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A new decision support system for knowledge management in archaeological activities"☆

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ABSTRACT

The use of Information Technologies (IT) has today become an added value for appropriate decision making. This has contributed to improving the companies' strategies in the market. However, the full potential of these technologies in the relevant field of Archaeology has yet to be fully exploited. To contribute to reducing this gap, this paper presents a new and original design of a Process Maturity Framework for archaeological knowledge and data management which may be applied for high-level timely decision making, supported by an 'IT Governance' reference frame, in order to improve the quality and efficiency of the services provided by the Diagnostic, Prospecting, Monitoring and Excavation processes of the Preemptive Archaeology Program.

This new Process Maturity Model (PMM) takes the processes which are currently established in each phase of archaeological projects as its reference to improve information analysis, reports generation and support decision-making processes, as well as to manage and control the materials and context found in the field. This is achieved by emphasizing the use of the information required for future queries and projections, ensuring its' quality and integrity in order to generate reports more efficiently, whilst also allowing a more agile and timely decision-making process. Said information has been collected during the field and laboratory processes by analysing the proper application and management of the technology from an 'IT Governance' framework in companies which offer archaeological services.

The different phases of the implementation of the model designed, based in ITIL, since it is the most holistic of the current benchmarks in Technology Services Management, are shown by means of a hypothetical, yet real, application of the PMM in an Archaeology Consultancy firm. Thus, a set of basic parameters is initially established in order to implement a PMM. Then, a diagnostic on the processes and IT Service Management applied to each archaeological phase is performed. Afterwards, an evaluation of the current maturity level of the processes is carried out and, finally, the continuous improvement plan is described.

1. Introduction

A Capacity and Maturity Model (CMM) is a simplified representation of the reality. CMMs contain essential elements of effective processes [1]. In the 1930s, Shewhart carried out the first studies to reach 'process improvement' using his principles of statistical quality control. Those principles were refined as time passed and were updated with the intention of being applied to the software within IBM [2].

Maturity models are focused on improving the processes of an organization. They evaluate and analyse all the essential elements to take them from an immature process to a disciplined, mature and effective one. These key elements for evaluation can vary from company to company, depending greatly on the size, structure and activity of the company; thus it is not common to find two equal analyses, they are defined based on the company and not on any class of standards.

The use and application of an IT-based model will allow us to differentiate the current situation from the ideal situation, which leads us to propose a model incorporating the best practices of different standards. At the same time, it does not lead to evaluating which tools or methodologies we should apply within each organization. Focusing on the use of a Decision Support

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System (DSS) as the best alternative for the management of agile and timely information within the different processes, taking into account that different disciplines are involved in a transversal manner.

Currently, there are different models or guides that can help an organization to assess its real state of maturity in different aspects. Initially the Process Maturity Models (PMM) were designed for the software industry, but their application area is very diverse. Within Small and Medium Enterprises (SME) they can be used to assess the growth status of an organization or business processes and they allow constant monitoring at the moment of the organization's transit from the inconsistency of business processes to their optimum level of continuous improvement. Clearly they outline improvement strategies and identify the areas or factors where the organization should focus on. Although there are different models and adaptations to each specific process, within SME the recommended model for its evaluation is the Process and Business Maturity Model. It is adequate given the ease of implementation, does not require expert staff and has flexibility within their processes that allow an SME to evaluate the state of the organization within its four levels [3]. Hence it allows companies to assess the maturity of their business processes and the responsiveness of their organizations to process-based change [4]. Another remarkable example of the implementation of maturity models applied in the measurement of performance, evaluating the need to have adequate performance measurement systems to support business development through the availability of useful and reliable information leading to the correct development of improvement plans can be found in [5].

We will focus on the evaluation of technological processes within an Archaeology Consultancy firm. Although real, the application illustrated is in fact fictitious.

Archaeology in Colombia is a branch of Anthropology that bases its work on the interpretations that are made of the data collected in the field work and the previous theoretical investigations. There are four types of processes in the field within the preventive archaeology programs: Diagnostic (DG), Prospecting (PR), Monitoring (SG) and Excavation (EX), and crucial information is gathered in all of them to develop knowledge about the communities that preceded us. The materials found allow for hypotheses to be postulated about the changes of the human being, so their study, classification and value is of great importance and relevance, as are the decisions that are made regarding them and which enable their safeguarding, without affecting the schedule of civil constructions where the Preventive Archaeology Plan (PAP) is immersed [6].

In Colombia, IT Management within Archaeology Service Companies has been limited to the provision and administration of the infrastructure to support these processes, collecting the information that is used for the analysis and the formulation of hypotheses about the findings. Currently, the management and control of the information compiled during the processes defined within archaeological projects (material culture, soil analysis, topography, and specially both field and laboratory data) are done manually and are too time consuming. This makes it very difficult to rapidly unify all the information about the projects that are being carried out and the archaeological objects that are found.

Therefore this paper reports in an original way the results obtained during the activity of research and analysis of the processes of an Archaeology Consultancy firm, and is structured as follows: first, in the second section, the concepts of the archaeological phases and projects that have applied systems for information analysis are presented. In Section 3 the proposed methodology for the creation and implementation strategy of the maturity model is described. Section 4 is devoted to present the results obtained from the proposed maturity model and, finally, in Sections 5 and 6 the results are discussed and the main conclusions are pointed out respectively.

2. Preliminaries

The originality and novelty of the subject recommends a brief review of the main concepts and advances on the same, which is what the rest of this section focus on.

2.1. Archaelogical phases

The preventive archaeology programs are developed in the phases of Diagnostic (DG), Prospecting (PR), Monitoring (SG) and Excavation (EX). A description of the methodological guidelines that ensure that they meet criteria of technical efficiency, scientific quality, proper management of assets and social responsibility is presented below.

2.2. Diagnostic (DG)

This phase includes the collection of previously existing information, analysis and bibliographic interpretation, as well as dialogue with the inhabitants of the area and private collections. In this phase, the landscape elements that help to characterize the area archaeologically are also identified. This characterization is structured into three levels: low, medium, or high potential; according to the level of ancient anthropic activity that would be expected to be evident. This stage is optional and does not require the request for Authorization of Intervention from the Archaeological Heritage before the ICANH in Colombia.[1]

2.3. Prospecting (PR)

Prospecting is a technique that seeks to obtain the greatest amount of archaeological information from a given area, handling a level of specific analysis capable of creating and/or testing hypotheses [7]. The methodological tool, of a non-destructive nature, is fundamental in the identification of archaeological evidence.

Different types of Prospecting are applied according to the investigative criteria. Extensive, intensive, extensive plus intensive prospecting, probabilistic sampling and directed sampling. Each one is defined according to the size of the area to be surveyed. Within each process, specific areas are selected in which surveys based on statistical patterns are carried out [8].

The factors that are not directly controlled by the archaeologist are generally related to the natural characteristics of the terrain and the archaeological records [9]. The fundamental issue to be addressed is the degree of certainty to identify whether there are archaeological contexts and being able to perform thorough analyses. While it is true that the results need not always be positive, the identification itself should be, especially the association of the corporate and scientific environments.

2.4. Excavation (EX)

The result of the excavation will consist in acquiring all the entities that are entered in the stratigraphic record. Within the excavation phase, the defined archaeological zone is intervened. The purpose of the archaeologist is to obtain associated contexts, i.e. a set of objects that are arranged in relation to each other, in such a way that they identify a social activity carried out in a given time [10].

[1] Decree 763(2009), artícle 55, paragraph 4°.

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