Abstract

This article objective is to explain background and functioning of the integral collaborative model for software development (ICMSD). ICMSD is a methodological model to assist custom made software development and it is address to enterprises and expert developers who don’t count with methodological processes well defined to built software. Software development allow information technologies innovate on productive processes in any organization leading to economic growth regionally or in a country. That is why the urge to generate a model for software development small and medium companies. ICMSD proposes five levels to provide the best practices in software development; and it is supported by Project Management Institute (PMI) to generate quality software aligned to organizational objectives. ICMSD considers the evaluation of software quality through indicators validating its functioning, this indicators are based on quality international standards. Finally ICMSD seeks to generate a knowledge database across social business and social networks, to put into best practices software development projects.

Keywords
Strategy, Software, Agile Methodology, PMI, Social business.

Introduction

When we talk about any country’s economic growth, we must take a reference to what allows the rise in a particular area. [7] states that the current economic development stage is based on new knowledge incorporation, and it shows the relevance of inducing innovations to productive processes, as a fact that it is not just techno-economic matter, but also incorporates social, political and cultural processes. Innovation can be seen as the process to translate knowledge into economic growth or social welfare. [15].

The Models role is fundamental in software development in order to promote different software elements reuse and make easier the tasks of different personal roles participating in the process [10]. The use of Methodologies/models agile or traditional in software development is not available in every Project, besides time, Money and effort should be invested in every area in a software development enterprise. Software industry is a young, big size and very dynamic industry, where reasons conducting software creation deifier among actors involved in this industry [18]. In some organizations follow a methodology in software development projects leads to a paralysis-analysis stage. In
other words, invests the majority of efforts in methodology usage and some cases make human resource involve in software process, work entirely to the methodology, instead of using it as a Handy tool, a guide in the mentioned project realization.

Due countries, need to have institutions and organization developing technology, is very important to have models to be followed in software development and required in technological projects [11]. And it is also needed knowing the impact that this models might have in public and private organizations, in result of this needs the principal questions to be answer in this investigation are: 1) How to create a model capable of being the methodological axis in quality software development? And 2) How to develop a cutting edge tool capable of generate custom made software as an aid to public and private organization to promote economic growth in central-western Mexico? With these questions in mind, the proposal is to design and implement a model capable of being the base for software development and helps in attainment of technological projects for Mexico’s central-western region. Fulfilling the following activities: 1) Actual models and methodologies analysis for software development, which will determine the first stages of the new model. 2) Comparison of software industry enterprises, especially those with greater results in technology innovation, methodology use and market orientation. 3) Establishing minimum phases for planning, execution and closure in software development. 4) Implement the model that has the capability to enhance critical points in existent models and methodologies, in an object oriented approach. 5) Validate the theoretical model proposed focused to the software industry study object in Central-Western México.

An enterprising and innovative culture with an adequate social organization is the basis from which to develop the nation’s pyramid of wealth [19]. In figure 1 shows [8] process description, where there is a narrow relation between organization and technology. “Technological considerations” mentioned are responsible for other company areas, which allow a corporative strategy to emerge and produce a technological strategy that will lead to a technical plan that must be followed by the organizations.

increase software engineers’ productivity, help in process control of software development and give developers basis to build high quality software in an efficient way [3]. A methodology defines an easy way to manipulate models, communication and information exchange among all parts involved in a system construction. [4] presents that experience has shown successful projects are administrated following serial processes which organize and then control the project, considering projects that doesn’t follow those processes have a higher failure risk. It is necessary to address the methods importance in projects’ success, but it depends even more in effective communication process, expectations management and people involved in the project. There are different models and methodologies that have been support tools in software development, for instance [16] mentions:

- **Software development model**: A simplified process representation for software development, presented from a specific perspective
- **Software development methodology**: A structured approach for software development including systems models, notations, rules, design suggestions and process handbook.

Project administration has had a great development this last years because the need to be able to administrate a greater number of projects with different characteristics and variables in the organizations, and in addition each project is in a different stage in its life cycle, this represents new and difficult challenges in the companies [2]. Project administration is a discipline capable to manage project successfully, and can and should be applied during the whole project’s life cycle [1]. Each project builds a product, service or unique result, and also they have a beginning, development and end. This information might seem evident, but working with project management is vital this identification of projects stage, because it is the base of what steps should be done and the options that could be present. With this software quality is one of the elements that should be taken care during development stage, having this context integral collaborative model for software development (ICMSD) seeks for the integration structure from “Project Management Institute” (PMI), which ensures customer satisfaction and fulfill closure stage in each project based on integral collaborative model.

**Method**

The project was made in different stages, from the process “model creation and/or preparation” for software development, followed by “model design” and finally the “model implementation” stage, as shown in figure 2. On model creation and/or preparation stage should initiate with research proposal’s processes, project preparation, most popular model and methodologies comparative analysis, parallel to information gathering from different knowledge sources. On model design stage should start with strategic plan definition processes, levels and processes definition, model integration with PMI and quality control. Finally, model implementation stage will allow obtaining generated results from model’s validation and start-up.
The study’s methodological design consists in an exploratory research, non experimental, transectional, descriptive, co-relational and documental analysis-synthesis. This research also has different characteristics: 1) **Exploratory outreach**, as [5] indicates, this type of study is realize regularly when the objective is to examine a theme or research problem that has been studied few times. For explorative studies, the case method is widely recommended, but also the validity of the survey method in explorative studies finds support, because it can help to uncover or provide preliminary evidence of association among concepts [6]. 2) **Non experimental process** because it was made without deliberated variable manipulation, only phenomenon observation in their natural context, for further analysis. 3) **Transsectional** as discussed by [5] the purpose of the investigation is describe variables and analyze their impact and inter-relationship in a particular moment, in other words, data for this research will only be gathered once. 4) **Descriptive**, it involves critical and analytical review of the most relevant results that previous researches have achieved, their conceptual problems and methodological limitations. 5) **Co-relational**, is a descriptive type of study, and has as its main objective determine relationship degree or non causal association exists between two or more variables. 6) **Documental**, because is a process by which scientific methods are applied, and seeks to obtain relevant, reliable and impartial information, to extend, verify, correct or applied the knowledge. And 7) **Analysis – synthesis**, all phenomenon presented to human consideration are wide complex if examine close attention.
Survey design required an on-line form development with the principal variables and questions where open, close, dichotomies, multiple choices and mixed [17]. The focus for this investigation was software industry, specifically center zone of México, defined by the states of Nayarit, Jalisco, Colima Michoacán, Querétaro, Guanajuato, Estado de México, D.F., Hidalgo, Puebla, Tlaxcala y Morelos.

The first step was to determine the instrument’s reliability level based on the study named “Alpha de Cronbach” [12] with the software SPSS from IBM which trough as a result a value 0.812 above minimum accepted value, and getting this value as a representative for the instrument (survey) is reliable. Afterwards the study “Pearson bi-variable correlation” was analyzed by SPSS software to determine relationship degree between variables and organize a hierarchy the data with it.

**Results**

The research yielded the expected answers; the answers considered in the sample, with those it was obtain a significant representation of the answers.

A sector description was built based on the answers and correlations emerged from the study through SPSS, as shown in table 1.

<table>
<thead>
<tr>
<th>Table 1: Pearson bi-variable correlation.</th>
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<tr>
<td>1. There is a positive correlation among organizations that has a wide trajectory in software development and organizations that has over 16 workers involved directly with software development.</td>
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<tr>
<td>2. There is a moderate positive correlation among organizations with workers with university degree and those who work with several programming languages.</td>
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<tr>
<td>3. There is a moderate positive correlation among workers with university degree, uses methodologies, with knowledge in project's administration and those working under process approach to generate quality software.</td>
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<tr>
<td>4. There is a moderate positive correlation between several programming languages “domain” and innovations implemented to produce software with higher quality.</td>
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<td>5. There is strong positive correlation between personal working under process approach and those using methodologies, “basing” project's administration to generate quality software.</td>
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<td>6. There is a moderate positive correlation among organization's personal working with process and using the latest software to produce quality software.</td>
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<tr>
<td>7. There is a moderate positive correlation among organization's personal working with process and those using models and methodologies to produce quality software.</td>
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<td>8. There is a moderate positive correlation between organization's personal “dominating” project administration based on PMI - PMBOK and support gained by PROSOFT in Mexico.</td>
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<td>9. There is a moderate positive correlation between using the cutting edge software and cutting edge hardware use.</td>
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<td>10. There is a strong positive correlation among analysis, design, development and implementation stages with the indicator named “easy to use”, which was identified as the most important quality software measurement.</td>
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<td>11. There is a moderate positive correlation between the “easy to use” indicator and the analysis stage for quality software development.</td>
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Based on empirical study previously obtained, the proposed model was design, which has as its main objective to present serial steps trough five levels to facilitate software project administration in small and medium companies developing software agilely. The five levels shaping the model are:

a) Level 0: Problem detection

b) Level 1: Analysis and Design
ICMSD can be read easily because it has the capability to understand its functioning from upper left part to lower right and up to bottom. Besides is made of processes shapping different levels, following is described those levels functioning. **a) Level 0.** This process allows identifying a problem, and contemplates 3 to 10 meetings tops, to find project’s specific needs and its reach. Generating a reliability and viability analysis in order that the customer realizes advantages and disadvantages of software generation, this type of efforts allows to reduce costs, time and to increase product benefits. **b) Level 1.** This level focuses in the product’s analysis and design, which are the most important stages for the polled enterprises; having in mind that this model will allow an agile software development. Taking into account one of the basic principles of strategic planning, aligning information technology with organization objectives, accomplishing an adequate project’s requirement and specification analysis (software) to be captured in a Work Breakdown Structure (WBS). **c) Level 2.** References to application buildup, looking for divide system development into modules, permitting its making by parts, facilitating the evaluation and testing of programmed modules. Next step should do requirements comparison against prepared modules, the approval to move to next level “implementation” will be based on fulfillment requirements. **d) Level 3.** This level is about system implementation. Different tests should be done related to system functioning, presenting a preliminary delivery to be evaluated by the user, and fix it if need it. Finally it gets to documentation to delivery and post-development processes. **e) Level 4.** The last level references eleven quality indicators, divided in three groups and they are able to measure software quality [14].

1) Integral project’s administration
   - Viability Analysis
   - Reliability Analysis
   - Justification
   - Project constitution agreement
   - Project statement (Project’s preliminary scoping)
   - Stakeholders’ expectations
   - Environmental factors related to project-organization
   - Organization’s assets in the processes

2) Scope
   - Time
     o Requirement survey
     o Scope Definition and activities
     o Scope planning and activity sequence–WBS (Work Breakdown Structure)
     o Methodology
     o Scope Verify
     o Scope Control
     o Risk analysis and response
     o Costs
     o Cost Estimation
     o Project budget
     o Resource allocation

3) Quality
   - Close Process
     o Administrative closure procedure
     o Contract closure procedure
     o Product, service or final result
     o Organization’s assets in the processes (update)
     o Finalized Contracts
     o Project closure
     o Contract closure
In addition to review the first processes described by Project Management Institute (PMI), which integrates specific activities for project success. Integration of PMI’s tasks on the different model’s levels allow to produce a quality job (software). Below is presented the ICMSD’s general structure shown in figure 4.

**Figure 4. Integral collaborative model for agile software development - ICMSD**

**Discussion or Conclusions**
After designing a model to used as model/methodology for quality software development we can mention:

- The empirical study was made analyzing gathered information from interviews with experts in most used methodologies management and data from the best results in software projects within Mexico’s
central-western region enterprises. The most used methodologies and models actually are those referencing agile software development and those with emphasis on work based on processes.

- The empirical study had an online survey generating results to produce a “Cronbach Alpha” study, allows knowing the instrument’s reliability. Additionally the knowledge that enterprises consider their workers should manage all processes in software development, these processes must be based on project administration and implementation of innovators processes, on the other hand it is very helpful to belong to a cluster, because it enhance quality in their projects.

- Correlation analysis throws the variable relationship that conduct to the integral collaborative model design for software development (ICMSD), indicating that there is enough statistical evidence to support the model.

- Analysis and design stages are fundamental to software development, these can be put together and accomplish the process in a more agile way without diminish quality.

- The most important stages for organizations are: analysis, design and development.

- Simultaneously through the empirical study it was known that documentation is still a problem in organization’s projects.

- Based on the empirical study, information analysis from enterprises working with software development methodologies and the different investigations comparison, was made the principal structure of proposed model, named “Integral Collaborative Model for Software Development” (ICMSD). ICMSD adopts the principal processes on “Project Management Institute” (PMI).

- ICMSD walks with experts into software development through five different levels; giving them the best practices. Assisting in generation of software aligned with organizations’ objectives and goals.

- ICMSD proposes a serial of indicator to validate software quality, based on international standards, taking under consideration social network’s contributions improving the processes for project’s development.

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References