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Factors Affecting Process Effectiveness in The Development Of Information Systems: A Case Study

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1. Abstract.

In the framework of the concept of systemic global quality, process effectiveness, the dimension of quality in information systems, is associated to human, social and organizational aspects surrounding the development process thereof [Silva,96]. The field study undertaken is of an **exploratory** nature and included the selection of the organization where the study is to be carried out and the set of projects to be analyzed. The set of variables to be observed was also selected and operational definitions were set forth for each one of them. Data was collected through the use of questionnaires, interviews and group discussions. Finally, the data collected was analyzed combining descriptive statistical methods and qualitative-type analyses.

2. Methodology.

The methodology used to undertake the study included the following phases:

- **Definition of the type of research:** Non-experimental research is empirical and systematic, whereby no direct control exists over the independent variables because they have already occurred or because their manifestations are inherently incapable of being manipulated. In this study, facts of a nature that cannot be manipulated and that have already occurred are observed and therefore correspond to a **non-experimental** type research.
- **Selection of the organization object of the study:** The following criteria were taken into account for the selection of the organization:
 1. A reasonable level of quality in the remaining quality dimensions, to avoid confusion in the results through the presence of serious problems in achieving other dimensions.

2. The presence of a certain volume of projects with participation by various persons.
 3. The commitment of management to achieve the participation required. The foregoing considerations led to the selection of the Unit of Fertilizers (UNF) in a petrochemical complex in Venezuela.
- **Selection of the systems development projects to be analyzed:** The selection of the projects was strongly conditioned by practical considerations:
 1. The availability of leaders for evaluation
 2. The possibility of locating a good part of the persons participating in the projects
 3. The projects had to be almost finished or recently finished
 - **Selection of the variables to be observed:** As was mentioned at the beginning of this paper, process effectiveness is associated to human, social and organizational factors such as work group behaviour factors, the leadership style, the structural and cultural characteristics of the development organization and the users [Silva, 96].

Process Effectiveness In order to determine the factors affecting process effectiveness, it is of utmost importance to observe the degree of process effectiveness achieved in each project analyzed. Only the immediate results were considered, which are **the level of individual satisfaction of the participants in the development process and the quality of the human relations among said participants** [Silva, 96].

Group Behaviour The process of developing UNF information systems is an activity involving mixed work teams integrated by analysts and users. Therefore the study shall concentrate on the observation of group elements. Based on the group behaviour elements analyzed theoretically, it was considered that the **group processes** constitute the set of elements with the greatest potential of incidence over the achievement of process effectiveness inasmuch as they refer to the interaction among group members [Robbins, 93].

Leadership style Even though the leadership style is considered to be an element in group behaviour, the importance attributed to this factor and its inherent complexity requires a separate analysis. In this sense, the considerations found about **transformation-type leadership** and its effects on the satisfaction and motivation of the employees are most conclusive [Robbins, 93].

Organizational Structure In the literature reviewed, some proposals were found that should be taken into account. In the particular case of the organization of the departments dedicated to developing and maintaining information systems, a certain **degree of decentralization** was suggested, so as to better.

Organizational culture The cultural gap among users and analysts is a possible source of conflicts in the process of development, which is indicative of its potential relationship to the achievement of process effectiveness[Silva, 96].

Change management elements Various authors stress the importance of an effective management of change processes[Beckhard & Harris, 88], [French & Bell, 96],[Margulies & Wallace, 89].The implementation of a system in the field of information systems implies a process of organizational change that should be managed as such [Davis & Olson, 89] and it is stated that the methodologies for developing systems in general do not contemplate an important part of the change management process - the use of strategies for obtaining the participation and commitment of the users in developing a system[Silva, 96].

Technological variables and other quality matrix dimensions Observation of these dimensions was included in order to discard problems relating thereto within the projects to be analyzed, that could be affecting the process effectiveness and that could confuse the results obtained. Product efficiency variables, product effectiveness, process efficiency and satisfaction with the system development process support technology were included to measure other quality dimensions.

- **Definition of the variables:** The variables in the study were defined from a constitutional as well as an operational standpoint. Of all the variables included in the study, the one requiring a more in-depth reflection was **process effectiveness**. The construction of an operational definition of this variable was made through its immediate results, inasmuch as these constitute the part with the greater possibility of observation and measurement: the level or degree of individual satisfaction and the quality of the relations among participants.
- **Selection of the data collection methods:** Three methods were used for collecting data:

1. Personal interviews with the Systems department manager

2. Questionnaires

3. Group discussions

- **Design of the questionnaire:**
 1. **The enumeration of the variables to be measured**
 2. **The review of their conceptual and operational definitions**
 3. **Development of their dimensions and indicators for each dimension**
 4. **The validation of the list of variables:** a contents validation was used.
 5. **The selection of a scale of attitudes:** Likert's scaling method was selected to measure all the variables in the questionnaire. Scales of four possibilities were designed to avoid the problem of central tendency stated by Kendall[Kendall &

- Kendall, 91] and highlighted by one of the valuers as the most frequent problem.
6. **Codification of the answers:** A scale of values from 0 to 3 was used to codify the answers.
 7. **Wording of the questions:** To word the questions the recommendations of Aaker and Day[Aaker & Day, 89] were taken into consideration regarding the use of vocabulary familiar to the interviewed persons, the elimination of ambiguous or vague words, the avoidance of double effect questions, the formulation of questions applicable to the persons interviewed.
 8. **Order and physical design aspects of the questionnaire.**
 9. **The adaptation of the Leadership Profile questionnaire.** The indicators that were of no interest to the research were eliminated from the leadership profile questionnaire, the scale was reduced from five to four values and the leadership profile format was modified to match another questionnaire.
 10. **Validation by the Systems department manager of UNF:** Once the design of the questionnaire was completed, it was validated by the systems manager of the UNF, who eliminated questions that did not apply to the organization, adapted the vocabulary to the terminology that was familiar and suggested pertinent modifications.
 11. **Pilot test:** Once all the modifications were introduced, a pilot test was conducted in order to calculate the instrument's reliability coefficients.
 12. **Calculation of the reliability indexes:** the Cronbach alpha coefficient method was used.
 13. **Final application of the questionnaire.**
- **Application of the collection methods**

Interviews: the interviews to the department manager were conducted in a non-structured fashion, focused towards the extraction of specific information.

Questionnaires: The leadership profile questionnaire and the questionnaire prepared in this work were applied jointly and were self-administered.

Group discussion: The group behaviour variables (decision style, communication pattern and strategies of influences) were also included in the questionnaire.

- **Selection of the analysis of results method:** Descriptive methods were employed to independently describe the different variables taken into account, as well as to compare the measurements of two or more variables.

In order to describe individually the values of the variables, the following analysis methods were used: distribution of frequencies, tables and graphs, central tendency measures (*average, median*), variability measures (*range, standard deviation, variation coefficient*). In order to determine the existence of relations among the variables, qualitative analyses were used together with dispersion graphs so as to illustrate the relationships found. In order to determine the existence of cultural differences among

analysts and users the crossed tabulation method was used, whereby a comparative analysis is made of the frequencies observed in the values of a variable measured in two or more groups. Fisher's test was also applied.

3. Conclusions

A series of variables to be observed was selected as well as the decision-making style, the communication pattern, predominant influence strategies and the leadership type. Also selected were the structure, organizational culture and the presence of change management elements. The study-dependent variable was development process effectiveness. An operational definition and a specifically designed questionnaire were used for this study as data collection methods, arising from the observation of the variables. Descriptive-type statistics and qualitative analyses were used for data analysis. It was determined that the decision-making style and the communication pattern among the members of the group constituted possible factors affecting process effectiveness. It was found that homogeneity of the results regarding predominant influence strategies within the groups, did not allow evidence to be found about the incidence of this variable on process effectiveness in the projects analyzed. It was determined that the transformational leadership style favours process effectiveness and that a passive leadership style negatively affects it. No cultural differences were found between analysts and users. Therefore the incidence of this variable on process effectiveness could not be determined. No evidence was found on the incidence of the use of organizational change management elements in process effectiveness. Regarding the organizational structure within the systems department, a broad communications network was observed with a high degree of participation by the employees in technical-type decisions. The information obtained through this research constitutes a valuable contribution to improve the process of developing systems within the organization selected for this study.

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