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Information Management Model for Short-Term Planning in Technological Universities

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Abstract: The objective of this research is to propose an information management model for short-term planning carried out by the Technological Universities of the state of Hidalgo, which facilitates compliance and alignment with strategic planning; in order to address areas of opportunity related to the disconnection between the objectives of operational projects with institutional, state and national strategic objectives; where the assignment of resources to these projects is generalized; which causes delays in procurement and failure to meet the goals and achieve the objectives. The DEXPLIS methodology is used, which in its initial phase allowed the collection and analysis of quantitative data through the ANOVA statistical method; for the second phase, through the review of documents and the application of interviews to project leaders and those responsible for the planning areas of the Hidalgo Technological Universities, functional requirements were collected that gave rise to the design of the information management model. Subsequently, in a theoretical manner, the model was evaluated by a group of experts through Delphi and Kendall statistical methods to determine the degree of global concordance of the model. The results showed that there is a significant relationship between the objectives of the Annual Operating Program and the Institutional Development Program, as well as a connection between the degree of specificity with which the Annual Operating Program is elaborated and the fulfillment of the goals of the substantive and administrative functions of these institutions. The relevance of the model lies in the fact that it allows an adequate linkage between objectives, goals, resources, and short-, medium-, and long-term needs, making it possible to establish budgets at a detailed item level, obtain disaggregated information, and facilitate information for decision making.

Keywords: information management model, short-term planning, annual operating program.

科技大学短期规划信息管理模型

摘要： 本研究的目的是为伊达尔戈州技术大学实施的短期规划提出一种信息管理模型，以促进战略规划合规性和一致性；为了解决与业务项目目标、国家和国家战略目标脱节相关的机会；这些项目的资源分配是普遍的；导致采购延误、无法实现目标和实现目标和实现目标。采用序贯解释性设计方法，其初始阶段允许通过方差分析统计方法收集和分析定量数据；第二阶段，通过审查文件以及对项目负责人和负责伊达尔戈理工大学规划领域的人员进行

访谈，收集了功能需求，从而设计了信息管理模型。随后，从理论上讲，专家组通过德尔福和肯德尔统计方法对模型进行了评估，以确定模型的全局一致性程度。结果表明，年度运营计划的目标与机构发展计划之间存在显著关系，年度运营计划制定的具体程度与实质性目标的实现之间也存在联系。以及这些机构的行政职能。该模型的相关性在于它允许目标、目标、资源和短期、中期和长期需求之间的充分联系，从而可以制定详细项目级别的预算，获取分类信息，并为决策提供信息。

关键词：信息管理模型，短期规划，年度运营计划。

Introduction

In Mexican Public Management, planning is represented by the National Development Plan, the States Development Plans, Sector Programs, Institutional Programs, and Annual Operating Programs; each of them with different periodicities: long term, medium-term, and short term, with the Annual Operating Programs planning to be executed in the short term considered as one year.

Technological Universities emerged as decentralized organizations of state governments in 1991 [1] to offer education to social extracts with less

economic possibilities at the medium-higher level through a lower public educational investment and the reduction of study time; with greater employment opportunities [2], thanks to the direct link with the productive sector [3].

Through the Annual Operating Program, the Technological Universities rationalize and prioritize resources according to their priorities of the projects that comprise (Fig. 1). These programs constitute the basis on which these institutions must propose their budget for each year.

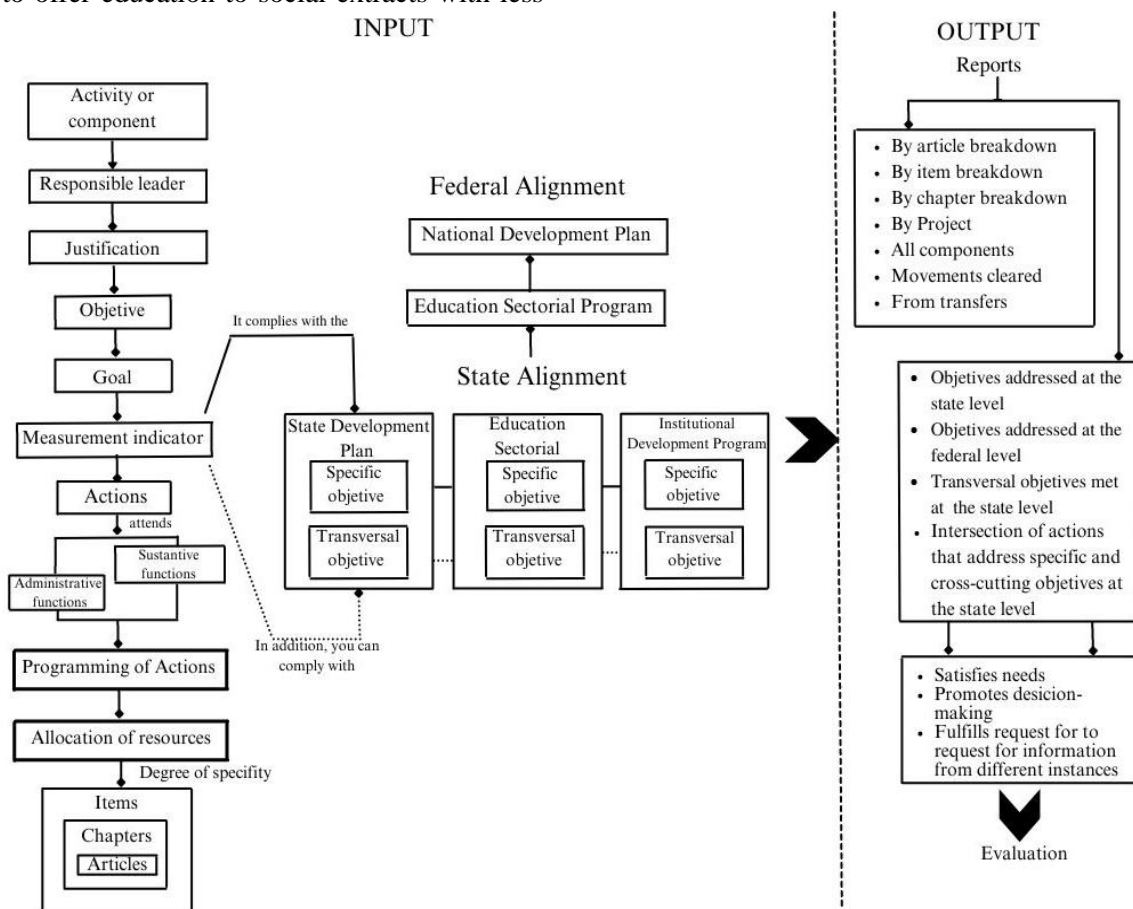


Fig. 1 Information management model proposed for the annual operating program for Hidalgo's technological universities

Technological Universities use the same model for operational planning as for public management, and for

this reason, some aspects are not covered; for example, the programmatic structure of this model allows for a

limited allocation of resources at the level of chapters and items, which is carried out through the complementation of technical sheets prepared by project leaders, this may limit the degree of specificity and detail of the programming of the Annual Operating Program, having an impact on the generalization of the budget allocation items that do not determine the requirements for the substantive functions: teaching, research, linkage, and extension; as well as, the administrative functions of the institution.

One of the main consequences of the above is the disconnection of the allocation of resources with the objectives, goals, actions, and indicators, both institutional and by educational programs, which leads to delays or deviations in acquisitions, difficulty in the integration of reports in real-time and with reliable information.

The objective of the project is to develop an information management model for the Annual Operating Program that addresses the substantive and administrative functions of the Technological Universities of Hidalgo in terms of planning and budgeting of their resources, which contributes to the fulfillment of strategic planning, which is the purpose of this research. This model can be translated like an information system.

1. Literature Review

1.1. Planning in Public Management

According to Hans, there are three levels of planning [4].

At the first or strategic level, they establish the priority objectives and goals as well as courses of action (strategies) to achieve these objectives [5]; and it is a key tool for decision-making in public institutions [6]. In the case of Technological Universities, the Institutional Development Program represents it [7].

Giebels affirms that at the middle level is tactical planning, which allows the connection of strategic planning with operational planning [4] and is responsible for articulating in the best way the human efforts and available resources to obtain the expected results [8].

At the last level is the operational or short-term planning with an annual or multi-year validity; in this, activities, resources, deadlines, costs, and the most immediate results in the form of products or services are established [9]. Within public management, the annual operating program is prepared at this level [10].

The Annual Operating Program consists of a document that establishes the commitments to be developed during the following fiscal year and describes the course of action and specific processes. For each process, the responsible areas, indicators, objectives, activity scheduling, goals achieved, justification, and executing areas are defined [11].

Strategic planning in public management is a relatively young academic discipline; in the United States, in the early 1980s [12], public sector organizations began to use strategic planning concepts and techniques, and it was a successful innovation that contributed positively to improve the performance of that sector [13].

In Mexico, the First Law of General Planning in the Republic was issued in 1930, and three years later, the First Six-Year Plan was elaborated. The second six-year plan was raised in 1939. Between 1962 and 1964, surge the Immediate Action Plan. From 1964 to 1970, Mexico's government exposed the Economic and Social Development Program, which was to be executed for the following period 1966-1970, and which gave rise to the Public Sector Action Program. In 1980, the Global Development Plan [14] was issued and in 1983, the National Planning Law was published, which repealed the General Planning Law of the Republic of 1930 [14].

The purpose of this law is to transform the reality of the country under the norms, principles and objectives established by the constitution and through the rational and systematic organization of actions [14]. In Hidalgo State, Mexico, the Planning and Prospective Law is in force, which, in its article 10°, indicates that "The agencies and entities of the State and Municipal Public Administration must plan and conduct their activities in compliance with the objectives and priorities of the State Development Plan, seeking congruence with National Planning"[15].

1.2. Information Management

"Information management is the management of organizational processes, technologies and people that collectively create, acquire, integrate, organize, process, store, disseminate, access, and dispose of information. Is a vast, multidisciplinary domain that syndicates various sub-domains and perfectly intermingles with other domains" [16].

Three categories are distinguished:

- Oriented to Information Technology (IT) and professionals related to computer science; in which management is channeled to data and IT [17].
- Oriented to content, its use and exercised by library and information science professionals; in this, information management is directed to document management, external information supply, people-centered information management, and information resources management [18].
- Oriented to decision-making and management science professionals; through the appropriate use of information and IT, information resources are planned, organized, and directed to support management functions, organizational performance, and decision-making, i.e., with a strategic character [19].

Ponjuán compiles several representative models of

information management existing in the literature [20]. According to Ponjuán, an information management model is a strategic process that occurs in an organization of any kind, encompasses all the processes and activities of that organization and its components, and therefore is closely related to the system that rules it and involves different elements, among which are: information, user needs, and expectations, generation of new information, information policies, systems, information life cycle, processes, and technology [21].

1.3. Information Systems

Information systems comprise a set of interrelated processes that have standards, resources, and procedures; they can be manual or automated [22] and in them, operations, tactics, and strategies for the administration, knowledge, commerce, and future of companies are traced in an appropriate format and time [23].

According to Haag, are formed by the set of organized elements that are responsible for processing, managing and disseminating data and information, which must be made available for later use and whose objective is to meet an organizational need and increase its operational effectiveness and efficiency [24], as well as provide reports to the parties involved [25].

2. Methodology

The research design was sequential explanatory, known as DEXPLIS, since quantitative data were collected and analyzed first and then qualitative data were collected and analyzed. The research subjects to whom the measurement instruments (surveys and interviews) were applied were the planning units of the Technological Universities of the state of Hidalgo and project leaders, responsible for the elaboration of the projects that make up the Annual Operational Program of these same institutions.

2.1. Quantitative Approach

The scope of this research is descriptive and correlational. Simple random sampling was used for the application of the questionnaires. The population is made up of eight Technological Universities located in the state of Hidalgo in the municipalities of Tula, Huejutla, Ixmiquilpan, Tulancingo, Zacualtipán, Tolcayuca, Mineral de la Reforma and Zimapán [26].

Each university has a maximum of 23 projects. On average, a leader is responsible for two projects.

Therefore, taking the maximum number of 23 projects divided by two for each Hidalgo Technological University; the population is finite and is formed by 92 people, the sample was formed by 40 people with a confidence level of 90% and a margin of error of 10%.

For the development of the instrument used for the collection of quantitative data, a Strategic Planning

instrument presented in 2003 [27] was used as a basis.

The instrument was formed by 55 items, 85% of the specific questions were multiple choice and the Likert scale was used to measure the answers. Six experts validated the content of the questionnaire.

Ten project leaders from three technological universities located in the municipalities of Ixmiquilpan, Tula Tepeji, and Huejutla participated in the pilot test.

Subsequently, for the reliability of the instrument, SPSS Statics software was used to capture the responses of the pilot test and the Alpha Cronbach coefficient of the items was calculated, thereby obtaining a value of 0.889, which is considered acceptable. The administration method of the instrument was self-administered employing google forms.

2.2. Qualitative Approach

For this aspect, the sample was non-probabilistic of the confirmatory kind. In a first moment, the Technological University located in Ixmiquilpan was taken; in a second moment, the sample is directed to a group of experts.

For the first stage, semi-structured interviews were conducted with the person responsible for the Planning and Evaluation area as well as with five Technological University located Ixmiquilpan project leaders; additionally, some printed report formats were examined in order to gather the functional requirements and business rules of the Operational Program that served as the basis for the elaboration of the management model proposal.

The type of data collected came from audio recordings because of interviews, handwritten notes, and some formats used for the elaboration of the Annual Operating Program.

For the second stage, the data collection instruments were initially a structured interview and four questionnaires, since a mixed method was used to evaluate agreement among the experts.

3. Results

3.1. Quantitative Results

The most important descriptive results were:

Of the 40 people who answered the questionnaire, 55% were men and the rest were women. 35% of the respondents are Department Heads, 2% are Vice-Directors, 3% are Academic Secretaries, 30% are Office Heads, 3% are Academics and 27% of them are Directors. 22% of those surveyed are assigned to the Technological University located in Ixmiquilpan, 12% in Huejutla, 8% in Tulancingo, 5% in Zacualtipán, 8% in Zimapán, 25% in Tizayuca, 8% in Mineral de la Reforma, and 12% in Tula Tepeji.

40% of the project leaders or components have only

one project under their responsibility, and the rest is responsible for two or more projects. 50% mentioned that decision making occurs at the senior management level. 42.50% considered that such decision making is inclusive and that they are open to learning.

Regarding technological universities' Annual Operational Program inclusion of substantive and adjective functions 52.50% consider that currently these functions are not covered. Regarding the allocation of organizational resources (i.e., human resources, capital and specific time) to complete a task or activity, 42.50% answered that no such allocation is made.

Currently, for annual operating program integration, 25% of the personnel surveyed do it at the chapter level, 65% at the line item level, but only 10% at the article level.

The tools used to prepare the Annual Operational Program are 85% spreadsheets prepared in Microsoft Excel, 7% word processing, and 8% administrative information system. 42.50% of the respondents mentioned that the aforementioned tools support the elaboration of the budget programming while another 55% think that the tools do not support the organization, standardization, and structuring of the operational programming.

On the other hand, the first alternative hypothesis is related to the degree of alignment of the objectives of the Annual Operational Program (independent variable) with the fulfillment of strategic planning (dependent variable).

The ANOVA statistical test was applied, and Table 1 shows Leneve's test of equality, this indicates that the variances are generally not equal since the significance value is 0.030 less than 0.05, which implies rejecting the null hypothesis.

Table 1 Leneve's test for equality of error variances^a

F	df1	df2	Sig.
2.473	9	30	.030

Notes: Dependent variable: Linkage_short_medium_term; ^aDesign: intercept + alignment

Table 2 shows more specifically the degree of significance between the dependent variable and the alignment factor, which in this case is 0.020 less than 0.05; therefore, theoretically, the null hypothesis is rejected and the alternative hypothesis is accepted, this implies a relationship between the degree of alignment of the objectives of the Annual Operating Program and the fulfillment of strategic planning.

Table 3 Test for intersubject effects

Origin	Type III sum of squares	gl	Average quadratics	F	Sig.
Corrected model	20.074 ^a	9	2.230	2.683	.020
Interception	212.243	1	212.243	255.337	.001

Alignment	20.074	9	2.230	2.683	.020
Error	24.937	30	.831		
Total	458.889	40			
Total corrected	45.011	39			

Notes: Dependent variable: Short_medium_term_linkage; ^a R-squared = .446 (adjusted R-squared = .280)

The second hypothesis is related to the level of specificity with which the Annual Operating Program is prepared and the attention to the university's substantive and administrative functions.

Again, the ANOVA is calculated between the level of specificity, the level of breakdown (article, item or chapter), and the substantive and administrative functions.

Table 3 Dependent variable: compliance. Leneve's test for equality of error variances^a (tests the null hypothesis that the error variance of the dependent variable is equal between groups)

F	df1	df2	Sig.
9.573	2	37	.001

^a Design: Intercept + specificity + Variable 32

Table 3 shows Leneve's test of equality, which indicates the variances of the three factors: compliance with the substantive and administrative axes of the university, specificity and breakdown (variable 32), in general; in which it is observed that the variances between these factors are not equal, since the level of significance was 0.001 less than 0.05.

Variable v32 collects information regarding the degree of breakdown with which the Technological Universities elaborate their short-term planning. The results of this variable are shown in Table 4.

Subsequently, and similarly, the ANOVA is calculated in which the three factors: specificity, disaggregation, and compliance.

Table 4 Dependent variable: compliance, Variable 32

Variable 32	Mean	Standard error	95% confidence interval	
			Lower limit	Upper limit
Chapter	3.046 ^a	.253	2.533	Chapter
Item	3.429 ^a	.445	2.527	Item
Article	4.513 ^a	.466	3.569	Article

^a The covariates appearing in the model are evaluated at the following values: Specificity = 2.6380; Variable 32: At what level of disaggregation is the operational program integrated into your institution?

The results are shown in Table 5, where the degree of significance between the dependent variable compliance and the independent variables: Specificity and level of disaggregation; are less than 0.05. For the specificity factor, the level of significance is 0.001, and for the disaggregate factor (variable 32), the level of significance is 0.035, which implies that theoretically the null hypothesis is rejected, the alternative hypothesis is accepted, and the degree of relationship between these three factors.

Table 5 Dependent variable: compliance, test for intersubject effects

Origen	Type III sum of squares	gl	Root mean square	F	Sig.
Corrected model	31.294 ^a	3	10.431	10.891	.001
Specificity v32	14.179 7.028	1 2	14.179 3.514	14.804 3.669	.001 .035
Error	34.481	36	.958		
Total	508.000	40			
Total corrected	65.775	39			

^aR-squared = .476 (adjusted R-squared = .432)

3.2. Qualitative Results

The results of the qualitative instruments allowed us to obtain the necessary information requirements to design the Information Management Model for the Annual Operating Program of the Technological Universities of Hidalgo, which is shown in Figure 1. Once the model proposed in Figure 1 is implemented, we proceed to test the last hypothesis related to the evaluation of the model for operational planning of public management, which is the Model current for the Annual Operating Program of the Technological Universities of Hidalgo with respect to the proposed model. For this purpose, the Delphi statistical method is used.

The proposal of the information management model was shared with a heterogeneous group of 13 experts competent in the subject of Operational and Strategic Planning (academics and administrative) with diverse specialties (administration, education, information technology and industrial engineering) with a Ph.D. and a master's degree.

Three rounds were conducted; in the first round, two questionnaires (A and B) were applied to the experts via Google forms; the objective of questionnaire A (with 10 items), was to know the influence of the proposed model on the improvement of the determination of the needs of the Technological Universities; the elaboration of strategies for the integration of the Annual Operational Programs; the quality of their elaboration and their alignment to federal and state public policies; the use of information systems; the achievement of managerial skills and the quality of the organizational forms to develop a culture in the use of information systems.

The purpose of questionnaire B was to perform a self-assessment by the expert concerning experience, theoretical analyzes national and foreign authors he/she has read, as well as his/her intuition regarding the research topic. Then, the level of the competence of the experts was calculated by averaging two factors: the Knowledge Coefficient (Kc) and the Argumentation Coefficient (Ka).

The criteria establishes that operative planning and information systems enable informed decision making and allow better carrying out the prioritization of needs.

The limitations of the application of the results consist in the fact that only one state of Mexico is considered and each higher education subsystem in Mexico presents differentiated regulations depending on each state.

Table 6 Kendall's expert levels of competence W test (The authors' elaboration with Statistical package SPSS® v.22)

Item	Average	Range	Test Statistics
1	5.62	N	13
2	4.31	W's Kendall	0.643
3	4.08		
4	7.15		
5	7.69		
6	2.85		
7	6.77		
8	4.54		
9	2.00		
10	10.0		

^a Kendall's coefficient of concordance. N is the number of experts.

4. Conclusion

The research showed that there is a significant relationship between the alignment of the Annual Operating Program objectives with the Institutional Development Program and the link between short- and medium-term planning.

It agrees with the appreciation of Tarifi that strategic planning is a tool that allows leaders of different types of companies and organizations [28] to achieve business objectives through tactical and operational strategies in the short-, medium-, and long-term [29].

Similarly, it was found that there is a connection between the degree of specificity and level of disaggregation with the fulfillment of the adjective and substantive functions of these institutions; the greater the degree of detail in the elaboration of the AOP, the greater the fulfillment of the adjective and substantive functions of the Technological Universities.

This agrees with the literature when it is mentioned that the elaboration of an AOP at a detailed level, although it is more complex in operation, represents an adequate identification of the needs and inputs required by the substantive and administrative areas of each institution and enables those who execute such planning to establish measures or actions for the optimization of resources [11].

The third alternative hypothesis considers that evaluating the proposed Annual Operating Program model with respect to the current version allows for a comparison of the goals and objectives achieved in both models. Theoretical evaluation, as mentioned above, was carried out using Delphi and Kendall statistical methods to determine the degree of global concordance, which allowed verifying that the proposed model contributes positively to the following criteria:

- Improving the determination of the needs of the Technological Universities of Hidalgo;

- The elaboration of strategies allows the integration of assertive annual operating programs and their alignment with federal and state public policies;
- The use of information systems functions as a means to streamline the process of integrating the information of projects to facilitate decision making and their correspondence to the strategic objectives of the organization.
 - Provides information for subsequent processes in a programmatic-budgetary evaluation system.
 - In the achievement of managerial skills as part of the improvement of the annual operating program integration process;
 - In the quality of the organizational forms to develop a culture in the use of information systems.

In the future, derived from the results of this research, it is suggested the implementation of a new model. Experimental research can be carried out with a post-test design and control group to establish more complete analyses regarding the correlation between the results obtained from an implemented model and the current model.

It is considered that this proposal should be presented to state and federal authorities of the educational sector for its consideration in a pilot phase and its possible replication in institutions that belong to the General Direction of Technological and Polytechnic Universities, both at the state level and in other states.

The limitations of this research are that the proposed model has been limited to the needs of the Hidalgo Technological Universities and for its replication in other types of higher education institutions within the state or at the national level, it will be necessary to expand the research through research - action that allows enriching the factors for the identification of new specific information needs for other types of institutions and in accordance with the programmatic structures of each entity.

This research was conducted from the perspective of the three epistemological axes: the planning axis, specifically at the operational level and its relationship with strategic planning; the information management axis that combines the use of information and IT to support management functions and decision making; and finally, the axis of information systems that is essential for the implementation of the model.

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