

MANAGEMENT FOR SPACE TECHNOLOGICAL DEVELOPMENT

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ABSTRACT

Technological Management for space technological development is defined as: the decisions adopted by a country on policies, plans, programs, etc. in terms of creation, dissemination, use and transfer of satellite technology to achieve technological development.

Developing countries with their educational institutions and research centers have made efforts, founding organizations, programs, and projects, to promote space technological development, these instances arise and disappear without achieving the objective for which they were founded.

The fundamental purpose of technology management is technological development; To achieve this, integration is necessary: government academia- industry. Technological development makes it possible to reduce political, economic, and social conflicts in poor countries.

For this reason, a systemic model of spatial technological development is proposed, which allows the integration of scientific research in companies based on the goals, objectives, and market strategies of these companies, to achieve technological development.

The proposed systemic model has three stages: entry E, consists of the analysis of the satellite system in the international and national context; box C, made up of: diagnosis, proposal, planning to carry out the proposal, and output S, in this case it is the technological development of the space. $S=EC$, that is, E and C can be adjusted to achieve S.

Holding E and S fixed, C will have an infinite number of solutions, which can be adjusted by those implementing the program. Therefore, the performance of a model can be validated, especially by its results.

The foundation of the Latin American and Caribbean Space Agency for this year is proof of the need for countries to transmit and receive information for the benefit of their peoples.

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INTRODUCTION

Technological management for the satellite system requires investigating international and national regulations, as well as the steps that must be followed to request an orbital position, which is mentioned in the corresponding summary in order to have satellite technological development. This research was carried out virtually and in person with the human resources, students and teachers participating throughout the process of the research project. The Mexican Satellite System was taken as a case study in order to carry out the corresponding technological management for the Mexican satellite technological development.

Satellites are essential for remote communications since there are no obstacles to the transmission of information they send and receive; the satellite system is useful both in urban areas and in regions where there is no land coverage because the investment is not attractive for telecommunications companies due to the difficult access and low population of the most remote locations. For a user to place a satellite, it is required to be assigned an orbit through the International Telecommunications Union (ITU), which is a very scarce resource. This situation generates a worldwide search for orbital positions that operate more efficiently for the technological development of the satellite industry. Therefore, international, regional and national regulations are required to be constantly reviewed in order to address the corresponding problems at the ITU World Conference, which will take place in 2023. In Mexico, regulatory problems need to be detected in order to present them at this Conference to optimize the technological development of the Mexican Satellite System.

The 7 Mexican commercial satellites are placed at a height of approximately 37,000 km above the geostationary orbit in the positions assigned by the ITU. These satellites are synchronized with the earth's rotation axis in such a way that they are apparently fixed, but they actually rotate. at a speed of 11070 km/h around the earth describing a circumference, the earth rotates on its own axis at 1670 km/h and around the sun the earth rotates at a speed of 1666 km/h describing an ellipse; three satellites are licensed to the French company Eutelsat in orbits 113°OA, 115° OA and 117° OB; The Quetzsat company has the concession for Quetzsat 1 in orbit 77°O; Mexsat is a company owned by the Mexican State and manages the other three satellites, the Bicentenario at 114.9 W, the Centenario at 113°W, and the Morelos III in orbit 113.1°W (Graham, 2015).

Emerging countries do not have technological development, particularly space, if they have orbits assigned by the International Telecommunications Union to place their satellites, these are designed, built and launched in industrialized nations. Due to the high costs to place a satellite in orbit, our countries cannot cover these expenses, which puts the cancellation of the orbits in danger.

To achieve technological development, particularly space development, a State policy is required that integrates basic and applied scientific research in companies based on their objectives, goals and market strategies. This is what developed countries do.

With the upcoming founding of the Latin American and Caribbean Agency in September of this year, there is the opportunity for our lagging countries to generate space technological development.

METHODOLOGY

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When analyzing models of planning, Ackoff (1986), Steiner (1969), Ozbeckhan (1974) and Sainz (2012) concluded that any model of this type can be designed into five phases: I. Analysis of information; II, detection of the problem; III, Planning to solve problems and to project the organization; IV, Results; V, Evaluation. These phases can be divided into sub phases which are a function of the importance that each author gives. In the proposed model, eight sub phases are considered which are contained in the five phases shown in Table 1.

Table 1. Phases and sub phases for the satellite technology development

Phases	Sub phases
I. Analysis of information	1. Analysis International satellite system 2. Analysis of the national satellite system
Problem II. Detección	3. Diagnosis
III. Proposed solution	4. Proposed solution
IV. Planning	5. Mission, vision, values and strategic objectives of the proposal. 6. Strategies, using SWOT combinations: OD and DA 7. Action Plan.
V. Evaluation Results	8. Technological development

The following describes each of the eight sub phases:

1. Analysis of the International satellite system

The Satellite Industry Association (SIA) released its 17th report on the performance of the sector in 2013. The study conducted by Tauri Group, says that the growth of the satellite industry increased slightly both in the US and worldwide with revenues of 195,300 million in 2013.

The industry grew up by 3%, from US economic growth to 2.8% and the global average of 2.4%. The satellites provide 60% of revenue from the space industry, 320.000 billion, and 4% percent of the revenues of the telecommunications industry that was five billion dollars.

From approximately 1200 satellites currently operating today the SIA states that industry revenues have nearly tripled since 2004, with an annual growth of 11% on average. Satellite services have grown by 5%, generating 97,900 million (infoespacial, 2014).

Based on work done by Voss, (2011) Meacham, (2013) Ellis, (2010). Lucena, (2011); the success of international satellite technology development is mainly due to government intervention through space agencies such as the National and Space Administration (NASA) of the United States; the Russian Federal Space Agency (ROSCOSMOS); the China National Space Administration (CNA) and the European Space Agency (ESA).

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All emerging, developing space agencies are considered as a strategy of state policy in each country; strengthen basic and applied research generated in educational institutions and research centers, including the space, and link and integrate the industrial sector of space. The bodies of national security, defense and marine, have their own development based on basic and applied scientific research as any technological advantage is the main strategy of the armed forces. However participating and collaborating with space agencies, results in a greater impact on the DT. Space agencies in each country or European community, are closely related to each other and therefore participate in joint space projects.

2. Analysis of the national satellite system

The Mexican government regarded the Mexican satellite system (SSM) as a strategic area to provide voice, data and video services to both national public and private institutions, which amended the Constitution of the United Mexican (Constitution) in Article 28, and began to communications services since 1985, with two satellites in orbits 113.5 and 116.8 ° W. Technology management (GT) of the Mexican government was so efficient that by 1993 it had already obtained from the International Telecommunication Union (ITU), a new orbit, 109.2 ° W, with characteristics of continental coverage, where the Solidaridad was placed 1; in 1994 and Solidaridad 2 was placed in the 113.5 ° W (Tun, 2006).

In 1995 the Mexican government considered that the SSM was no longer a strategic, but priority area, so it changed again CPEUM, Article 28, which allowed the emergence in 1997 of the private company known as: Satelites Mexicanos SA de CV (Satmex), with a share for the Mexican government of 20% of the shares without voting rights (Tun, 2006).

The Satmex 5, launched in 1998 in the orbit 116.8 ° W, four years behind schedule, also presented failures in 2010 and was replaced three years later, in 2013 by the Satmex 8. The Solidaridad 1 presented failures in 2000, so he pulled out of orbit and having no substitute satellite, ITU canceled orbit 109.2 ° W. However, this body accepted the request of Mexico and Canada to exchange 109.2 ° W by the 114.9 ° W to reduce interference problems. In this situation in 2006, six years later, the Satmex 6 was launched into orbit that had the Solidaridad 2, with a slight modification instead of the 113.5 ° W was changed to 113 ° W and Solidaridad 2 occupied the new orbit 114.9 ° W (Cofetel, 2013).

The Solidaridad 2 had to be relieved in 2008, which never happened, so it was placed in orbit inclined from that date to be out of orbit in 2013 leaving communications services to the Federal government for failure to inform Mexat. In August 2013, the French company Eutelsat bought Satmex for 831 million dollars. This company is the third largest in the world, handles around 31 satellites that provide services in Europe, Africa, Asia and from this acquisition will provide services to the American Continent (Guadarrama 2013).

To avoid the possible loss of satellite orbits by the difficulty Satmex had to replace its satellites in orbits allocated by the ITU and the need for national security and services for their sectors. The Mexican government announced in 2010 the beginning the Mexsat system. Telecom Telegraph dependence Secretariat of Communications and Transportation (SCT) is the corresponding operator. In December 2012 the first of three satellites, called Bicentennial, in the same orbit as ranked Solidaridad 2, four years behind

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schedule was released. Two satellites were scheduled for Mexsat, to be launched in 2013 and 2014 to date has not been made (SCT, 2012).

On December 17, 2010, the SCT signed with Boeing Satellite Systems International, Inc, an agreement for the Mexsat system. The cost is about 16 billion pesos. For the construction 14434 million pesos, with 1358 million relating to the launch, 235.2 million for insurance and 22 ground stations (SCT, 2012).

The ITU has a program assigning satellite orbits to countries that are part of this organization. Mexico was assigned four geostationary orbits (69.2, 127, 136, 78 ° O) from 2005, which covers each of the national territory. Mexico got the ITU to assign a change from 77 ° O to 78 ° O as the first covers the region of the USA, the Caribbean, Central America and Mexico. Under these circumstances Quetzsat and US companies, SES Americom, Inc. kept the concession; satellites of the last company were placed in this orbit from 2005 until 2011, when the Quetzsat 1 satellite to be placed in that orbit was launched. The remaining three orbits are not being used (Cofetel, 2014).

Once completed, the SSM analysis concluded that:

Satellites used to cover the orbits assigned to Mexico, are designed, built and launched in other countries, implying that the cost thereof is very high, according to Kalinatic (2009), the import of technology increases up to 40% of the actual value; This situation resulted in the cancellation of 109.2°O orbit as well as endangered the 114.9 ° and 116.8 ° W. In the end the government rescued the inefficient Satmex founding Mexsat. The Mexican government in 12 years, bought 6 satellites. Satmex in 17 years bought 2. The import of satellite technology has involved the isolation of space research in our country. There are satellite orbits not being exploited, and no technological development satellite

3 Diagnosis

To perform diagnostics, apply the tool to determine the strengths, weaknesses, opportunities and threats (SWOT) for the SSM

3.1 Strengths of the Mexican Satellite System

Domestic and international services are provided.

Has a regulatory communications system and in particular a satellite system that fits the strategies and technologies of the time.

Has human and technical resources with researchers in all areas of knowledge.

Has experience in designing and building rockets and satellites.

The Mexican Space Agency is a management agency for technology and space research.

3.2 Opportunities for the Mexican Satellite System

Participate in solving the problems of the satellite system, through the ITU and international satellite context. The development sector (ITU-D) supports the development of telecommunications in the country mainly to fewer resources. Our country can apply for this support. Mexico has been allocated seven geostationary satellite orbits by the ITU and has the opportunity to conserve and manage others. Mexico can continue signing agreements with public and private institutions, as well as participating in meetings and forums.

3.3 Weaknesses of the Mexican Satellite System

Mexico has been allocated seven satellite orbits, which is only 2% compared with the US which has about 500. There are no companies in Mexico for development, consulting, management, design, construction and launch of satellites. Only with great effort can Mexico keep their geostationary satellite orbits. There must be autonomous organizations such as the Federal Telecommunications Institute (IFT), which grants permissions assigned to users in the first instance benefiting the nation, rather than the interests of factual groups.

- Professionals and researchers indirectly involved in satellite technology development human resources are generated.
- There is no systemic integration of scientific research and development satellite development companies.
- The satellites covering geostationary orbits have not been replaced in the time required.
- Brain drain due to lack of opportunities for technological development.
- Strength of economic and political groups working mainly for their own interests.
- Disregard for basic and applied research.
- Impairment of ecology and environment.

3.4 Threats to the Mexican Satellite System

Mexico could lose the orbits assigned ITU by not replacing the satellites in the required time and not using the three orbits, assigned since 2005. Satellite garbage pollutes the space and Earth principally and endanger astronauts and satellites.

4 Proposal for satellite technology development

The Mexican state as regulator of the economy and driver of national policy, correlated with international, can set the policy of integrating scientific research in business and

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promote public and private investment to establish self-financing satellite companies that generate wealth, which can be public, mixed, or private initiative, which systemically integrate basic and applied scientific research to space technology development in order to provide an efficient, fast, safe and cheap service that meets the demand for domestic users and international.

5 Mission, Vision, Values and Strategic Objectives of the proposal

5.1 Mission

Interface with the system of national and international communications to provide innovative national and international satellite services.

Foster the emergence satellite companies and integrate research, development and technology management in them, to create, transfer, disseminate and use satellite technology.

Strengthen, through SSM, national security, technological infrastructure for efficient communications coverage in all regions of the country, as well as educational, ecological, cultural and social programs.

5.2 Vision

Business. Generate profitable companies that provide individuals, professionals and researchers and graduates of educational infrastructure, from all areas of knowledge, the opportunity to participate in the technological development of SSM to reduce technological dependence and impact on the political, economic and social development of our country achieving results through rationalization of resources

5.3 Values

Integrity. Act and communicate with responsibility, honesty and transparency within and outside companies.

Aspiration. Acting with passion and sense of urgency, impose challenges and achieve goals and objectives. Make decisions wisely, without fear of error or failure.

Human Resources. The reason for the organizations must be the welfare, nourishment within the company, human resources to work efficiently and effectively, considering the contributions of each member with a systemic approach for the common goal.

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Natural Resources. No company is justified without caring and improving the ecology and environment.

5.4 Strategic Objectives

5.4.1 General Strategic Goal

Obtain technological development in the country.

5.4.2 Particular strategic objectives

Integrating research and technological development management in satellite companies.

Provide innovative, efficient, effective, quality and low-cost national and international public and private institutions as well as individual users.

Integrating people, professionals and researchers to satellite technology development.

Promote the development of ecology and environment.

Provide staff for the company, nourishment, training, welfare, cultural services and other benefits.

6 Strategies for the development of the Mexican Satellite System

To raise the strategies we use the following combinations SWOT: FO, FA, OD, DA.

6.1 Strength opportunities (FO)

The SSM will continue to provide international services. The Mexican regulatory framework related to the international, will contribute to solve global problems and international satellite technology development. Apply primarily to ITU-D, support to channel our resources to satellite technological development of our country.

The Mexican Space Agency is responsible for promoting the aerospace technological development in Mexico and represents the SCT internationally. If we have satellite technological development we will be in a position to disclose to the world our creation and use of technology.

6.2 Strength threats (FA)

Mexico actively participates in international organizations and for this reason should use ITU aid resources for satellite technology development, otherwise it has to depend on

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foreign technology and therefore is vulnerable to the risk that one or more satellite orbits will be canceled .

The development of SSM should take into account satellite ecology garbage and for that reason Mexico should make proposals to the ITU and other international bodies to assist with the concerned countries for the solution of these problems.

If human resources of the country are not channeled towards technological development of the country, they will seek opportunities in other countries and continue to have increasing problems in the political, economic and social fields.

Mexico has the resources to develop technologically, and if not, will be subject to the interests of countries and transnational corporations, in addition to technology transfer costs about 40% more than its actual cost (Kalinatic, 2009).

6.3 Weakness Opportunities (OD)

Mexico can manage ITU support primarily the development sector (ITU-D) to promote entrepreneurship satellite development. Mexico can participate in ITU forums as it is an active member of this organization. Currently many efforts the geostationary satellite orbits are preserved, due in part to the import of technology that has a high cost. With technological development in the long term costs are lowered and less expensive and heavy satellites can be developed.

6.4 Weaknesses Threats (DA)

With satellite development the country will ensure its seven satellite geostationary orbits allocated by the ITU and be in a position to obtain others, otherwise they will be in danger and the social, political and economic problems we have now increased. In Fig. 4.1 the model for diagnosis and strategies for SSM is presented, using SWOT.

7. Strategic Plan for the development of the Mexican Satellite System

7.1 International

Make international agreements with nations and various public and private institutions, primarily with space agencies to develop a system of interaction and cooperation, in order to establish mutual benefit generating scientific policies related to basic and applied research, creation, dissemination , transfer and use of technology in the area of communications, particularly in the satellite, enhancing innovation and ongoing review of the international regulatory framework that contributes to technological, political, economic, social and ecological development of our nations.

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Participate in various forums, meetings and international working committees concerning space communication to actively participate in the development context of international satellite system and to address problems, among others, the hazards of the waste and Satellite ecological damage it causes.

Mexico can rely on the development of telecommunications (ITU-D) sector. This sector was established to help spread equitable, sustainable and affordable access to telecommunications and, thus promoting greater economic and social development in nations and companies, especially the poorer countries (ITU, 2011). Membership offers the opportunity to establish relationships with the best talent in the industry represented by more than 700 private sector entities, in addition to 194 governments that make up the UN and its regulators. Participation in the process of ITU standardization allows to directly influence the technological forces that decide the future of the industry of ICT (ITU, 2011).

7.2 National

Establish agreements with public and private institutions and governments of the States of the Republic to generate business for the creation, dissemination, transfer and use of technology in the area of satellite communications, in order to contribute to technological development, political , economic and social development of our nation.

7.3 Legal framework

Mexican Satellite System began to have a reference from the first wire telegraph system in 1951 to reform the LFT and TRF and TV in April 2011, the legal framework for telecommunications which is implicit has been reflecting changes in the Mexican state: an interventionist state to a promoter and regulatory state.

To foster technological development in communications the State should at least greatly reduce the powers of political and economic power groups working mainly for their own interests and to a lesser or greater extent some public officials have been involved . Throughout the history of communications, the Mexican government, with honorable exceptions, primarily benefited from those interests before those of the Nation (Alvarez, 2014).

7.3.2. Scientific Research

Space science research has led to the founding of agencies to coordinate, promote and support projects (Méndez, 2009). These agencies that the Federal government has generated are: the National Commission of Outer Space (SENCO), the Mexican Institute

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of Communications (IMC) and the Mexican Space Agency (AEM). The first two were considered as failures (Méndez, 2009). In addition to these failures are abandoning the Satex project and the disappearance of the University Program for Space Research and Development (PUIDE) (Poveda, 2009). This is due to a lack of policy that systemically integrates scientific research in the productive sector.

Mexico has public and private institutions of higher education in basic scientific research which engineering, technology management, systems thinking, management, economics, design is generated and applied in all areas of knowledge, among others, and development, etc. essential for technological development. Therefore, to make the connection of scientific research in satellite technology development it is necessary to do so through companies. These companies must systemically integrate scientific research as did developed countries over 20 years ago (Nelcy, 2007).

8. Technological development

With this step the cycle model for development in Mexico Satellite closes. Generally it is necessary to analyze each stage to make the necessary changes and constantly updating settings, because the system is constantly evolving. The space technology development is essential for everyday life as it has voice, data and video to at any point on earth. Space technology development will result in economic and social political development of our country. The high costs for imported technology can be used to create long-term infrastructure with a decrease in costs and an increase in quality and thus enter a dynamic of constant innovation. In Fig.1, the phases are present, see table 1, and the sub phases model for the satellite technology development.

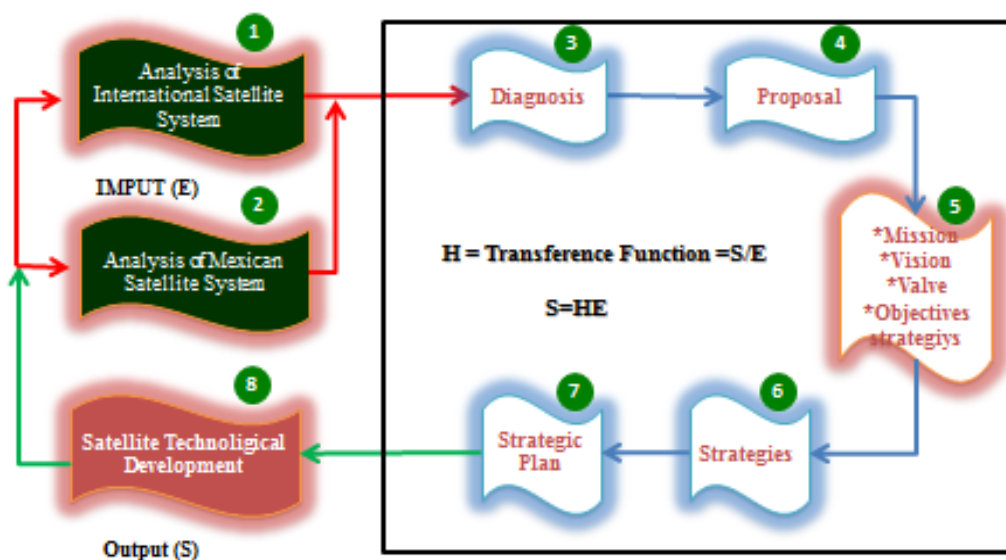


Fig.1. Model for the satellite technology development in Mexico

CONCLUSIONS

Based on what has been described, this document concludes that achieving technological development is essential to reduce the political, economic and social conflicts that are being generated in emerging countries. It is feasible to have DT since generally you have all the academic resources such as higher education institutions, research centers, researchers; To achieve this, an effective and efficient reform is required that allows the integration of basic and applied scientific research in companies based on their objectives, goals and market strategies.

For the development of space communications, developing countries are building small satellites, but the construction must be based on the operating frequencies which are assigned by the International Telecommunications Union, the characteristics required by the launch bases, and operate within the national and international regulatory framework.

Starting in September 18 of 2021, Mexico, together with Argentina, Bolivia, Costa Rica, Ecuador and Paraguay, will found the Latin American and Caribbean Space Agency (A.S., 2021). It is the opportunity for the countries of Latin America to have space technological development, and get out of the current situation, where they do not have launch bases and have to be sent to developed countries to launch their satellites, which is extremely expensive.

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