellectual Property (IP) for themselves. Although both these aspects have been acknowledged in the literature on university-industry linkages, relatively few studies have investigated the nature of the barriers and the factors that might mitigate them ^[1].

Universities play a crucial role in society as producers and transmitters of knowledge. In recent years the discussion about whether universities can encompass a third mission of economic development, in addition to research and teaching, has received greater attention ^{[2],[3]}.

Many scholars have argued that within the remit of the third mission university-industry research collaborations are extremely important mechanisms for generating technological spillovers. Such collaborations contribute positively to address innovation market failures and help realize the full social returns of R&D investments, there is a burgeoning empirical literature showing an increasing level of academic commercial activities, such as patenting and licensing, and generation of spin-out companies ^{[4],[5]}. This has been accompanied by an increase in research joint ventures and joint scientific publications. At the same time, many governments have introduced an increasing range of policies encouraging the involvement of universities in technology transfer ^[6].

Despite this growing interest among academics and policy makers, there are a number of gaps in the understanding of university-industry linkages. The first is related to the variety of channels through which knowledge transfer occurs. The second neglected issue in the literature is related to the factors underlying the interactions of academic researchers with industry. Existing research shows that the distribution of science technology interactions among academic researchers is highly skewed, with a few researchers engaged in a large number of interactions ^[7].

[1]. Hall B.H., Link A.N., Scott J.T., 2001, 'Barriers Inhibiting Industry from Partnering with Universities: Evidence from the Advanced Technology Program', *Journal of Technology Transfer*, 26, 87-98.

[2]. Etzkowitz H., Leydesdorff L., 2000, 'The dynamics of innovation: from National Systems and "Mode 2" to a triple helix of university-industry-government relation', *Research Policy*, 29,109-123.

[3]. Leydesdorff L., Meyer M., 2003, 'The triple helix of university industry- government relations', *Scientometrics*, 58 (2),191-203.

[4]. Shane S., 2004, 'Academic Entrepreneurship', *University Spinoffs and Wealth Creation*, Edward Elgar, Cheltenham, UK.

[5].Friedman J., Silberman J., 2003, 'University technology transfer: do incentives, management, and location matter?', *Journal of Technology Transfer*, 28, 17-30.

[6]. Calvert J., Patel P., 2003, 'University-industry research collaborations in the UK: bibliometric trends', *Science and Public Policy*, 30, 85-96.

[7]. D'Este P., Patel P., 2007, 'University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry?', *Research Policy*, No.36, 1295-1313.

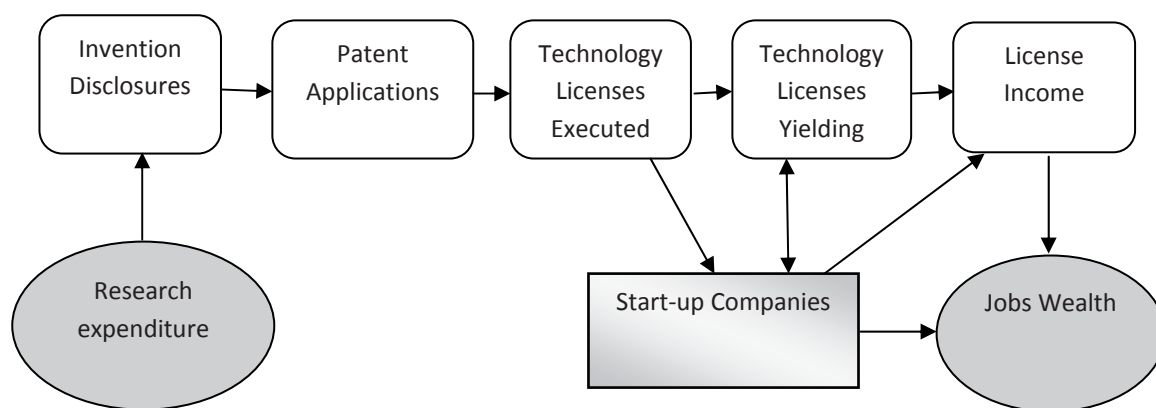


Figure 1. The process of a university technology transfer

The term “technology transfer”, as used for academic research, refers to the process whereby invention or intellectual property from academic research is licensed or conveyed through use rights for profit entity and eventually commercialized (figure 1) [8]. This is a process that takes several steps [9].

In traditional technology transfer processes, which have been common, university’s faculty members, students or staff members who recognize or discover a new technology or invention that has commercialization potential, try to disclose the invention to their institution’s Technology Transfer Office (TTO). Almost all research universities should have such offices, although the exact name of the office varies among universities. After an invention is conveyed to the TTO, it is responsible for patenting it. Once a new technology is patented, the university owns the intellectual property rights and may be able to license the patented technology to another entity. University technologies are also licensed without a patent.

The next step occurs when an individual or a commercial company, secures a license for the patented technology from the university. After this licensing agreement is executed, and if there are commercial uses of the license, the institution may begin to earn license income from the transferred technology. Some universities now take equity positions rather than license income from an executed license agreement. Typically, several years pass from patenting a technology and the realization of royalties’ income [10].

According to TTO records in EU and some US universities, it found that the role of patents and the role of the university technology transfer office, varies significantly from case to case. In some cases, it is unlikely that technology transfer would have occurred absent intellectual property rights. In others, intellectual property rights did facilitate universities earning royalty income, but the technology would have been used in industry even absent patenting and licensing by the university. Similarly, in several of the cases, the university technology transfer offices did assist in bridging the divide between the lab and marketplace, but in others the divide was not that big with [11].

[8]. Thursby J., Jensen R., Thursby M, 2001, 'Objectives, Characteristics and Outcomes of University Licensing: A Survey of Major U.S. Universities', *Journal of Technology Transfer*, 26 (1, 2), 59-72.

[9]. Parker D., Zilberman D., Castillo F., 1998, *Offices of Technology Transfer, Choices*, 13 (1), 19-25.

[10]. Friedman J., Silberman J., "University Technology Transfer: Do Incentives, Management, and Location Matter?", *Journal of Technology Transfer*, 2003, No.28, 17-30.

[11]. Colyvas J, et al., 2002, 'How Do University Inventions Get Into Practice?'. Special Issue on University Entrepreneurship and Technology Transfer, *Management Science*, Vol. 48, No. 1, pp. 61-72.

Table 1. Key stakeholders in the transfer of technology from universities to the private sectors

	Action	Primary motive(s)	Secondary motive(s)	Perspective
1- University scientist	discover of new knowledge	recognition within the scientific community- publications, grants	Financial gain and a desire to secure additional research funding (mainly for graduate students and lab equipment)	scientific
2- Technology transfer office	works with faculty members and firms/ Entrepreneurs to structure deals	Protect and market the university`s intellectual property	Facilitate technological and secure additional research funding	bureaucratic
3- Firm/ entrepreneur	commercializes new technology	Financial gain	Maintain control of proprietary technologies	Organic/ entrepreneurial

The key stakeholders in common knowledge and technology transfer from universities to private sectors with consideration of the actions, motives, and perspectives are mentioned in table 1. Differences in the actions, motives, and perspectives of the three key players in this process underscore the potential importance of organizational factors in effective university management of intellectual property. One key goal of the researches was to explore these differences so that they could identify a set of organizational and managerial policies and practices to overcome critical barriers to effective technology transfer. In addition, Bayh-Dole and much of the existing literature stresses commercialization of university-based technologies as the predominant outcome. (e.g, licensing and start-up formation) ^[12].

Firms can acquire knowledge and technology from many external sources. These sources include competing firms and their R&D, research centers, laboratories, and universities. Universities and research centers related to them are unique in terms of their potential. Not only can a firm obtain knowledge and technology, but it can also recruit graduates and faculty to serve as employees and consultants. While much of the interorganizational literature focuses on the collaboration between two or more industrial firms, we concentrate extensively through them, from universities and research centers and labs to industrial firms and R&D units collaboration.

Although the literature on university-industry links has begun to uncover the reasons for types of collaboration between universities and businesses, it offers little explanation of ways to reduce the barriers in these collaborations. This paper seeks to propose a model from supply chain management for an effective knowledge and technology transfer with an interconnected network aspect.

3. Supply chain parts and SCM model

In definitions, supply chain is the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services delivered to the ultimate consumer ^[13].

In other words, a supply chain consists of multiple firms, both upstream (i.e., supply) and downstream (i.e., distribution), and the ultimate consumer. This chain from beginning to end, and from supplier to service or product delivery should be seen as an interconnected network with its associated elements and processes from the Supply Chain Management viewpoint. SCM generally has

[12]. Bercovitz J., Feldman M., Feller I., Burton R., 2001, 'Organizational structure as a determinant of academic patenting and licensing behavior: an exploratory study of Duke', Johns Hopkins, and Pennsylvania State Universities. *Journal of Technology Transfer*, 26, pp. 21-135.

[13]. Christopher, Martin L., 1992, *Logistics and Supply Chain Management*, London: Pitman Publishing.

been defined as coordinating and managing all various tasks and parts, so that the customers can receive high quality, rapid and assured services at the minimum time. Successful coordination, in turn provides competitive advantages for the company and its suppliers and customers [14],[15].

Below in figure 2, a simple model of supply chain is shown. The main three parts are suppliers, enterprise and the customers. On the arrows we have the flow of materials and products or services from upstream to downstream, and in return on Dotted arrows, we have the flow of information which may include the demand and money flow.

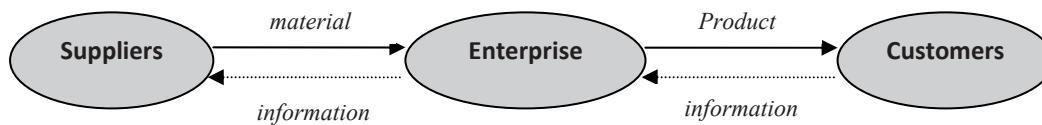


Figure 2. A simple model of supply chain

In the manner of SCM strategies, all the parts and processes have interact to each other integrated and Continuously in order to attain the define goals of the chain.

In this paper according to different elements and factors of the supply chain, three parts are playing the main role from beginning to end of this chain in knowledge and technology transfer processes. These three parts are as below:

- 1- Research & innovation centers
- 2- Science and Technology parks
- 3- Industries

In our research we are looking to these parts as a whole system, so that regarding to to supply SCM processes and its Integrated approach, we are seeking to have the better efficiency from this system refer to its objects which are defined for.

As briefly mentioned before, supply chain management has main three sections, which each of them has members and processes refer to their recognized functions.

1- Upstream chain: Includes suppliers, and their Partners. The main part of the upstream supply chain, includes sources and suppliers. Therefore, in this part supplier relationship and its process management (SRM) is considered with the other parts of the chain. The systematic attitude towards the supply chain, which streams from top to down shows the effective role of the upstream part of the supply chain.

2- Internal chain: Includes all processes used by an organization that transform all input in the form of materials and data provided from suppliers into desired output. Most of the processes of the SCM system and its strategies have been determined here. This part plays the most significant role in SCM processes, which is known as internal supply chain management (ISCM).

3-Downstream chain: Includes all processes related to distribution and delivery of products and services to the final customers. In this part, customer relationship management (CRM) is considered.

[14]. R.Lummus Rhonda., J.Vourka Robert., L.Alber Karen, 1998, 'Strategic supply chain planning', Production and Inventory Management Journal, Third Quarter, 94-95

[15]. Lapid L., 'What about Measuring Supply Chain Performance?', 2000, <http://lapide.ASCET.com>

It could be highly affected on the Ongoing relation between the providers and Recipients of the services or products and their Satisfaction. The other parts of the supply chain should have special attention for estimating the demands in this section.

All three sections of supply chain management and macro processes are shown in figure 3.

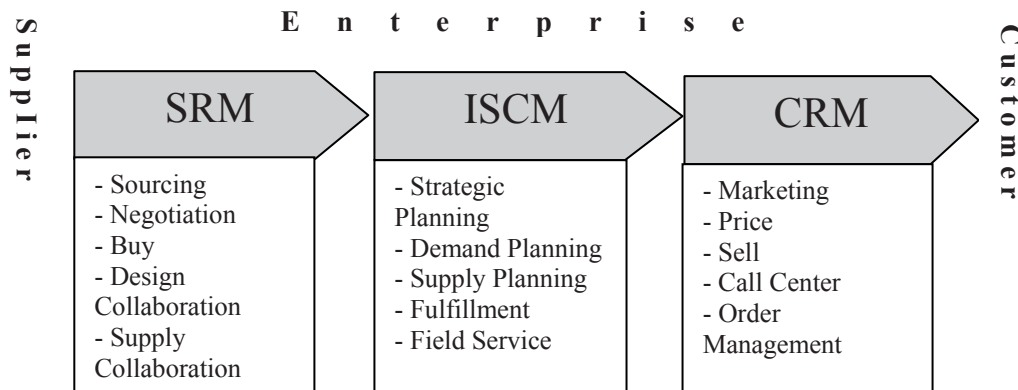


Figure 3. SCM and its macro processes

It can be observed that all three macro processes are aimed at serving the same customer. For a supply chain to be successful, it is crucial that the three macro processes are well integrated. The organizational structure of the enterprise or firm has a strong influence on the success or failure of the integration effort.

In many firms, marketing is in charge of the CRM macro process, manufacturing handles the ISCM macro process, and purchasing and supplying oversees the SRM macro process with very little communication among them^[16].

The provided SCM model and strategies in this paper for technology transfer, enhances described issues with increasing leadership role of STPs in commercialization technologies and products. In the follow, the contribution of this paper is going to be described.

4. Adjusting the SCM model for knowledge and technology transfer

Considering to three main sections of the supply chain, we are going to adjusting these sections via this paper model with the aim of transferring knowledge and technology between the mentioned parts.

I- Research & innovation centers: Here includes Public and private research and innovation centers, universities and their laboratories. In this part, we have researchers, university students and professors.

One of the important members of this part, which can be brought here are the knowledge or technology-based companies. They are placed in the Science and Technology parks as tenant companies. These tenants could be individual firms which have an innovation or patent in their products and services, or could be spin-offs which derived from the bigger companies to carry out their missions as a research & development unit (R&D).

In our model for SCM, this part is placed in the upstream chain as a supplier, which is responsible for the provision of knowledge and technology in order to apply in the other sections of the supply chain towards the downstream chain.

[16]. Chopra S., Meindl P., 2007, 'Supply Chain Management: Strategy, Planning, and Operation', Pearson Education, Inc., 3rd edition.

II- Science and Technology parks (STPs): This part is include the Science and Technology parks and their incubator, which have the role for managing the knowledge and technology transfer from upstream chain to downstream chain under consideration of the supply chain management (SCM) strategies and its integration viewpoint in this network. Here STPs are considered as the internal chain, and as a sustainable interface playing the main role for managing the all processes that is required for the determined supply chain in this research.

III- Industries: This part includes all companies and users, which are working in various industries or cooperate with large companies. They do their business using the commercialized technology, which have been transferred from upstream chain. Also the applied technology maybe used directly with the end customer in this part. We should be aware of the desires from this section of supply chain. Customer demands and the sales happen in this part, In other words it could be said that the starting point of commercial transaction along the supply chain is stationed here, downstream chain.

According to the above description, the three parts of the knowledge and technology transfer in this paper, from its production agent to its market, playing the main roles in three section of the supply chain. Research & innovation centers are the main parts of the upstream chain, Science and Technology parks in internal chain and Industries in downstream chain are defined in the same way.

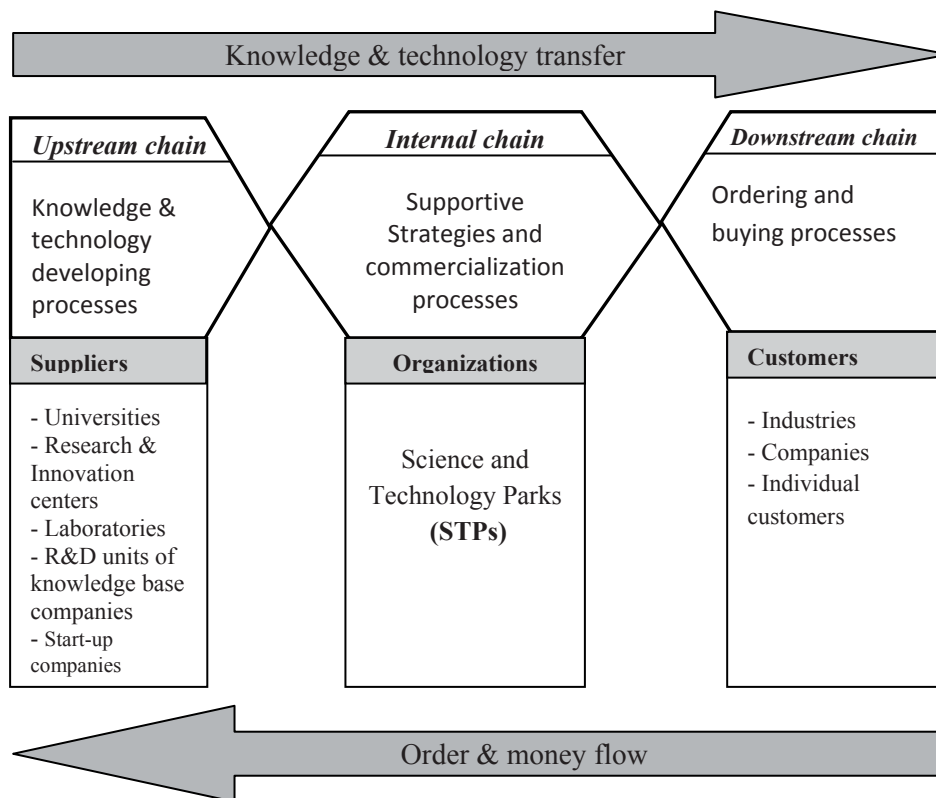


Figure 4. Customized model for SCM in knowledge and technology transfer

As it was explained before, it could be seen in the figure 3, the SCM model is adjusted to the parts that are playing roles in transferring knowledge an technology. In comparison to SCM general model in figure 2, the modified model in figure 4 has decreased the processes from upstream and

downstream chain, and according to the priority of technology commercialization processes, they has shifted to internal supply chain with a required customization.

The strategy of this model is that the upstream and downstream chain, focus on doing their own responsibilities and tasks without concerning to other border activities, which have non-priority refer to their mission. Instead of them, STPs as the governmental organizations do the processes related to the supporting and leading the parts of the supply chain for the aim of effective collaboration and commercialization in technology transfer.

5. The leadership role of STPs in defined SCM

As it discussed before, science and technology parks are placed in internal supply chain. These types of organizations act as an interface within the recognized supply chain in this paper to manage the processes of transferring knowledge and technology created from upstream chain to the related customer in downstream chain.

Science and technology parks due to their facilitating function have an effective role in promoting applied research at universities and technology commercialization at research centers. In the internal supply chain the main processes of SCM is located.

The communication and coordination between the parts of supply chain is managed in this section. Transforming and transferring the inputs from the upstream chain should be happen in the appropriate conditions to downstream chain in order to have the desired added value. STPs should do these and play they leadership role among the supply chain parts. They received the new technology from the members of the upstream chain, which named before. The required technology is developed for the determined customer in the market, or it is ordered from the members and industries in downstream chain.

All these activities are in line that the supplied technology, could be presented in the market and purchased by the industries as customers. In essence, the commercialization happens here, which is one of the major missions for STPs.

To know how the leadership role of STPs is applied here, we are going to explain it via the recognized strategies in SCM with some modifications aligning to this paper contribution.

6. Modifying push and pull strategies in SCM for enhancing STPs role in commercialization process

A supply chain is a sequence of processes and flows that take place between different parts and combine to fill a customer need for a product. The processes in a supply chain are divided into two categories depending on the strategies whether they are executed in response to a customer order or in anticipation of customer orders. *Pull* strategy has processes which are initiated by a customer order, whereas *push* strategy has processes that are initiated and performed in anticipation of customer orders.

The business terms *push* and *pull* originated from SCM, but are also widely used in marketing^{[17],[18]}. Wal-Mart is a suitable example of a company that uses the push strategy versus Dell Company, which mostly uses the pull strategy. A push-pull system in business describes the movement of a product or information between two subjects. On markets, the consumers usually *pull* the goods or information they demand for their needs, while the officers or suppliers *push* them toward the consumers.

Customer or demand push is usually defined as a business response in anticipation of customer demand (based on forecast demand), and customer or demand-pull as a response resulting from customer demand (based on actual or consumed demand).

In supply chains, the stages are operating normally both in push- and pull-manner. The interface between these stages is called the push-pull boundary or decoupling Point ^[19].

[17]. J.Paul Peter., H.Donnely James., 2002, 'A Preface to Marketing Management'. McGraw-Hill Professional, p. 132.

[18]. Dowling, Grahame Robert, 2004, 'The Art and Science of Marketing', Oxford University Press, p. 266.

[19]. P.Harrison Terry., L.Lee Hau., J.Neale John., 2003, The Practice of Supply Chain Management, Springer.

In the modified model for this paper, the product of our supply chain is knowledge and technology, which is created in upstream chain. This production could be classified related to the push or pull strategy.

In our upstream chain one of the members of this part are the students of universities, which their instructors assign some projects in their courses. Also for the scholars in the Postgraduate and Ph.D, a subject is proposed for their thesis to study and survey on a special issue. Now if their work goes well, we can expect that some applied knowledge is emerged from that research. With some try and examination, if the research has a significant innovation, it could be patented as a new technology or invention. So after these stages and on the purpose of commercialization the innovative products, they should be presented to the industries or potential customers, which are estimated to buy it. This procedure is fit to the push model for our supply chain. Also if the laboratories and some research centers act like this, they could be categorized in the push strategy. As it can be seen in this function, the upstream chain does its activities through their interest or forecasting of some issues, which they may have observed in the industry or society for solving. If they have Commercial outlook for their achievements, it must be presented for the potential customers and have marketing in its specific market.

On the other side, we have the pull strategy for our supply chain. Here the demand-pull arises from downstream chain from the specific customer or industry. The part of downstream chain should find the suitable centers or researchers in universities or laboratories in its specialized field to solve or innovate, some product or technology, which have been solving its problem. After offering the specific order from downstream chain as a customer to upstream chain as a supplier, research centers or universities researchers know to work on an identified problem or developing a new product. Here the industry or services client is specified and there is no need for marketing in primary sales.

In figure 5 the strategy model of push and pull system in SCM have been compared, which related to the function of our supply chain, both can be appropriate for knowledge and technology transfer.

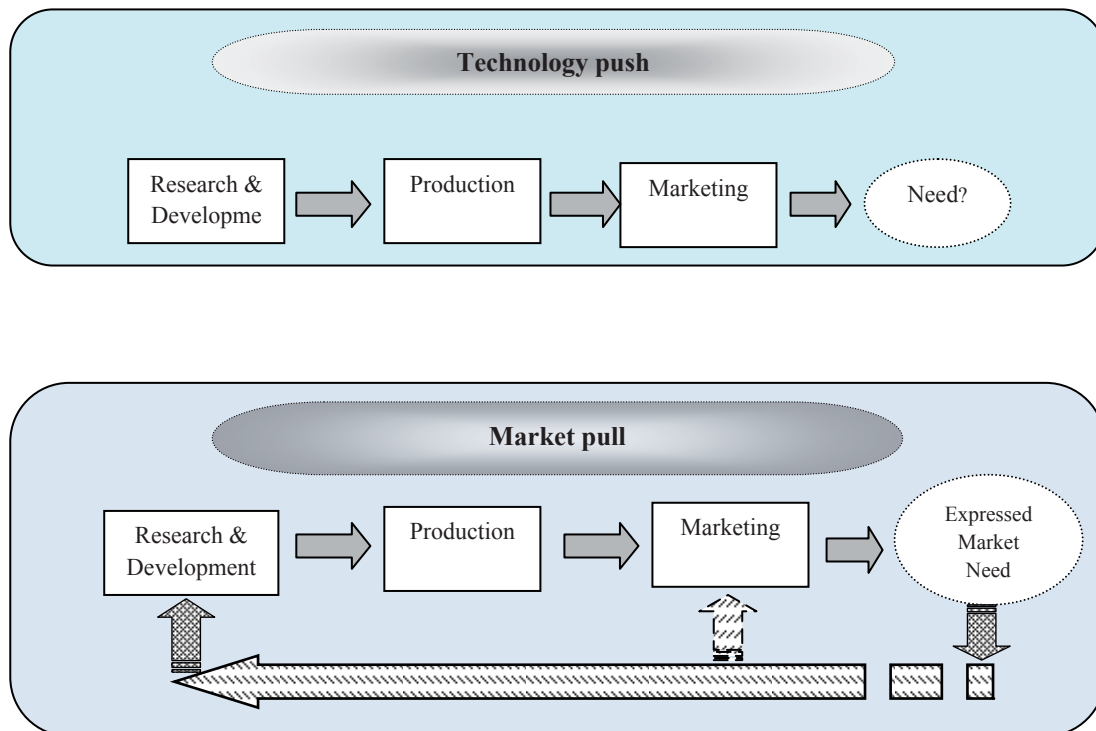


Figure 5. Technology push strategy, versus Market pull strategy in modified supply chain

Now an important question is that "How these relationship and processes should be managed?", "Which part is going to be responsible for?"

The most reasonable option, which is available in this kind of technology transfer, is the science and technology parks. STPs fit to the internal supply chain as it mentioned before. They should perform their leadership role via SCM processes.

- In the "push strategy" in SCM, the STPs should make an effective communication between the universities and research centers and make a long list of their underway researches. This list should be evaluated with the commercialization experts. Those subjects or projects that lead to a technology or innovative product, must be separated and a suitable business plan be considered for them. If the required factors in the business plan and its feasibility study acquired the proper condition for commercialization, then STPs can put them into order and plan for an appropriate marketing process. For the marketing stage, STPs should connected to the industries in various fields and negotiate with them about the new technologies or products, which has received from its upstream chain. This relationship could be established via the memorandum of understanding or agreement between STP and that industry. If the agreement came into force, the STP could provide the administrative arrangements and the legal documents as a facilitator for the upstream chain.

- In the "pull strategy", one of the STPs roles is to find the potential market for its tenants and its beneficiaries in a wide range of market. STPs can gather the problems of industries, which could determine as a project and assign them to their members in upstream chain for accomplishment. These projects could be defined from the request for proposals (RFP) or could be a technology or product, which is exclusively needed for that industry. Also in this pull strategy, the STPs are known as a hub for the new knowledge and technology, which is created by its members that we categorize them in upstream chain of the intended SCM. In this hub, STPs manage the processes linked to transferring products or services with the characteristic of being knowledge or technology base. Technology users and industries know that the STPs are the place for satisfying their demands and they may refer there individually, or according to the agreement, which has been signed before. Actual demand received from the customer or industry in downstream chain and after signing the contract and carrying out the related activities between the STP and the customer, it assign to the third party for execution. This third party is a member of upstream chain, which has a subcontract with STP for fulfillment the main contract. In pull processes the supplier and the customer are certainly exist but in the push method the customer is uncertain and estimated probably.

- *Which strategy is better?*

At the end of the above description, how to understand which strategy is better fit to our customize supply chain?

Customer or demand push is usually defined as a business response in anticipation of customer demand, and customer or demand pull as a response resulting from customer demand. In explaining the merits between two push and pull strategy, a basic tenets of the "Lean Thinking" business model in Toyota Company is noteworthy: "Only make what is pulled from the customer at the rate of their requirement". The closer a business can move to real-time customer demand fulfillment, the greater is the reduction in risk of producing or locating in the wrong place what is not wanted by the customer. In addition, a company operating in a demand-pull mode can be expected to be better positioned to innovatively respond to changes in customer tastes and expectations.

However, as explained above, not all participants can rationally or easily apply a demand pull strategy. A business operating in demand pull mode will strive to move the inventory decoupling point further upstream to its supplier.

All supply chains must be a combination of push and pull processes. Merely push or merely pull supply chains exist only in theory. Technically, every supply chain strategy is a hybrid between the two strategies. A fully-push based system still stops at the producer or upstream chain, where it has to wait for a customer to "pull" a product or service!

The usual prime determinants of whether a business operates in push or pull modes, are economies of scale and the uncertainty of demand and customer. In the high-tech and knowledge-base companies, there is more uncertainty, so that the pull strategy is more recommended, specially, at the initial stage of the commercialization. Then after that when that technology-base product or service were presented in the market and reached its growth stages, the push strategy could be planned for the market development.

According to this, the tenants in STPs, as knowledge-base companies, could have been managed with both processes in push or pull strategy, or a combination of them. It depends on their final products, technologies or services. If their product has general usage in market, push method is proposed for them, but if it is specialized product or technology which have a specific use for limited customers or industries, the pull strategy is suggested. In this way it is recommended that STPs on behalf of the tenants enter the negotiation with that industry to be informed of their actual needs. It's because of that the upstream chain, before fulfilling their business processes, perform in the way of their customers desires and achieving their satisfaction and best quality in service delivery. Also in the hybrid model, we could combine these two strategies, where both specified customer is exist and the marketing process execute for developing the market and finding more client for that product or technology.

7. Conclusion and Implication

Several parts are involved in a supply chain that each one can improve the effectiveness of the whole supply chain in various sections. SCM models in a supply chain can be applied in many different fields and positions. Refer to main subject of the paper, the role of the STPs were considered in knowledge and technology transfer, which was defined as a supply chain processes. The customized SCM model in the paper due to its administrative processes has the ability to empower the leadership role for technology transfer by STPs. In addition, for one of the main process of the STPs via the technology transfer, the suitable strategies were discussed. Prosperous commercialization is one the most important goals in transferring knowledge and technology, which it has been defined as one of the critical success factors in performance evaluation for the STPs. In the proposed strategies, the commercialization process is focused on, in order that the SCM model has been attaining the higher performance.

One of the advantages of the SCM model and its strategies is flexibility. In the supply chain of knowledge and technology transfer and its parts, we have a high variability, so that for managing such a system and its related processes, the applied model should have the enough adaptability and flexibility. In the defined supply chain in this paper, several suppliers, customers and their characteristics is taken into consideration, which refer to the SCM strategies and goals, it can be attained properly. As instance it was explained in the paper, the push and pull strategies could be modified refer to the suppliers and categorized customers with regarding to their requirements, which is significantly important for commercialization process.

The administrative role of STPs is considerable in the defined supply chain. The STPs perform as an interface with various functionalities. They can act as a powerful element in the system for engaging all the parts of the supply chain in the effective manner.

As it has been seen in literatures and articles, the both SCM and knowledge and technology transfer have several aspects, which various patterns could be considered and applied in its specified purpose. SCM could be customized in a wide range of issues for developing knowledge and innovation in society beyond the physical borders. In this way the "Open Innovation" is one of the recommended topics for the future researches. In terms of SCM perspective, its comprehensive and integrated approach will have a significant effect on targeting the innovation. Creating a network of inventors and researchers from different areas, including a supply chain with supporting organizations like STPs and incubators, could be determined for a new study.

The role of the government in providing supportive programs should be investigated via commercialization. Surely, the government policy has an important outcome in technology transfer and commercialization. Refer to that, another suggested subject could be considered via "Triple Helix". A triple helix is a network of academic-industry-government relations, which tries to set up a structure for Inter-organizational relationships, in order to developing and commercializing the innovations from universities with collaborating to industry firms. As the university crosses traditional boundaries in developing new linkages to industry, some new tools and models should be contributed for this issue. The SCM strategies and models could be a solution for it, and as well for the supportive role of the government in triple helix, the STPs could be a proper alternative as a governmental agents.