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Review of the Strategies for Technology Transfer In Manufacturing Sector

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ABSTRACT:– Over the past decades, Technology transfer was a fast-growing activity. which has received substantial attention from the industry sector. transfer of the new and superior technology as one of the Methods of maintaining a competitive advantage. Technology Transfer enables the organization to shortcut access to new technology. to reach this goal, the technology transfer strategy should completely be considered. The objective of this review article is to study how technology is transferred to the manufacturing sector. However, the article attempts to highlight the issues involved in the technology transfer in manufacturing and understand the aspects related to technology transfer. In terms of the strategy, methods, the process of transfer, and technology transfer in the context of Industry 4.0.

Keywords:- Technology transfer; Transfer strategies; Technology Transfer process**;** Technology Transfer in the Industry 4.0

I. INTRODUCTION

Technology is one of the most significant success drivers in the field of competition for organizations. Technology transfer is also an important issue which allows for access and technology acquisition to be effectively used for economic development and technological growth in least-developed countries. Migration of technology from the technology and technical information owners to other countries in different forms. [1]

The need to determine the elements that add value to an enterprise requires developing different strategies with technological developments, customer needs, differences in customer perception in many aspects, business profitability, the needs of the enterprise, the acquisition of sustainable competitive advantage, the business analysis, and the value chain. These strategies will be possible with the adaptation to the internal and external environment of the business. Technology transfer is an area where these strategies need to be developed. The existence of new technologies that have achieved success brings the efforts of enterprises to transfer them to gain a competitive advantage. However, the fact that the environment of the enterprise differs from the environment in which new technology is applied constitutes a risk factor for enterprises in developing countries. For the minimization of risk, specific strategies should be developed and the transfer process should be carried out in adaptation. [2]

Technology transfer can be divided into two main areas: 1) Trade-in goods and services: this consists of manufactured goods and services, for instance, computer software and financial services. This can be done either through direct export, export sales teams or local agents or through joint ventures; and 2) skills and knowledge exchange: direct selling of technical skills, licenses, franchising, knowledge contracts, management contracts and providing consultancy. [3]

Organizations may be able to explore their technological assets in a variety of ways in order to improve revenue and multi-dimensional total growth, but the internal use of technological assets has been significant (by understanding, preparation, design, production, manufacture and marketing/sales of goods, processes, and services). Importantly, developments in TT have increased internationally in recent years. [4]

Taking into consideration that the high production costs of new technologies and the fact that more than 50% of the new products and processes are outsourced, a wide range of disciplines, including economics and administration, have been widely studied for many years. Generally, technology transfer is all processes designed to transfer technological know-how from a donor company to a recipient. Technology transfer is a complex process requiring clear definitions from the outset in order to ensure that both the dispatcher and the receiver of technology understand the ramifications clearly and seek to optimize the advantages for both parties. Transfer of technology is a process of trade-off that allows a beneficiary business to access or mimic the donor' s maximum technical capacities. Technology transfer means moving technology from one person and organization or country to another via certain communication channels. For developing countries, which as one Group conduct little domestic R&D and therefore have little domestic sources of new technologies, transfer of knowledge and thus information becomes even more critical for productivity growth. Over time, the cycle of

technology transfer from industrially developed countries to developing countries has become increasingly important. [5]

Industries are not generally born with Industry 4.0 characteristics. The new technologies from their own offices, branches, manufacturers and/or even the models of their TT industry are being implemented through an evolutionary process. Therefore TT is required in one way or another so that an industry can be regarded as suitable for accompanying the Fourth Industrial Revolution. The production and dissemination of new technologies will meet the needs of the increasingly competitive market.[6]

Therefore, the motivation of this study is to provide a conceptual framework for technology transfer within the manufacturing sector. In addition, define approaches for how companies can move the technologies needed to make a successful transition to an advanced production environment. Through recognizing this, organizations may more effectively transfer the appropriate technology to compete at a time when the competition has intensified

II. TECHNOLOGY TRANSFER

The technology transfer involves the practical use of new technology by an academic or industrial research group and seeks to promote the use of technology in an industrial setting. New technology and leading technology must be transported in a controlled way to an industrial environment. A new technology or process can not automatically be expected to match an organization and the initial emphasis is on the analysis and evaluation of the advantages resulting from its use. [7]

TT is a mechanism by which technology transfers from one business to another. Technology transferred is a multidimensional asset that may take several forms: tangible and intangible. An effective TT will not only transfer the technical knowledge required to produce the product to its destination but also the opportunity to learn, create and manufacture the technology behind such products independently. Therefore TT has gained that popularity not only in the developed world but also in many developing economies as the strategy for rising competitiveness both at company and industry level. [8]

The product life cycle is continually shortened by the rapid advancement of technology. A business organization has to continue developing new technologies to distinguish it from rivals in order to compete against other companies in fiercely competitive international markets. Technology may refer to a complex phenomenon of know-how and techniques and be identifiable as an applied useful information system represented or expressed in human beings and physical objects and may not be possible without going into formal agreements and formal procedure from' industrialized / developing countries' to the still' developing countries'. Organizations use advanced technologies to adapt to current obstacles and new / better products, processes/activities, programs and practices to improve efficiency and performance. Inter-organizational transfer of technology (ITT) is a key component of the innovation processes of business organizations.

Technology transfer facing challenges in the global economy for societies and businesses. In reality, the mechanism is complex by means of which technology moves from external sources into the business, country and supply chain. The increasing numbers of researchers, whose findings are considered to be useful in technology decision-making, have studied the complexity of transfer process. [4]

2.1 Types of methods for technology transfer

Through technology transfer methods, the applicant can access the necessary technology via a number of pre-defined activities. The most important ways to transfer technology are:

1. Faulty technology transfer: technology is first put on the production track and then moved to research centers slowly in order to make the use of findings in the production area at some time.
2. Unfinalized or independent transfer: in this state, research center technology is progressively growing and wind up at the production level. It will take a while for this process.
3. Complete technology transfer: this approach incorporates the two previous approaches, in which technology is being used concurrently for the first time in research and production centers, as well as in research and development centers to try expanding and improving productivity with creativity.
4. Commercial technology transfer: after the degradation of manufacturing equipment, any new technology is replaced directly. Thus, research institutions will have no position. [9]

2.2 Technology Transfer process

The technical transfer process includes six general steps:

Step 1, technology selection and acquisition: technological picking process from current technologies and negotiation and contract finalization for their procurement; Step 2, the adaptation of the technology being imported: method of closely linking imported technology with scheme requirements and the country's sources and conditions; Step 3, Imported Technology Attraction: full recipient knowledge of all technology components acquired; Step 4, transferred technology application: acquired technology utilization process; Step 5, expansion

of imported technology: the phase whereby the technology acquired can extend its technology and its processes and enhanced processes by using its adaptation, appeal and application, knowledge, skills, and findings of internal research; Step 6, imported technology dissemination: the act of enhancing and expanded technical components acquired at national level. [9]

How knowledge is transmitted is seen as critical to successful transfer as to how researchers and industry work together and interact (i.e. how information is moving from researchers to practitioners). There are several articles that stress the need to have someone present for the introduction of new technology that has been created (ie, a researcher). Nevertheless, the use of insider technology as it proved to increase acceptance compared to the use of researchers or other external experts introducing a new technology. Practitioners are also often listed as a predictor for effective transitions to use new technology. Therefore, the value for software developers of workshops and meetings is underlined. The outcomes of cost-benefit or risk evaluations are also often reported. Another factor is crucial. The way the transfer is performed, which medium is also essential. Scientific publications, often seen by the industry as difficult to understand, are in particular criticized as inappropriate. [10]

In the creation of a system at which technology transfer is feasible, a range of stages can be highlighted: 1. Generate an innovative technology concept and propose it; 2. Confirmation of the main means by laboratory work to achieve the principle of technology; 3. Creation of technology; 4. Developed innovative technology for a production system; 5. Production and distribution of products made by innovative technology established. In this sense, the technology transfer can be viewed as the promotion of the goals achieved following each of the above steps. [11]

The procedures and processes of technology transfer can be outlined as follows: [12]

- Technology selection: The first and most significant part of the transference process is the collection, assessment, comparison of the technology in the country of origin to the country of destination for the configuration and adaptation of the technology to the local requirements, of the type of system used for the consumer.
- Adaptation of technology: The adaptation process to certain locations, including infrastructure, community, expertise and training level, human resources, technology of manufacturing equipment, as well as geographical and national conditions and objectives of the imported technology must be identified. The foundation for technical self-sustainability is technological adaptation.
- Absorption technology: Technology absorption means implementing transferred technology across all processes so that the user of the technology acquires all the skills necessary to maximize the use of the technology (installation, development, etc.).
- Application and execution: The use of the acquired technology in the manufacturing and distribution of goods and services after adaptation to local environmental conditions.
- Imported Technology Development: This is a stage involving the acquisition of experience and know-how from technology transfers, the integration of domestic knowledge and the development of new technologies for the manufacture and provision of products.

III. TRANSFER STRATEGY

The implementation of an established plan can be the key to successful technology transfer, as with any complex system. The strategy is described as a roadmap for the purposes of this article that describes the progress of the task and identifies potential barriers. The National R&D facilities have been staffed with three types of technology transfer strategies: passive, aggressive and entrepreneurial. Each strategy requires the developer and end-user to be committed to achieving the strategy.

A passive strategy for information dissemination or a response to a pull effect includes information or answers to questions. If final consumers first communicate technical specifications (and/or requests) and then attempt to access the technology, a pull technique occurs. The organization is aware of the business need, it finds and discovers a solution that meets this need (source) and passes innovation.

A push-through approach includes "pushing" innovations to the market. Beginning with one or more creativity, moving forward transmission strategies. In addition, the market/operator (destination) is made aware of the innovation, the related market need and business opportunities and innovation are transferred from source to destination (via some transfer mechanism). There may be no need for technology at this time, but the idea is to push the technology forward to change the paradigm for technology. The business strategy combines passive and active approaches and incorporates the idea of using the technology to boost an organization's economic well-being, and then to create jobs. [13]

3.1 Technology Transfer method

The transition of technology can be described as a flow from technology holders to technology users. They can be bought, leased, lent or licensed. Various organizations can consist of technology transfer. Innovation (technology creators), marketing (businesses) and central government (economic policy) are the most important. The rate of technology transfer and the innovation potential of countries are highly correlated. [14] Main types of legal agreement for technological transfer are: [15]

• License deals or partial or full IP license transfers.
• Contracts of competence. The object of the know-how contract is in some cases included in the license agreement.
• Franchise contracts are arrangements in which the franchisor gives the franchisor the right to take advantage of the franchise.
• The purpose of the selling and importation contracts for capital goods with information transfer is to sell or to buy items for use in accordance with particular know-how.
• Contracts for joint-venture. Cooperation between two or more firms, in the creation of a single, special project through creativity, creates a new company based on the same business strategy. This joint venture involves cooperation among companies.
• Turnkey projects include the execution of a project based on an order for a third party by a specialist team.
• The technological collaboration means cooperative arrangements between two or more organizations to develop new products or technologies. It involves partnership arrangements between different organizations.
• The Technical Assistance Trade Agreement covers the selling of certain goods or services requiring technical assistance.
• The manufacturing agreement means the selling of the commodity or service manufacturing right.
• Single or non-exclusive IP ownership contracts.
• Contracts for counselling.
• Agreement to Subcontract.

The legal relationship between the individual or the transmitting company and the person receiving the technology is contractual and thus the transferor of technology intends to transfer the ownership, consent or knowledge to the intellectual property in question. Such deals are licensed in many countries by the National Intellectual Property Office.

For successful technology transfer, organizational culture must be addressed. The way people behave and the manner things are done represents every organization's different culture. Organizational culture comprises the organization's ethos and core values, its dedication or its resistance to change, etc. For societies where transparency and willingness to change are possible, the introduction of new technologies will be simpler. In other societies, it may be difficult to deploy new technologies because of resistance to change in the organization. [7]

3.2 Success of Technology Transfer

The aspects of successful technology transfer could be as following:

- Communication: In terms of distance and time, the technology transfer chain is often long. Another key ingredient in the recipe for effective technology transfer is therefore effective communication. Efficient and effective bidirectional communication and business between key stakeholders will do much to eliminate obstacles.
- Certainty: the lack of certainty and the consequent high levels of risk, both real and perceived, are recognized as major obstacles to the effective establishment and continuing functional market activity. To key stakeholders such as developers, suppliers and users, removing barriers to technology transfer also translates into increased confidence and decreased risk.
- Challenges: There are many hurdles to successful transfer of technology. Throughout the transfer route, from the supply side of technology to the demand side, impediments exist at very nodes and for every connection in the technology transfer chain due to restrictions on the flow of information and materials.
- Capacity: improve technology transfer that promotes sustainable development in the sense of creating favorable technology transfer circumstances, ensuring that all stakeholders are able to fulfill their positions and fulfill their obligations in a timely manner. All key players and stakeholders need the requisite knowledge and skills to fulfill their expected roles and tasks.
- Commitment: A strong commitment to the successful transfer of technology can be accomplished to meet challenges, provide technology consumers with the right choice, increase trust, decrease risks, enhance contact between stakeholders involved in technology transfer activities and buildings and enhance the enabling climate and thus capacity to move technology. [16]

IV. TECHNOLOGY TRANSFER IN INDUSRTY 4.0

Manufacturing processes were upgraded to a smart level in Industry 4.0. Intelligent manufacturing uses advanced data and manufacturing technology to achieve flexible, intelligent and reconfigurable manufacturing processes to meet a competitive global market. [17] Industry 4.0's vision can be interpreted as a holistic digitalization and integration of production processes from the order of the consumer to downstream product services through the development of manufacturing processes. [18]

Nevertheless, with a focus on emerging countries that still have many resource constraints, dynamic mechanisms of technology acquisition and transition arise. In order to adapt to the principle of Industry 4.0, an industry must first undergo internal and external TT processes. Internal TT processes are the ones whose industry is limited to its resources such as the transfer of knowledge between experienced employees and new-employees. When a company restricts its TT to internal processes (for example, from headquarters to branch), remaining on the market may be challenging. The industry sector deals with external vendors, research institutions, the government etc. services in external processes. External technology transfer saves resources, research and development, investments and offers competitive advantages, it would be infeasible in other ways. [6]

In Germany, the project that propelled Industry 4.0 united the country's universities, industries, and government, mainly focusing on global competitiveness. In TT research, the university-industry-government relationship is much discussed, mainly in already consolidated scenarios. In face of this new industrial scenario, this relationship needs to be contextualized, due to numerous changes in the productive and organizational systems. This process of TT in Industry 4.0 will mobilize the entire country, and will demand the effective university-industry-government integration with high-technology manufacturers. [19]

V. CONSLUSION

Technology is one of the most important factors that will be present in the field of global competition in the performance of organizations. Technology transfer is also an important issue which offers the possibility of accessing and acquiring technology to use it effectively in terms of technology for the economic development and growth of less developed countries.

To ensure efficient and high-quality manufacturing processes, appropriate technology transfer is important in industry. The transition of technology does not mean the transfer party's one-time behavior towards the transferred party, but rather constant exchange of information between both parties in order to retain the upgraded technology. The choice of a method of technology transfer should be focused on the study of technology, long term strategy of collaboration with the manufacturer of a product, investment capital, and the company's technical capacity to incorporate the technology.

The more complicated the system is, the relations between the customer and the manufacturer should be closer when selecting a transfer process. As noted earlier, the transition of technology does not stop with delivery of equipment. Equipment does not generate new abilities in itself. A transfer of expertise, skills, and intellectual property rights will make real changes in the work of the business.

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