SPECTRUM DISTRIBUTION FOR THE SATELLITE SYSTEM

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ABSTRACT

Saturation spectrum for geostationary satellites of medium and low height, has caused other options to seek and provide telecommunications services and research, using new technologies. Among these options are the technological development of small satellites and to investigate the frequency bands that are not currently being used, such as some segments of the KA band, etc. This fact has opened a market with new possibilities for growth. The technological development of communications has had an impact on the advancement of space technology. This has had an impact on industrial and research environments, generating opportunities for greater productivity and efficiency. The availability of advanced electronic devices and lower costs has impulsed the participation of academic entities in the space environment seeking to develop and integrate systems. This situation has led universities and research centers in developing countries to contribute to the development of pico and nano-satellites. However, this has brought a series of challenges in the regulatory field such as the use of frequencies, space junk, registering objects thrown into space, etc. for the different administrations of the world.

1. INTRODUCTION

The objective of the Technological Management (TM) is the Technological Development (TD) [Núñez, 2011.] for the TD of the Mexican Space System (MSS). It requires among other factors: knowledge as a business strategy for a company to have competitive advantages [Paniagua, 2010], in order to achieve total productivity [Biasca, 2005] that allows the development of competition in the market [Arjona, 2009]; the development of technological and business innovation [Medellín, 2010], and above all, the decision of the Mexican State on public policies that allow the systematic integration of scientific research in companies.

The use of models has shown to be effective in this task. A model is a series of steps, or it can be an elaborate mathematical structure that represents the problem abstractly. A model is considered a conceptualization of the problem by which a solution will be advanced. In this sense, the models are a methodology to search for solutions [Van Gigch, 2008].

Based on the models of Wiener [1948] and that of the Mathematical Theory of Information [Shannon, 1948], the Systemic Model (SM) is designed for the detection of the MSS problem.

2. SYSTEMATIC MODEL

When analyzing some planning models, among others, those of Ackoff [1986], Steiner [1969], Ozbeckhan [1974] and Sainz [2012] it is concluded that any Systemic Model can be designed in five phases and the sub phases necessary, as shown in Table 1.

Table 1. Phases and sub phases for the Systemic Model.

Phases of the systemic model	Sub phases of the systemic model
I. Analysis of information	1. Analysis of the international space system 2. Analysis of the MSS
II. Detection of the problem	3. Diagnosis of the MSS system
III. Proposed solution	4. Proposed solution for the TD of the MSS
IV. Planning to solve the problem and project the system towards the corresponding objective	5. Mission, Vision, Values and Strategic Objectives for the TD of the MSS 6. Strategies for the TD of the MSS 7. Action plan for the MSS TD
V. Evaluation and Results	8. Evaluation and Results of the MSS TD

These phases and sub phases can be encompassed in three stages: Entrance, Black Box and Exit. In Fig. 1, we present the Systemic Model for the DS of the MSS based on the three stages of the model by Weiner [1948] and Shannon [1949] and with the five determined phases, which at the same time are divided eight sub phases.

Sub phase 1: Analysis of the Development of the International Space System (DISS)

The success of the international spatial TD is due fundamentally to the intervention of the State of the countries that have achieved TD, and they have done it through the space agencies such as the National and Space Administration (NASA) of the United States of America (USA); the Russian Federal Space Agency (ROSCOSMOS); the National Space Administration of China (CNA) and the European Space Agency (ESA).

Based on work done, among others, by Voss, [2011] Meacham, [2013] Ellis, [2010]. Lucena, [2011]. The space agencies are considered as a strategy of the State policy of each country to strengthen basic and applied research, educational institutions and research centers, particularly space research, and link and integrate the industrial space sector. The national security, defense and marine agencies have their own development, based on basic and applied scientific research since any technological advantage is

the main strategy of the armed forces. However, they participate and collaborate with the space agencies, resulting in great impact on the TD.

The space agencies of each developed country or community have a close relationship with each other and therefore participate in joint space projects. The analysis of the Development of the International Space System should allow the definition of the key success factors for the spatial TD, taking into account internal and external factors that are in order or out of control.

Sub phase 2. Analysis of the MSS

The Mexican State, founded the National Commission of Outer Space (NCOS), 1962-1977. This agency developed space research that resulted in the launching of rockets and space balloons; The Mexican Institute of Communications (MIC), 1987-1997, was an interlocutor and promoter of research efforts in educational institutions [Méndez, 2009].

Currently, the Mexican Space Agency (MSA) which began operating in 1911, has the same objectives as the previous two, which consist in promoting scientific space research in order to promote the TD. That is to say, the purpose for which it is wanted but it is not said how to achieve it.

The programs and projects that have been generated in the higher education institutions and research centers arise and then disappear, such as the Autonomous University of San Luis Potosí (AUSLP), which launched its first rocket before the USA launched their first satellite, Explorer 1, and two months after the Union of Soviet Socialist Republics (USSR) launched its first satellite, Sputnik 1. The University Program for Space Development Research (UPSDR) was canceled after designing to build and put into orbit its satellite in 1995, UNAMSAT 2; the SATEX project [Poveda, 2009], which started 22 years ago and has no results up to date.

Sub phase 3: Diagnosis of the MSS

Here are some research questions to determine the diagnosis of MSS

1. Did Mexico start its space research after the countries that have had technological space development?

Answer: Mexico started these activities at the same time as the USSR and the USA [Poveda, 2009].

2. Did you have the economic resources to start MSS TD?

Answer: Yes, 1600 million dollars were paid for designing the last three Mexican satellites of the Mexsat project to build and launch in other countries [García, 2012]. On the other hand Russia built a space launch base in French Guiana at a cost of 361million dollars [Space Daily, 2004]. Therefore if you have the financial resources.

3. Are there national researchers?

Answer: Yes, in 2010 we had the 16th place in scientific publications from around 194 countries, members of the United Nations (UN).

4. In Mexico, basic and applied scientific research is integrated systemically in the productive sector?

Answer: No, scientific research is stored mainly in educational institutions; unlike the developed countries that have systemically integrated the productive sector [Nelcy, 2009] based on their goals, objectives and market strategies.

Based on the questions, it is determined that there is no MSS TD in Mexico since the Mexican satellites that cover the orbits assigned by the International Communications Union (ICU), are designed, built and launched in other countries; because basic and applied scientific research has no connection with the productive sector.

Sub phase 4. Proposal for the TD of the MSS

A State policy is necessary that systematically integrates basic and applied scientific research in the productive sector in Mexico, in order to avoid the failures that have occurred to date in the Mexican space policy.

The Mexican state, as the regulator of the economy and the leader of national policy, correlated with the international one, can establish a policy of integrating scientific research into companies, as well as promoting public and private investment to found self-financing companies that generate wealth. They can be public, mixed, or private initiative, which integrate systemically basic and applied scientific research that allows the MSS TD to providing efficient, fast, safe and cheap service that meets the demand of national and international users.

Sub phase 5. Mission, Vision, Values and Objectives of the Proposal

Mission
The core of Mexican space policy must have deep social roots; promote social development, welfare, integration and national development. Interconnect with the national and international communications system to rationally provide space services.

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

Vision
Generate profitable companies that provide people, professionals and researchers and graduates of the educational infrastructure, from all areas of knowledge, the opportunity to participate in the MSS TD to reduce the technological dependence that impacts on political, economic and economic development of Mexico, achieving results through the rationalization of resources.

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

Aspiration. Act with passion and a sense of urgency, impose challenges and achieve goals and objectives in order to reduce political and social economic conflicts.

Human resources
They are the backbone of organizations, for this reason they should be sought within the company for their welfare.
Natural resources. The company is justified to take care of and improves the ecology and environment.

Strategic objectives
Strategies are used to combine the strengths of opportunities (OS), which make it possible to know the strengths of the MSS TD to take advantage of the opportunities presented by the international community in the area of communications; as well as take into account the strengths against external threats with the combination.
In the same way, the strategies corresponding to the combinations obtain opportunities weaknesses (OW) and threats weaknesses (TW).

Sub phase 6: Strategies for the MSS

In a systemic approach, strategies are a means to achieve long-term objectives, from three to five years, and generally cause the transformation of the system. On the other hand, if the approach is for a continuous improvement of the system, the strategies can be short-term, that is, less than two years [Van Gigch, 2008].

The strategies contemplate the goals and the development objectives of the MSS, through its external and internal development. In order to propose the strategies, the combinations of the strengths opportunities (SO) are used, which allow to know the strengths of the MSS to take advantage of the opportunities presented by the international community in the area of communications; as well as take into account the strengths against external threats with the combination (ET). In the same way, the strategies corresponding to the combinations are obtained: opportunities weaknesses (OW) and threats weaknesses (TW) [David, 2008].

Sub phase 7: Strategic Plan

In this sub phase, the design of the strategic plan is proposed, which must be based on coherence, with all that has been exposed in previous phases. The strategic plan for the MSS TD indicates how the technological management should be carried out, that is, it allows the Mexican State to implement decisions on policies, plans, programs, projects, etc. related to the creation, diffusion, transfer and use of technology.

Sub phase 8: Technological development of the MSS

With this sub phase we close our SM for the TD of the MSS, that is, we perform the corresponding feedback by joining the phase of 8 (output) with sub-phase 1 (input); at the end of the cycle we can modify each of the five phases that at the same time contain the eight sub-phases.

3. VALIDATION OF THE SM FOR THE TD OF THE MSS

Based on the SM for the TD of the MSS, proposed in Fig. 1, we began to validate it, based on the concepts of Wiener's model [1948], Shannon's mathematical information theory [1948] and Bertalanffy's general systems theory [1968].

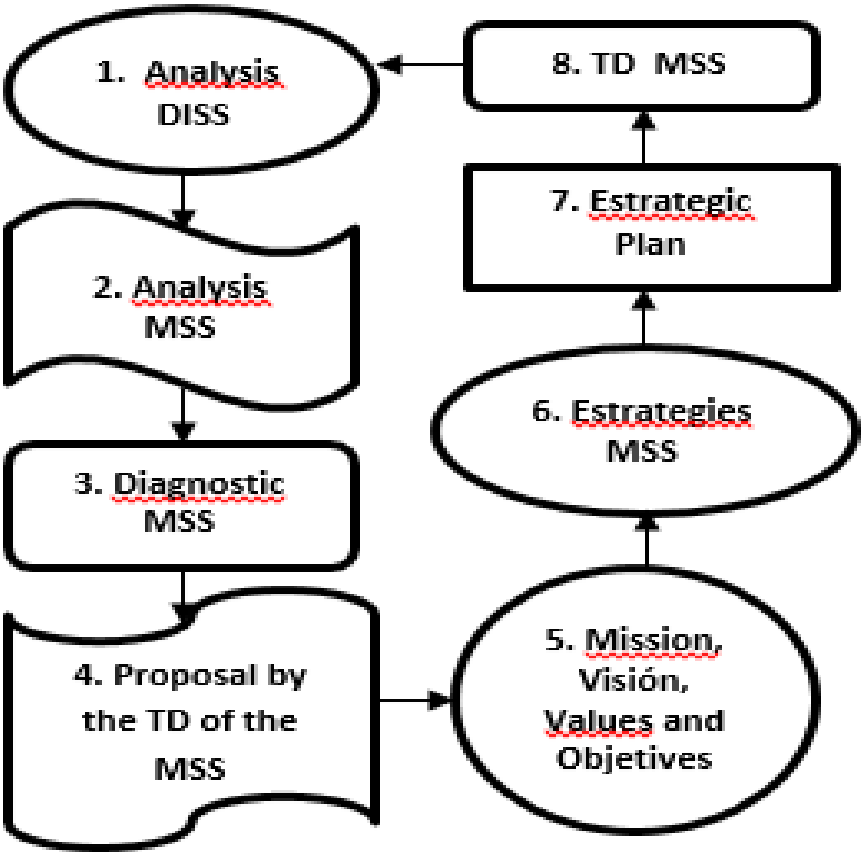

Figure 1. Systematic Model for the TD of the MSS

If we know the input (I) and the output (O) of a system, then we can design what is in the box represented by B, Fig.1.

The meaning of the box is that we do not know what exists within it, so model designers are free to propose infinite solutions as long as the output is the expected response, which in the case at hand, is the TD of the MSS.

4. CONCLUSIONS

Based on what has been described, this document concludes that achieving technological development in Mexico is essential to reduce the political, economic and social conflicts that are taking place in the country. It is feasible to have TD since there are all the resources such as higher education institutions, research centers, researchers; In order to achieve this, the Mexican State must carry out an effective and efficient reform that allows the integration of basic and applied scientific research in companies. In the case of space communications systems in Mexico, Mexican satellites that have provided communications services since 1985 to date were designed, built and launched in other countries because basic and applied scientific research is not integrated to the productive sector.

In Mexico it is important to investigate the frequency spectra as well as to manage a regulatory framework so that small geostationary, polar, medium and low altitude satellites can operate in order to have an efficient and effective spatial TD that allows satellite communication for services fixed and mobile

Nowadays, in the national academic institutions, space projects are being developed, among them, the National Autonomous University of Mexico, through the Faculty of Engineering, is developing three projects of satellites of scientific research for the studies of the ionosphere and observation of the earth. Therefore, it is necessary to have terrestrial infrastructure for telemetry, command and data recovery operations.

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