STATE POLICIES FOR THE TECHNOLOGICAL DEVELOPMENT OF THE SPACE SYSTEM

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SUMMARY

The Technological Management (TM) is defined as: the decisions that the State adopts on the policies, plans programms, etc. relating to the creation, diffusion, use and transfer of space technology in order to achieve Technological Development (TD).

In Mexico the government, educational institutions and research centers have made efforts to found organisms, programms and projects, in order to foster space DT, which arise and disappear without achieving the objective for which they were founded.

The main purpose of the TM is the TD. To achieve this, integration is necessary concerning government-academia-industry in order to reduce political, economical and social conflicts.

For this reason, a Systemic Model (SM) for the Technological Development of the Mexican Space System (TDMSS) is proposed, allowing the integration of scientific research in companies based on market goals, strategies and objectives.

The MS has three stages: the first is the input (I), consisting of the analysis of the satellite system in the International and National context; The second, box (B), consisting of: diagnosis, proposal, planning to carry out the proposal;

The third relative to the output (O), in this case is the satellite TD. O = IB, ie, I and B can be adjusted to achieve O.

1. INTRODUCTION

Mexico is better located in latitude with respect to Ecuador than USA, Russia and China, and for this reason they have better advantages for the space industry. The State of Quintana Roo is the most suitable for the construction of aMexican Space Launch Base (MSLB), since it is only at 18 ° latitude.

It is estimated that the cost for a space launch base is 300 million dollars, and if about $ 150 million were paid for the launch of the Bicentennial satellite, obviously with two launches would recover the investment.

With the installation of the MSLB satellite construction companies, launchers, fuel producers, tourist services, etc. will be founded in the vicinity, in order to avoid costs of transfer, that is to say, they would generate countless companies that contribute to the Technological Development (TD) of the country.

Othón Pompeyo Blanco, one of the ten municipalities of Chetumal, south of Quintana Roo, has a good strategic location for this project, due to its proximity to the Equator, thus saving fuel, and the trajectory of the spatial artifacts would be towards the east,not crossing populations and avoiding accidents (Ángel, 2011). Therefore, the MSLB is proposed to begin with the Technological Development of the Mexican Space System (TDMSS).

2. SYSTEMIC MODEL

The use of models has shown to be effective in this planning task; A model is a series of steps, or it may 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 find solutions (Van, 2008).

When analyzing some planning models, among others, those of Ackoff (1986), Steiner (1969), Ozbeckhan (1974) and Sainz (2012) conclude that any planning model can be designed in five phases: 1.Information; 2. Detection of the problem; 3. Planning to solve the problem and project the system; 4. Evaluation and 5. Results.In Fig. 1, the Systemic Model (SM) for TDMSS is presented based on the three stages of the Weiner and Shannon model and with the five determined phases, which are divided into eight sub phases.

The five corresponding phases with their respective sub- phases are described below, and all within the three stages mentioned.

The first phase of SM for TDMSS consists of sub phases 1 and 2 analysis of the development of the international space system and analysis of the development of the Mexican Space System. The second phase is constituted by sub-phase 3, corresponding to the diagnosis. The third phase is made up of sub-phase 4, in which the proposal is made. The fourth phase represents the planning to solve problems and to project the organization, is constituted by the sub-phases: 5, mission, vision, values and strategic objectives of the proposal; The sub-phase 6, strategies and the 7, strategic plan. The fifth phase, results and evaluation, make up sub-phase 8, corresponding to obtaining TDMSS.

The design of the SM for the TDMSS should be placed within the overall planning process, and outline the phases for its elaboration. The SM must have validity in the long term, and can never be made for the short-term plans.Moreover, from the systemic plan the system must continue to be transformed indefinitely (Sainz, 2012).

According to Ackoff (1986), a set of two or more interdependent problems constitute a system. This set is known as problematic and its solution must be focused on the system and not on each of its parts; The author states that interactive planning considers the present past

and future as inseparable parts of the problem, and if we do not take into account the three temporal aspects, the plan will be obstructed. The phases of interactive planning do not need a specific order since they are interdependent of the SM; Each feeds and is fed by others. The results of any phase can be adjusted in some others. Therefore there is no order of beginning and ending; more can be left incomplete and another started. Based on the foregoing, the design of the sub- phases of the SM for the TDMSS is described.

Sub -Phase 1. Analysis of the Development of the International Space System.

The success of the international space TD is primarily due to the State intervention of the countries that have achieved it, and they have done so through space agencies such as the United States National and Space Administration (NASA) (USA); The Federal Space Agency of Russia (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. Space agencies are considered as a strategy of the state policy of each country; Strengthen basic and applied research, educational institutions and research centers, in particular space research, and link and integrate the space industry. National security, defense and marine agencies have their own development, based on basic and applied scientific research as any technological advantage is the main strategy of the armed forces. However they participate and collaborate with space agencies, resulting in Great impact on the TD.

Space agencies in each developed country or community of countries are closely related to each other and therefore participate in joint space projects. The analysis of the status of the Development of the International Space System (DISS) should allow for the definition of the key success factors for the space TD, taking into account internal and external factors that are in or out of control.

Sub-Phase 2. Analysis of the Development of the Mexican Space System.

Mexico acquired its first packet of its own satellites, Morelos I and Morelos II, placed in orbit in 1985, in the two geo-stationary positions with their respective C and Ku frequencies assigned by the TIU at 113.5ºO and 116.8ºO respectively; Operated through the control center of Iztapalapa that began to operate with this satellite system. These satellites provided voice, video and data services to the national territory (Tun, 2006). For the management of both satellites and control centers, in 1989 Mexico Telecom (Telecom) was created based in Mexico City (Soto, 2010).
In order to offer C and Ku band services in Mexico and the American continent, the Solidarity 1 satellites were launched, which occupied the new 109.2 ° O orbital position provided by the TIU and Solidarity 2, which occupied 113.5 ° O; Placed in orbit in 1993 and 1994 respectively (Tun, 2006).

Mexico privatized its satellite system, granted the company Satmex, on October 23, 1997, the concession for 20 Years which was renewed on May 26, 2011, to begin October 24, 2017 until October 24, 2037. The Satmex system had three satellites: Solidaridad 2, Satmex 5 and Satmex 6 (SCT, 2011).

Satmex 5 was put into orbit on December 5, 1998 at 116.8ºO, replacing Morelos II (Mejia 2010). Satmex 6 was launched on 27 May 2006 at 113 ° O, instead of the 113.5 ° O position,

due to adjustments made by TIU. Solidarity 2 occupied 114.9 ° O, instead of 109.2 ° O (SCT, 2011). Satmex 8 was launched on March 26, 2013 at 116.8 ° O and Satmex 5 that was in that position was placed at 114.9 °, consequently Solidarity 2 was out of orbit.

In January 2014, Satmex was sold to the French company Eutelsat Comunication (Eutelsat), 75% of Satélites Mexicanos, S.A. Of C.V. As well as the 25% that corresponded to the Mexican State; Reason why the satellites that managed Satmex change of name:

1. Eutelsat 117 West A, formerly Satmex 8

2. Eutelsat 115 West A, formerly Satmex 5

3. Eutelsat 113 West A, before Satmex 6

On February 2, 2005, the TCS granted the Mexican company Med Com a concession for 20 years to exploit the 77 ° O orbital position. The Quetzat 1 satellite was launched on September 29, 2011 having a national coverage for the United States, Central America and the Caribbean, with an estimated useful life of 15 years (Quetzsat, 2012).

The Mexican government, through the TCS, decided to participate in the TDMSS reason why it founded Mexsat. The Bicentennial satellite was launched on December 19, 2012 for fixed communications in the extended C and Ku bands; The Morelos III was launched on October 2, 2015 in the 113 ° O orbit.

Mexsat depends from the functional point of view of the Secretariat of Communications and Transportation. This entity has designated Telecom as the operator of the MSS, attributing various responsibilities in the procurement, manufacturing, development and commissioning procedures of the system.

In 2012 two control centers were built, the primary in Iztapalapa and the secondary in the region of the Mexico City airport. There is another one in Hermosillo, Sonora, for the Mexsat System. These control centers carry out Mexican satellite monitoring, telemetry and command, as well as satellite orbital analysis maneuvers; So these control centers have principles of linkage with the National Development Plan and with the Sectorial Program of Communications and Transportation of Mexico (Telecom, 2012).

Sub -Phase 3: Diagnostics of TDMSS.

The Mexican satellites that provide services to the American continent are designed, built and launched in other countries therefore they do not have TDMSS. This technological import raises the real value up to 40%, due to the services added to this purchase (Percy, 1982).

In 11 years (1985-1997) that the Mexican government operated the Mexican Satellite System (MSS), it bought five geo-stationary satellites. Satmex, which had the concession for 17 years, only bought two, which indicated the inefficiency of the company. At the time of Satmex the TIU canceled the 109.2 ° O orbit; The Solidarity 2 satellite was never replaced and the Satmex 5, which began to fail in 2010 was replaced until 2012 with Satmex 8. The MSS is partially operating since the Satmex 5, now Eutelsat 113A, is in tilt orbit. There are three satellite orbits assigned to Mexico by the TIU that are not being used: 69.2 ° W, 127 ° W and 136 ° W (SCT, 2012).

Satmex by not replacing the satellite Solidaridad 2 which, together with Solidarity 1, operated in frequencies Ku, C and L, forced the Mexican State to found Mexsat in order not to lose their orbits with their corresponding frequencies. The L-band is the frequency that the Government had reserved for national security by privatizing the MSS (SCT, 2012).

The launches were delayed, and in order for the TIU not to cancel the allocation of orbits, the Communications and Transportation Secretariat (CTS) paid $ 417,000 to the Orbital Science Corporation to transfer the Bicentennial for three months in the two 113 ° positions O and 116 °. This trick was made based on the TIU regulations, which allows in the first instance orbits to be occupied for that time and not to be canceled. This costly operation reduces the life of the satellite and puts it in danger of collision with others or with some apparatus of the satellite trash (Tourliere, 2015).

Scientific research is completely unrelated to the productive sector due to the lack of TD. Mexico has 16th place, in published articles in the world (ISI, 2010); However, of 18500 INS researchers, more than 50% are in the UNAM and the IPN. The industry is practically lacking in researchers, only 14 companies that have INS researchers are reported. However, three have some significance: Grupo Kou, S.A. Of C.V, has 11; Corporación Mexicana de Investigaciones en Materiales, S.A. Of C.V, has nine and Parcar Developments and Services with seven and 10 companies with one. For example Chrysler of Mexico and Civil Engineers Associates, count on one (SIICYT, 2012).

A State policy (Poveda, 2009), is necessary in order to avoid the failures to date in Mexican space policy, such as the cancellation of the National Outer Space Commission (NOSC) from 1962 to 1977; This body developed space research that resulted in the launching of rockets and space balloons; The Mexican Institute of Communications (MIC) from 1987 to 1997 was the interlocutor and promoter of research efforts in educational institutions (Méndez, 2009). At present, the Mexican Space Agency (MSA), which began operating in 1911, has the same objectives as the two previous ones, which are to promote space scientific research in order to promote TDMSS, that is to say, the purpose but does not explain how.

Unless we organize, articulate and develop in an orderly way the space sector of our country we will not become a developed country and stop being users of the technology, and we will have to make another substantial investment in some years, to keep the country inside the development pace. In Mexico, the productive sector is not articulated with the educational and financial sectors. There are research projects and a good quality scientific infrastructure, however, their impact on the national TD is marginal to the needs of the country (Santillán, 2011). The organisms founded by the Mexican State, arise and disappear due to the lack of a State policy that propitiates the TDMSS.

Sub- Phase 4: Proposal.

After the analysis of the internal and external situation of the TDMSS. The diagnosis of the same, and after describing what has been done and what remains to be done, the proposal is made for the transformation of TDMSS. In this sub-phase it is important to present the proposal in such a way that it can be carried out, that is, feasible, and above all to be clear that the proposal is not an improvement of the system but is to change everything that has been done by a new strategy that allows the TDMSS.

STATE POLICIES FOR THE TDSS

The technological management for TDMSS is proposed based on the precepts established by the MSA: mission, vision, human capital formation, science and technology, industrial development, international affairs; Since it is the agency of the Mexican State in charge of the TDMSS, therefore the following proposal is made:

The Mexican state as a regulator of the economy and driver of national policy, correlated with the international one, can establish the policy of systematically integrating scientific research in companies, as well as promoting public and private investment to found self-financing companies that generate wealth, which may be public, mixed, or private initiative, systemically integrating the basic and applied scientific research allowed by TDMSS with the purpose of providing efficient, fast, safe and cheap service that satisfies 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, well-being, integration and national development. Interconnect with the national and international communications system to provide space services with rationality.
Strengthen, through TDMSS, national security, technological infrastructure for 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 individuals, professionals and researchers and graduates of the educational infrastructure, from all areas of knowledge, the opportunity to participate in TDMSS to reduce technological dependence and impact on political, economic and social development Of Mexico, achieving results through the rationalization of resources.

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

- Aspiration. Act with passion and sense of urgency, impose challenges and achieve goals and objectives. Make decisions wisely, without fear of error or failure.
- Human Resources. They are the backbone of organizations, for this reason one should look within the company for their well-being.
- Natural resources. No company is justified for not caring for and improving the ecology and environment.

Strategic objectives.
Integrate research and technological management for development in space companies.

Sub- Phase 6. Strategies.

In order to formulate the strategies, the combinations of the Opportunities Strengths (OS) are used, which allow to know the strengths of the TDMSS to take advantage of the opportunities presented by the international community in the area of communications; As well as taking into account the strengths against external threats with the combination (ST). In the same

way we obtain the strategies corresponding to the combinations: weaknesses opportunities (WO) and weaknesses threats (WT) (David,2008).

Sub Phase 7: Strategic Plan.

This sub-phase proposes the design of the strategic plan, which should be based on consistency, with all that has been exposed in previous phases. The strategic plan for TDMSS indicates how technological management should be carried out, ie, it allows the Mexican State to implement decisions on policies, plans, programs, projects, etc.

Related to the creation, diffusion, transfer and use of technology.

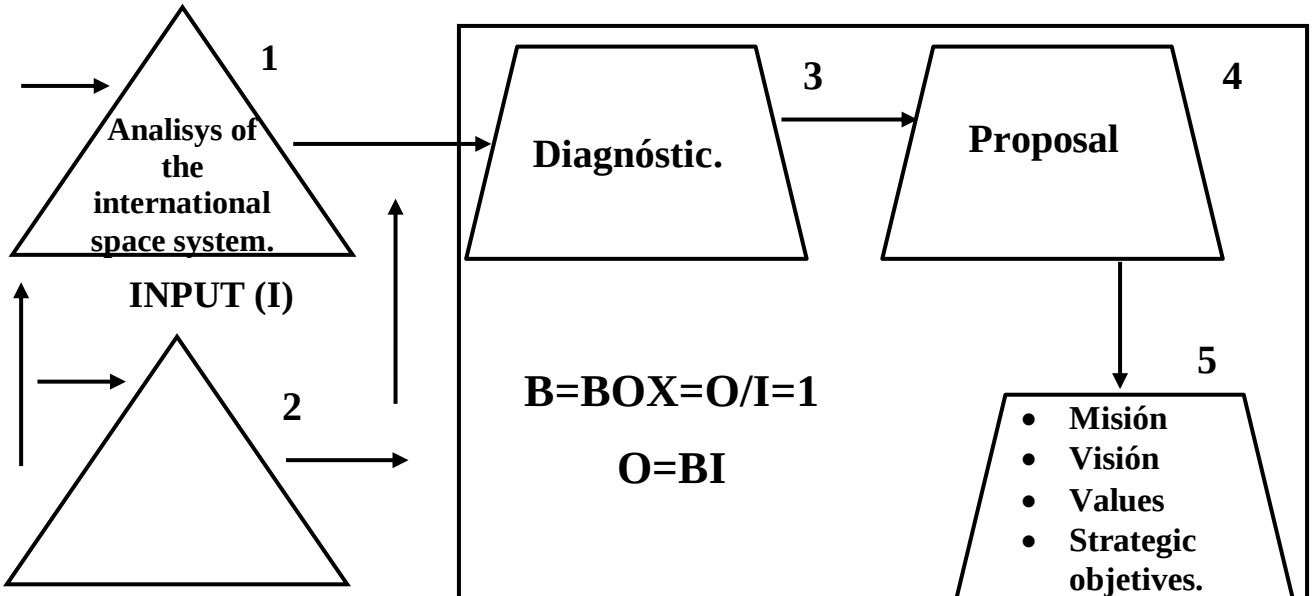
Sub -Phase 8: Technological Development.

With this sub--phase we close our SM for the TDMSS, that is, we perform the corresponding feedback by joining the space TD phase, sub-phase8 (output) with sub-phases 1 and 2 corresponding to the analysis of the developments of the International and National space systems. When closing the cycle we can modify each of the five phases that simultaneously contain the eight sub phases.

3. VALIDATION OF THE SM FOR THE TDMSS.

Based on the SM for the TDMSS proposed in Fig. 1, we begin to validate it based on the concepts of Wiener's (1948) model, Shannon's (1949) Mathematical Theory of Information and Bertalanffy's (1968) General Theory of Systems.

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 inside it, then the model designers have the freedom to propose infinite solutions provided that the output is the expected response, which in the case that concerns us, is the TDMSS beginning with the construction of a spatial launch base in Mexico since the model can be applied to any particular system.



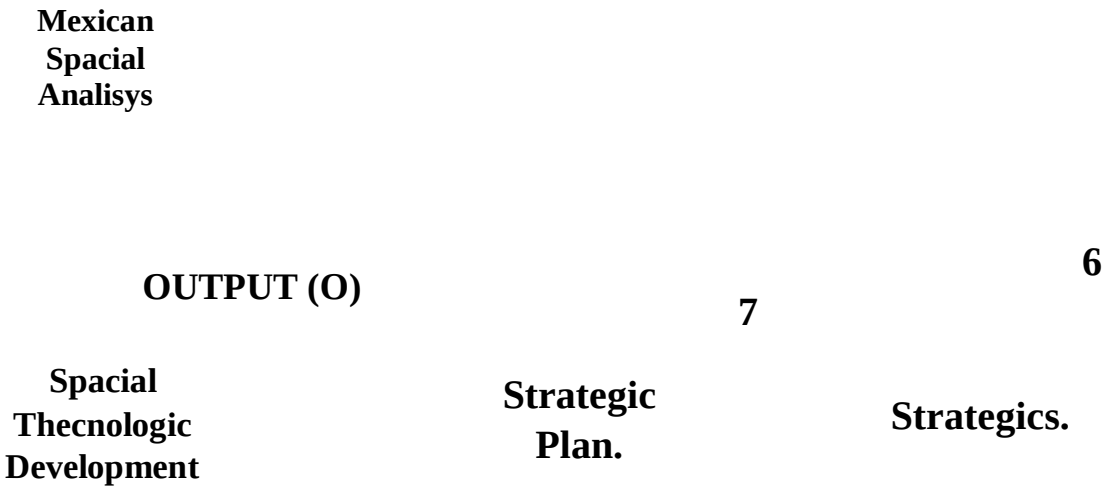


Fig. 1. Systemic Model for the Technological Development of the Mexican Space System.

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