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Quantitative methodology and mobile technology to evaluate the quality in use of projects-products-services in innovation events through metrics

Metodología Cuantitativa y Tecnología Móvil para Evaluar la Calidad en uso de Proyectos-Productos-Servicios en Eventos de Innovación mediante Métricas

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Abstract

The PROYEVA System is presented, based on international standards (ISO/IEC 9126, 14598, IEEE 1061) and Mexican models (MECHDAV, MECRAD), which allows a comparative analysis of the different projects and products participating in innovation and invention contests. It is based on the determination of the degree of compliance with the following quality characteristics: functionality, usability, as well as quality in use.As part of this proposal, the PROYEVA computational tool is included, which allows the practical application and testing of the evaluation model created, in innovation and invention competitions... allows to generically evaluate the quality of the projects-products before in the mentioned competitions.

Moquality report, Technical evaluation of projects-products, Creativity contest, Quality in use, External metrics

Resumen

Se presenta el Sistema PROYEVA, basado en estándares internacionales (ISO/IEC 9126, 14598, IEEE 1061) y modelos mexicanos (MECHDAV, MECRAD), que permite un análisis comparativo de los diferentes proyectos y productos participantes en concursos de innovación e invención. Se basa en la determinación del grado de cumplimiento de las siguientes características de calidad: funcionalidad, usabilidad, así como calidad en uso. Como parte de esta propuesta se incluye la herramienta computacional PROYEVA, que permite la aplicación práctica y prueba de los modelo de evaluación creado, en concursos de innovación e invención... permite evaluar genéricamente la calidad de los proyectos-productos antes en los citados concursos.

Informe Moquality, Evaluación técnica de proyectos-productos, Concurso de creatividad, Calidad en uso, Métricas externas

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Introduction

At present it is not easy to face making a judgment on projects that belong to disciplines that are not mastered or to areas that do not correspond to the evaluator's professional training. On many occasions, hasty and light decisions have to be made to determine the quality in use of a project based on subjective criteria, and that do not allow an objective evaluation of the different aspects that make it up.

A methodology and a technical evaluation model of the Quality of the Participating Projects in Innovation contests are proposed through the implementation of a Quality Metrics Plan and the use of software, which serve as support for the evaluators (jurors in certain contests) to issue a more accurate ruling. The PROYEVA model is presented, based on international standards [IEEE610,1994], [IEEE1061,1992], [ISO 9000-3,1991], [ISO/IEC9126, 1997], [ISO/IEC 14598,1998], [ISO 9001,1994], Project SQUARE [ISO 25000,2005], [SUMI, 2000], as well as in other Mexican models (MACS [Gutierrez, 2002], MECHDAV [Vargas-Gutierrez, et al, 2004, 2005, 2006], MECRAD [Vargas, et al, 2008]).

There are various standardized models that serve as a guide for organizations in measuring characteristics that allow them to access a high level of quality in their products and projects.

It is necessary to adjust them, theoretically and practically, to obtain a qualimetric model for the purpose of evaluating and measuring quality characteristics. In these cases, a comparative analysis of several products and projects serves to help decide which one will be selected as the best in terms of its quality in use.

A project can be defined in terms of its distinctive characteristics. Projects are developed at all levels of the organization. These can involve a single person or thousands.

Criteria for the elaboration of projects

1. The project must be realistic above all.

2. Estimate the experimental skills you have in the selected field.

3. Know the basic principles, involved in the project.

4. The estimated time for the complete completion of the project.

5. Lavailability and commitment to work on the project.

6. Analyze if there is the possibility of having external support in the consultancy of the project.

7. Consider the innovative aspect, since the construction of apparatus can be new in its design or because it constitutes a modification of an existing one.

8. Take adequate safety measures to avoid accidents.

9. Thorough elaboration of the protocol of the project to be developed.

10. Estimate of the approximate cost of the project.

Theoretical foundations

Due to the importance of having high-level professionals, teachers, developers and people capable of providing a technical scientific benefit to society, events are created through which creative activity is promoted. This is how creativity contests appear, where projects developed by different organizations and companies are presented and demonstrated. The following description shows how a project should be elaborated in a general way [Solleiro,1994].

The problem

Lo First of all, what is of interest is to know what will be investigated: Why? What for? What is the value or importance of the fact or phenomenon to be investigated? In addition, if the problem to be solved has criteria of priority, novelty, opportunity, conformism or behavior. This statement is subdivided into the following parts:

- Descriptive title of the project.

- Formulation of the problem.

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- Research objectives.

- Justification.

Limitations

Marc reference

It is important to distinguish in the project the close relationship between theory, the research process and reality, that is, the environment must be defined. The research can initiate a new theory and point to different points of view, paradigms or hypotheses; reform an existing one or simply define more clearly, existing concepts or variables that cause some kind of discrepancy or errors in their application. Within the frame of reference, the following points should be mentioned:

- Theoretical underpinnings.

- History of the problem.

- Elaboration of hypotheses.

- Identification of the variables.

Methodology

The methodology to follow is not necessarily so strict or marked and in some types of projects guidelines are given to follow; For example, in a project oriented to the administration, it will not necessarily have to follow the same methods or techniques for its elaboration as a project of a technological nature. Within the general form of project development, the following points are considered in its methodological part:

- Design of data collection techniques.

- Population and sample.

- Analysis techniques.

- Tentative analytical index of the project.

- Field work guide.

- Administrative aspects

They are of greater importance in those projects that need to obtain financing, total or partial, of a political, economic or social nature. At this point, aspects such as:

There must be a Technical Committee, which reserves the right to evaluate and admit the ideas presented and not admit ideas that are not aligned with the specific objectives and with the spirit of the contest initiative in question. The participation of a group or any of the members and the number of ideas to present has no restrictions, that is, several innovative ideas can be presented by the same group or by some members of the group.

Contest policies

- Human Resources.

- Budget.

- Schedule.

References

These references are important to consult previous works and create the state of the art in the respective areas of each project, as well as to know the origin of the relevant information related to them.

Project competitions

Anyone who has an innovative idea to turn it into a development project can participate in them. The idea should preferably be supported or grounded technologically and may be the result of the inventiveness of a person or a group.

Projects can be of various types: scientific research, technology development: new products, processes or services, or improvement of existing ones, etc. These must be feasible to be incorporated into the national or international production environment and must also meet each and every one of the requirements indicated below:

- Lot obtaining new products, processes and services, or improving existing ones, considering an effective technological transfer of the results, from the institutions that carry out research and development to the producers and marketers.

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- These entities that carry out research and development activities in the country, with companies and other national or foreign entities, producers and marketers of products, processes and services, must contribute to raising the knowledge and level of human resources and infrastructure with which the country counts, in the area of science and technology.

- A higher knowledge and better infrastructure scientific and technological and this sand translate and technology businesses that benefit institutions proponents a productive business that increase the competitiveness of and companies gene Ren be significant economic and social benefits for the country.

- Research and development must allow the obtaining of innovations that generate technological and productive businesses that produce significant economic and social benefits for the country. Its results and expected innovations must have a positive or neutral environmental impact.

- These Resulting innovations must contribute to solving internal problems or deficiencies and/or satisfy or create internal or external markets and must be clearly differentiated from alternative options that may already exist in the national and international market or that are of public knowledge, which will be available in the medium term.

- Especially, the project will be evaluated and qualified in terms of:

- Generation of new scientific knowledge.

- The generation of new and/or improved technologies and their potential uses (patents, technological packages).

- The generation of new lines of research and development.

- The carrying out of project activities by professionals who carry out doctoral, post-doctoral and master's degrees, preferably in the facilities of the participating companies.

- The quality of scientific hypotheses and technological hypotheses, methodologies, results and their coherence.

- The quality and rigor of the formulation of the project: its fundamentals, the analysis of the national and international state of the art related to scientific knowledge, technology and innovations, search for patents that demonstrate the non-existence of competing products, processes or services , analysis of alternative options to the innovation(s) and its competitive advantages in relation to the alternative options, analysis of related projects presented and/or approved with the contribution of public funds.

- The level of characterization of the innovation(s) and its level of development.

- The quality of the analysis of the applicable national, foreign, or international regulations that are related to the project.

National prototype competition today

The exhibition in contests of projects of a technological, scientific nature and technical prototypes has its peak since the 1990s. Creativity contests are of great importance both for the institutions that opt for an award, as well as for important companies and entrepreneurs who are looking for new ideas and services that provide added value to their productive management.

State of the art

An exhaustive investigation was carried out about the possibility of the existence of systems (software) for the evaluation of projects in terms of quality, focusing on this important issue in quality contests, such as creativity contests or where a project is evaluated. project for technological, scientific, social, cultural, environmental purposes, to be approved by and for society.

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The investigation yielded some results since the subject exists but the beginnings are weakly founded and with another approach; for example, there are specialized master's degrees in the field of quality project evaluation, which allow determining the magnitude of the evaluation results, which are a fundamental element of cost-benefit and cost-effectiveness analyses, widely used in evaluation of projects [Solleiro,1994]. No courses were found that prepare and certify juries to evaluate projects that participate in creativity contests, to direct the aforementioned benefits, and better prepare people as evaluators of the quality of projects.

For now there are some software that are dedicated to the evaluation of projects. Among others are: EvalAs [EvalAs, 2000] (Software for the Evaluation of Productive Investment Projects), the objective of this software is to determine, in the best of cases, the financial feasibility; It can also be used to determine the profitability of industrial, forestry and agricultural production projects. Intecplan [Intecplan, 2004], which only performs the evaluation of Investment Projects, both references have a totally different approach to the purpose of evaluating projects in order to obtain a score to determine the best of their kind in creativity contests. (SEPI)

SEPI allows you to register business units and associate investment projects with them. Each investment project will in turn be able to record the necessary inputs to be able to measure and estimate the degree to which the economic objectives set within the project will be achieved, executing profitability projections that will serve as the basis for determining the economic viability of the project.

The only antecedent as a computational tool found, are the articles presented "Software for the evaluation of the quality in use of projects through a plan of external quality metrics" [Vargas and Peralta, 2006], which showed a protocol of initiation of this research.

Project description

To evaluate projects-products participating in creativity, innovation and invention contests, the application of a metric plan is required within the framework of a methodology and a technical evaluation model of the quality of software products for visual environments, MECHDAV, from which this proposal is derived to evaluate products and projects participating in the contests, within a software in a visual environment.

This program of metrics will be reflected in a new model, with its methodology and evaluation software, PROYEVA - Methodology and Model for Technical Evaluation of the Quality of Projects participating in creativity contests, which will be able to guide the results of the evaluations obtained on the quality in use of a project, and propose actions to improve the process; In addition, it will allow the established process to be controlled, to ensure the quality of the evaluation of these projects to support the juries in the creativity, innovation and invention contests.

Oriented to the quality of products and projects

It is important that the measurements of the projects (products) can be done in an easy and cheap way, and that the result of the measurement can be interpreted in the same way. The way in which the quality characteristics have been defined does not allow them to be measured directly, so it is necessary to establish metrics that correlate these characteristics in a product (project). Each quantifiable internal and external attribute interacts with its environment and correlates with a characteristic that can be established as a metric. The basis on which the metrics are selected will depend on the priorities of the product-project and the needs of the evaluator.

A set of product metrics that can be applied to the quantitative assessment of project quality is examined. In all cases, the metrics represent indirect measures, and quality is never really measured, but some manifestation of it. The complicating factor is the exact relationship between the variable being measured and the quality of the product, which can be measured based on the classification of quality metrics in use.

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Quality in use is the user's point of view of the quality of a system (project or product) and is measured in terms of the result of its use before the properties of the product itself; it is the combined effect of the quality characteristics of the product for the user.

Methodology

For the development of the methodology, there are the following phases:

Requirement's analysis

According to the data collected by the potential users of the products, different people who have participated, both as a jury and as competitors in creativity project contests, have provided part of the requirements, which, when analyzed, refined and synthesized, provide the components and parameters of the system to be implemented.

Process applied evaluation code

To evaluate the quality of a product, the results of the evaluation of the different characteristics need to be summarized. The evaluator must prepare a procedure for this, which separates criteria for different quality characteristics, each of which can be in terms of individual sub-characteristics or lean towards a combination of them. The procedure includes other aspects such as:

Evaluation specification. This part specifies the scope of the measurement, that is, the characteristics and sub-characteristics established in the proposed quality model, and which determine the starting point for the selection of attributes and metrics proposed for the evaluation. Metrics for evaluation. They are grouped according to the corresponding sub-characteristic and attribute and will serve to carry out the evaluation.

Measurement types. They are used to compare the quality in use of the various products-projects to be evaluated. They are represented by discrete evaluation variables of two types: binary discrete elementary evaluation variables and discrete multilevel evaluation variables.

Range of levels for the metrics. The numerical scale to rate each of the metrics is Figure 1.

Value	% Fulfilment	Meaning / Interpretation	Range
1.0	90.100	Excellent	A
0.8	70-89	Satisfactory	B
0.6	50-69	Acceptable	C
0.4	30-49	Poor	D
0.0	0-29	Unacceptable	E

Figure 1 Ranges of metric levels
Source: [Vargas, et al, 2008].

Capturing the results of the evaluation of the quality of the product-projects, both partial and total, is not an easy task, so simple and understandable formats must be chosen to achieve a rapid and reliable assessment of the quality of the different representations of the products. Projects: For this reason, formats such as checklists and simple relationship tables have been chosen. In Figure 2 it is shown in its 42 Characteristic-Factor / Subfactor combinations / / Attribute / Metric, used for the undergraduate and graduate academic level.

Each component of the requirements of which are represented by a metric, according to the application of the possible model, which corresponds to the one with which the project is most related. The projects participating in creativity contests can be classified as:

1. Scientific – Technological.
2. Health and Environment.
3. Socioeconomic, Administrative and Educational.
4. Craft and Cultural.

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Característica / Factor		/ Sub característica / Sub factor	/ Atributo / Atributo	/ Métrica / Métrica
1.1.1.1	F1	/ Proyecto 1	/ Científico-tecnológico	/ A
1.1.2.1	F1	/ Proyecto 2	/ Salud y medio ambiente	/ B
1.1.3.1	F1	/ Proyecto 3	/ Social-Económico-Educativo	/ C
1.1.4.1	F1	/ Proyecto 4	/ Artesanal	/ D
1.1.1.1.	F2	/ Identificación	/ Definición problema	/ A1
1.1.2.1	F2	/ Identificación	/ Hipótesis	/ A2
1.2.1.1	F2	/ Objetivos	/ General	/ B1
1.2.2.1	F2	/ Objetivos	/ Específicos	/ B2
1.3.1.1	F2	/ Alcances	/ Técnicos	/ C1
1.3.2.1	F2	/ Alcances	/ Socioeconómicas	/ C2
1.4.1.1	F2	/ Limitaciones	/ Técnicas	/ D1
1.4.2.1	F2	/ Limitaciones	/ Socioeconómicos	/ D2
3.1.1.1	F3	/ Originalidad	/ Invención	/ A
3.2.1.1	F3	/ Originalidad	/ Innovación	/ B
3.3.1.1	F3	/ Originalidad	/ Otros	/ C
4.1.1.1	F4	/ Factibilidad	/ Técnica	/ A
4.1.2.1	F4	/ Factibilidad	/ Socioeconómica	/ B
5.1.1.1	F5	/ Justificación	/ Técnica	/ A
5.1.2.1	F5	/ Justificación	/ Socioeconómica	/ B
6.1.1.1	F6	/ Formalidad	/ Nivel	/ A
6.1.2.1	F6	/ Formalidad	/ Grado complejidad	/ B
6.1.3.1	F6	/ Formalidad	/ Modelo matemático	/ C
6.1.4.1	F6	/ Formalidad	/ Modelo gráfico	/ D
7.1.1.1	F7	/ Registros	/ Patente	/ A
7.1.2.1	F7	/ Registros	/ Industrial	/ B
7.1.3.1	F7	/ Registros	/ Modelo de Utilidad	/ C
7.1.5.1	F7	/ Registros	/ Trazado Circuitos Integrado	/ E
7.1.6.1	F7	/ Registros	/ Marca	/ F
8.1.1.1	F8	/ Nivel	/ Cobertura	/ A
8.1.2.1	F8	/ Nivel	/ Exposición	/ B
8.1.3.1	F8	/ Nivel	/ Concurso	/ C
8.1.4.1	F8	/ Nivel	/ Foro	/ D
9.1.1.1	F9	/ Producto	/ Terminado	/ A
9.2.1.1	F9	/ Informe	/ Completo	/ B
9.2.3.1	F9	/ Informe	/ Manuales	/ D
9.2.4.1	F9	/ Informe	/ Maquetas	/ E
10.1.1.1	F10	/ Presentación	/ Dominio del Tema	/ A
10.1.2.1	F10	/ Presentación	/ Diapositivas	/ B
10.1.3.1	F10	/ Presentación	/ Video	/ C
10.1.4.1	F10	/ Presentación	/ Animación	/ D

Figure 2 PROYEVA model

Second - once the location area of the project has been chosen, a general procedure proposed by the PROYEVA model (derived from MECHDAV) is proposed by 10.

A characteristic (factors), 26 sub-characteristics (sub-factors), 42 attribute-metrics, which is fully represented by type I., then (a few less metrics) by type II, III, and finally IV, to which several component elements of the model are needed (subfactors and attributes-metrics).

Third, each category or type of project is assigned a score, according to the percentage of compliance with the PROYEVA model, for each and the combinations factors / subfactors / attributes / metrics that corresponds to it, depending on the type of project. The first score assigned is the first metric to be calculated, which is given as follows for each of the types: I =1.0, II= 0.9, III= 0.8, IV= 0.7.

Figure 3 shows a subset of the PROYEVA model, it refers to the type of health and environment project, used to evaluate projects at the primary level and shows the metrics that intervene at this level and in that category.

Critic proposals for this model

To obtain the final grade for a competing project in any category, for each jury, PROYEVA calculates the metrics (equations) of each of the specified points, depending on the type of project to which it corresponds: the value assigned in each evaluation is combined with the rest of each fraction of the evaluated factor, accumulating the partial values, with which the result of each of the 10 factors is calculated. Finally, an equation is applied, which represents the evaluation of all the factors, to obtain the opinion granted by a jury, for the contestant project.

The final score of a project will be the combination of the opinions given by all the juries that take part.

Final evaluation report

When the respective values of the evaluation of the chosen project are obtained, as well as its percentage of quality compliance, the final report of the evaluation is generated, where definitive results and the percentage of compliance are given. A scheme is provided where the points are shown, both where the product-project stands out in quality and where it does not reach it.

It also determines what level of quality it achieves according to the points discussed, and, if required, some modifications are recommended so that this project-product is accepted as a quality project, or if it should be definitively modified and improved. Figures 5, 6 and 7 show the main screens that describe the operation of the system.

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Característica Factor	Subcaracterística Subfactor	Atributo Atributo	Métrica Métrica
1.2.1.1	Proyecto 2	Salud	B
2.1.1.1	Identificación	Definición problema	A
2.2.1.1	Objetivos	General	B
2.3.1.1	Alcances	Técnicos	C
2.4.1.1	Limitaciones	Socioeconómicos	D
3.1.1.1	Originalidad	Invención	A
3.2.1.1	Originalidad	Innovación	B
3.3.1.1	Originalidad	Otros	C
5.1.1.1	Justificación	Técnica	A
7.1.1.1	Registros	Patente	A
7.1.2.1	Registros	Indautor	B
7.1.6.1	Registros	Marca	F
8.1.1.1	Nivel	Cobertura	A
8.1.2.1	Nivel	Exposición	B
8.1.3.1	Nivel	Concurso	C
9.1.1.1	Producto	Terminado	A
9.2.1.1	Informe	Completo	B
9.2.4.1	Informe	Maquetas	E
10.1.1.1	Presentación	Tema	A
10.1.3.1	Presentación	Video	C

Figure 3 Subset of the PROYEVA Model Used in competitions at the primary level

In Figure 4, the sample of the documentation of one of the 42 combinations mentioned.

Característica: Factor 9 (F9) Documentación presentada.
Sub característica: Sub factor 9.2
Informe.
Atributo: 9.2.2 Prototipo.
Métrica: 9.2.2.1 Prototipo final completo
Objetivo: Determinar el nivel de la completitud del prototipo final requerido por el usuario del producto del proyecto.
Método: Analizar cada parte del prototipo para determinar la completes que debe contener que debe de contener para que el prototipo final se considere completo.
Fórmula: X=C
Medidas: C= Nivel de completitud del prototipo final **Evaluación:** E(x)= {(0,0), (0.4,40), (0,6, 60), (0.8,80), (1,100) } **Interpretación:** Nivel de completes del total de las partes del prototipo
Final 0<=X<= 1; lo más cercano a 1 es lo mejor.
Fuente de referencia: MECHDAV.

Fórmula para calcular el puntaje de la característica total Factor 9 (F9)
(A, B)= { (0.4, 40), (0.8, 80), (1,100)}, D= { (0.0), (1,100) }

Fórmula: $\overline{X} = A^{x} [C+D]^{*}B$

Figure 4 Documentation of one of the 42 metrics used within PROYEVA

Results, conclusions, and future work

The project is finished in its first phase, which covers the complete model and its methodology for the technical evaluation of the quality of the projects participating in creativity contests through the application of quality metrics in use (PROYEVA). The first prototype of the software was also developed, which is the proposed tool for a jury to efficiently evaluate the quality in use of the participating projects in a given creativity and innovation contest, with four intellectual property registries.

Tests are currently being carried out on the second PROYEVA software prototype with new registrations or software patents.

The software will allow to give a very generic technical evaluation, based on the quality in use, the creativity and the application of the project. The evaluation focuses on very general aspects, so an opinion can be issued on any project and at any level, in order to give a reliable decision as a jury of creativity, innovation and invention contests. Complementary manual evaluation formats are provided for these contests, for various juries, for various applications (academic levels: primary, secondary, high school, undergraduate and postgraduate, and at each of these levels, introduce a craft category).

Figure 5 Welcome screen and Start to the PROYEVA system

Figure 6 Evaluation view with the points to be evaluated of the ruble Statement of the Problem

These manual evaluation formats are used for the traditional evaluation of each project, in each of the stages. At the end of evaluating each project, each point can be captured in the PROYEVA system, so that the results are given automatically, quickly and easily, avoiding the known setbacks and customary deliberations.

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Figure 7 Results view of evaluation of a project

This prototype is proposed for the creativity contests that are held in: the National System of Technological Higher Education, for the state contests organized by the different universities, for the national contests organized by the National Women's Institute, National Linkage Contests and Exhibitions of ANUIES Projects, among others. The English version PROJEVA is available for innovation events abroad (Figures 8, 9, 10 and 11).

Figure 8 Evaluator data repository, for jury login, in PROJEVA for competitions abroad (English version)

Complementary manual evaluation formats are provided for these contests, for various juries, for various applications (academic levels: primary, secondary, high school, undergraduate and postgraduate, and at each of these levels, introduce a craft category). These manual evaluation formats are used for the traditional evaluation of each project, in each of the stages; At the end of evaluating each project, each point can be entered in the PROYEVA system, so that the results are given automatically, quickly and easily, avoiding the known setbacks and customary deliberations.

Figure 9 Selection screen of the academic level of the project to be evaluated, in PROJEVA for competitions abroad (English version).

Figure 10 Start screen of PROJEVA evaluation items for competitions abroad (English version).

As a finished software product) it can be installed in a multi-user environment, in a WEB environment (client server architecture), with mobile technology.

Figure 11 View of the results of the evaluation of projects with PROJEVA for competitions abroad (English version)

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The model can be adapted for the new project-product-service contests that are emerging in the different government and state agencies, among other contests, such as the project contests of the technical conferences of the Association of Petroleum Engineers of Mexico, section Tamaulipas.

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