

MODEL FOR STRATEGIC MANAGEMENT OF TECHNOLOGICAL INNOVATION IN MANUFACTURING COMPANIES: A PROPOSAL

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Abstract

Small and medium manufacturing companies have continued with the basic use of administrative management technologies in its core business processes. Recent studies on adoption of processes for the integration of information and communication technologies, have shown that these companies have problems with the innovation, production, and the generation of knowledge. It also had problems with its practical application in products, processes, and services. The aim of this study is to develop a model for strategic management of technological innovation as the basis for the development of a computational tool that integrates the different phases of the model. However, it can be applied to manufacturing companies, which will help to increase the competitiveness, productivity, and innovation of these companies. In addition, a proposal for the model was developed and the analysis of the software for managing the model was conducted.

Keywords: Innovation, SME's, Technological Model, Management, Knowledge

Introduction

Innovation, technological improvement, and the transfer of technology which is applied to productive activities, are the major drivers of economic growth of the companies for the globalization of markets (Goycochea, 2012).

Therefore, it is necessary to create a strategic solution to improve the capabilities of these companies and respond quickly to the challenges, either business related or technological, which is today's markets demand (López-Acevedo & Tan, 2010).

Porter defines innovation as the creation of new products, processes, knowledge or services using existing or new scientific or technical knowledge. Porter also mentions that firms are evolving into value chains that is based on intangible assets such as knowledge, technology, intellectual property, and others (Porter, 1991).

Afua also defines “innovation as the use of new technological knowledge, market knowledge, and business models that can deliver a new product or service, or product/service combinations, to customers who will purchase at prices that will provide profits” (Afua, 2003).

Consequently, the "Innovation Economy" is the production and generation of knowledge and its application in products, processes, and services. Thus, it has become the main asset of developing dynamic competitive advantages (Porter, 2008).

Innovation is very important for companies to grow successfully. Therefore, some factors are changing the environment where the companies are competing. Among these include (Warren & Susman, 2013):

- Access to knowledge: Permit to companies provides them access to the best ideas, technologies, research resources, and experts at low cost.
- Trade Barriers: Are rapidly being dismantled; hence, all markets are been opened up to global suppliers.
- Access to Capital: The funds may now seek opportunities on a global basis, and companies must compete internationally for capital.
- Technological Obsolescence: Market life cycles are now less than product development cycles. Thus, companies are developing new methods to reduce their product development times.

Therefore, we are migrating into an innovation era, where wealth firm will be created through innovation.

A study by the Centro de Tecnología Avanzada A.C. (CIATEQ) developed in 2008, found an insufficient capacity of Small and Medium Enterprises (SME's) for the production of knowledge and technology. As a result, little demand is on them and there is a disconnection between demand and the possible public offering (Lizardi, Baquero, & Hernández, 2008).

Furthermore, it also reflects that SME's had greater difficulties during the process of integrating it into the productive chains. This integration is done along with a lack of coordination between the system of technological innovation and the technological demand from firms.

Elizondo and Heredia argue that a combination of factors explains the lack of entrepreneurship in the technology of Mexico (Elizondo & Heredia, 2000). These factors include:

- The development model implemented by the Mexican Revolution that did not encourage private investment in Research, Development, and Innovation.

- The weakness of institutions to defend the rights of intellectual property.
- Developing countries are struggling to compete with industrialized countries.
- The Mexican businessmen have preferred to seek state protection against imports, rather than seeking to compete in the technological field.
- The educational tradition does not encourage criticism or research.

Other researchers have mentioned that innovation management involves elements such as: the process of innovation, strategy, technology management, knowledge management, information sharing among staff, measurement and monitoring, learning, customer orientation, environment monitoring, and partnerships (Velasco, 2008).

An important element for innovation is the alignment of technology management with strategic planning (Noisi, 2008).

However, an understanding of the dynamics of the generation and dissemination of knowledge in companies creates competitive advantages in an economic and a dynamic environment. In this environment, markets are subject to technological impacts arising from the supply side (technology push) and presses on the demand side (pull technology). Here, technology leadership is defined by those who show a greater capacity to create knowledge i.e. original and applied (Boutellier, Gassmen, & Zedtwitz, 2008).

Most SME's do not have a system of innovation management. However, they have a little knowledge of government financing, and do not invest in research and development, since they depend on customer's demands (CONACYT, 2009). This is in addition to the lack of infrastructure, qualified personnel, and a culture that supports innovation (Khalil, 2000).

Furthermore, the SME's should have a technological management model to receive government financial support.

Among the battery of recommended measures include those aimed at leverage private investment in research, development, and innovation; reduced fragmentation of public research system; as well as actions to promote collaboration and technology transfer. Other measures include human resources with highly qualified public R & D to business and productive sectors. Hence, this fosters the partnership of public - private medium to long term priority sectors. The study also considers it important to promote the creation of new business R & D, preferably domestic or foreign which is linked to the public research system. In addition, it promotes the demand of technological developments and innovation through public procurement in key sectors for the quality of life and development.

I.

Some management of technology (MOT) models has been proposed. Among these include a six sequential stages model that has been created. Thus, these stages are (Khalil, 2000):

- Technological environment.
- Technology categorization.
- Market and competition.
- Innovation process.
- Value added.
- Acquisition and export of technologies.

The process of technological innovation is a set of activities that transform ideas and scientific knowledge into physical realities and real-world applications.

Goycochea and Rivera, have proposed a MOT model with the components below (Goycochea, 2012):

- Planning: Strategic, technological, and business.
- Technology Surveillance: Patent centers and environment assessment.
- Financing: Programs and strategies for government financing.
- Research and development.
- Project management.
- Marketing: customer and market strategies.

Therefore, all these set of components of SME's aims to develop a model of strategic technology.

Darbanhosseiniamirkhiz and Khairuzzaman recommend Advanced Manufacturing Technologies (AMT) for improving manufacturing productivity. Therefore, AMT refers to technologies related to the manufacturing process (Darbanhosseiniamirkhiz & Khairuzzaman, 2012). Thus, they have proposed an integrative framework for AMT.

The proposed framework has three contexts:

- Environmental context
 - External pressures, supplier support, and financial resources.
- Organizational context.
 - Organizational structure, organizational culture, manufacturing strategy, human resources practices, and top management.
- Technological context.
 - Perceived benefits and technology in use.

In the environmental context, the external conditions have an important role in SME's inclination to adopt advanced technologies.

However, some researches contend that the main external pressure source is the market (Spanos & Voudouris, 2009).

The benefits of AMT adoption in manufacturing companies can be achieved only in cases of the compatibility of the organizational design. In addition, the structure of the company plays a crucial role in the implementation process, and the traditional hierarchical structure would create impediments for AMT adoption.

Also, there is an analyses of how organizational culture, manufacturing strategies, human resources practices, and top management, would be shifted or updated for alignment with the AMT adoption.

In the technological context, the recognizing of the practices is a powerful predictor of the AMT adoption success.

After the analysis of some MOT, the study of the proposal is shown in Fig. 1.

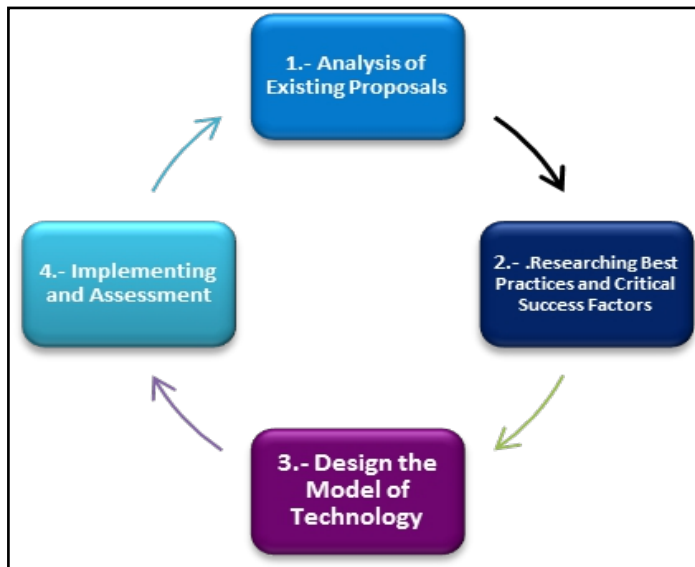


Figure 1. The methodology for the proposal

Beginning with the analysis of existing models of technology across the world, it continues with the research of best practices and critical success factors. Therefore, with these elements, the proposal for a model of technology, and another stage of the assessment of the implementation in SME’s manufacturing companies will be designed.

Best Practices

The firms that are highly profitable through innovative practices are classified into three categories:

- **Internal:** Intellectual property management, knowledge management, information technology applications, maturity, governance, culture, and human resources practices.
- **External:** Closeness to customers, supply chain and competitor knowledge, and proactive engagement with the environment for acquisition of technology.
- **Bridging:** Creative business model, partnership, integration across the stages of the product development cycle, and balance between external and internal factors.

However, these identified practices are similar to the characteristics of success models analyzed above.

The SWOT matrix shown in Fig. 2 for the manufacturing companies, give some insights about the state of this industry and how the model can be emphasized in terms of its weakness and threats (Valdez & Cortes, 2014).



Figure 2: SWOT Matrix

The threats identified are: High competency, high government, taxes, row material expensive, and others.

Consquently, these elements have been considered by the MOT proposal. With this information, the design of the model is displayed in Fig. 3 below.

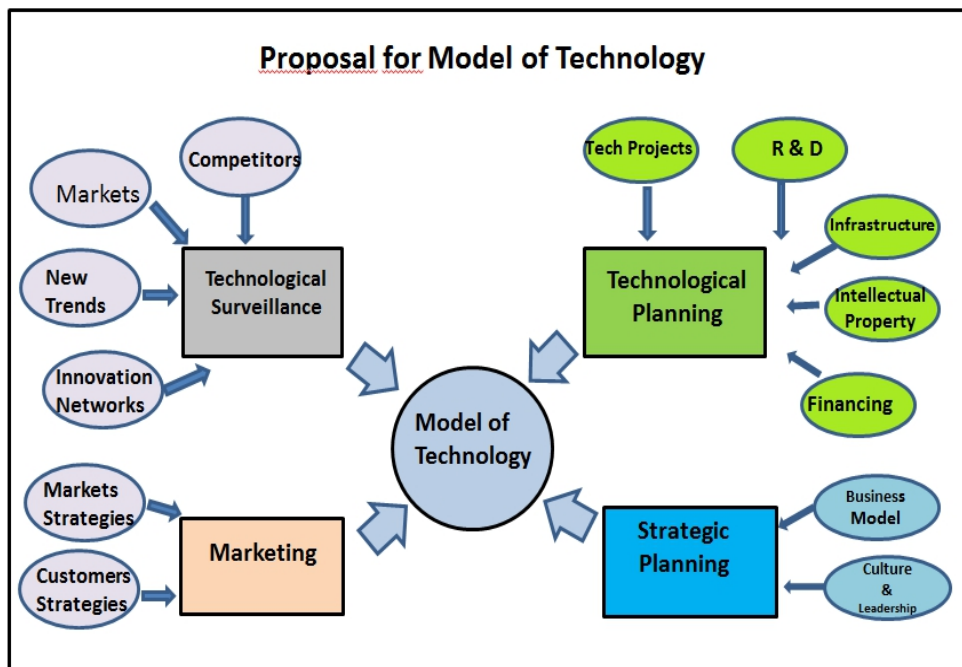


Figure 3. Proposal for MOT

The four main components of the model are:

- **Technological Surveillance:** Competitors, markets, new trends and innovation networks, focuses on the external environment for new trends and emergent technologies.
- **Technological Planning:** Management of tech projects, research and development, infrastructure required by projects, protection of intellectual property, and financing for tech projects. Also, it includes the alignment between technological planning and strategic planning.
- **Strategic Planning:** This involves a business model with a mission, vision, goals, strategic objectives, clients, market, competitive advantage, geography, organizational structure, organizational culture, leadership, human resources practices, motivation for innovation, and others.
- **Marketing:** Incorporation of new products into the market, strategies for customers, and strategies for markets.

All these components are the model of technology proposed for manufacturing firms.

Computational Tools for Scientific and Technological Surveillance (STS)

One of the main activities of the model is that the scientific and technological surveillance, are important services due to the increasing availability of data. Hence, this requires software tools to quantitatively analyze the information recorded on various sources of information.

The success of the process of scientific and technological surveillance depends on the way it is carried out, which includes both the organization and the software system used.

The metrics (bibliometrics, informetrics, scientometrics, cybermetrics, biometrics, and others) are those instrumental disciplines involved in analyzing quantitatively recorded information on various sources of information. For coverage of application trend studies, research lines innovation, market leaders, knowledge flows, user studies including others, have been introduced in some cases and for specific purposes. Thus, this entails the functional design of different tools used in the process (Macias, Guzman, & Martinez, 2009).

Furthermoe, the technical aspects is considered as:

- The equipment, hardware, or physical technology platforms used.
- The networks or communication platform used.
- The software platform used.

Software for STS:

- ThemeView.
- VxInsigth.
- Omniviz.
- Tetralogie.
- VantagePoint.
- Neurodoc.

Conclusion

In conclusion, this research project is at the beginning phase. Thus, there is little information about software that can manage the STS.

The application of the model will be in sequent phases for future works for the authors. Also, the proposal is in the trend of design and it has computational tools that fit with SME's.

Therefore, the review of the literature has shown the need for innovation in the manufacturing companies.

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