Evaluation of Software Requirements Management Practices in Some Nigerian Software Companies

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Abstract

Software requirements management is one of the key process areas of the Software Engineering Institute Capability Maturity Model Integration (SEI CMMI). It is the process of documenting, analyzing, tracing, prioritizing and agreeing on requirements and then controlling change and communicating to relevant stakeholders. This paper explored the software requirement management practices in some Nigerian software companies. Survey research and action research were the methodologies employed for the study. An abridged version of the SEI Maturity Questionnaire was the main instrument for information gathering. Specifically, a total of thirty (30) Nigerian software companies were involved in the study. The results of the study showed that while high levels of awareness and performance was experienced with some key practices, poor awareness and performance was associated with other key practices. It was suggested that more attention be paid to proper inclusion of system requirements management processes in written organizational policy, and adequate training be provided for concerned personnel.

Keywords: *Software Process, Process Management, Software Requirements Management, Key Practices, Nigerian Software Industry, Capability Maturity Model Integration*

I. Introduction

Developing countries have the potential of deriving many significant benefits such as job creation and foreign exchange from the production of software [1]. Nevertheless, many of the software companies in developing countries major in selling their products and services to domestic markets rather than the international market. This is a situation of typical survival strategy rather than one aimed at fostering development.

Nigeria is a federal republic in West Africa comprising of approximately twenty percent of black Africa's population and having a typical African state profile with regards technological infrastructure and human development indicators[2]. Bearing in mind her large population, Nigeria constitutes a strategic market for software applications in the African continent and her software industry plays a strategic role in the West African software experience. Solutions and software systems of different kinds solving diverse varieties of real world problems, including natural language grammaticality problems, are continually been developed within the Nigerian software ecosystem, making research into the adopted software process in general, and requirement management practices in particular, very important [3][4][5][6].

The studies of Aregbesola, Akinkunmi, and Akinola [7] and Aregbesola [8][9][1]on software processes employed by software companies in Nigeria revealed a high dependence on formal software methods developed within the organization rather than reliance on industry standards. Corresponding observations were made in comparable studies affecting other developing countries such as Turkey [10]. It was similarly shown that several software systems in developing countries experience some form of total or partial failure because of a design-reality gap resulting from the nonexistence of a functional software process model or the deployment of an immature one. Similar to the study by Sowunmi*et al.*[10] and Aregbesola and Onwudebelu[11]comparing software quality assurance practices in Turkey and Nigeria, Aregbesola, Akinkunmi, and Akinola [7]evaluated the Nigerian software industry and placed the maturity of the software process of her companies at the CMMI maturity level 1. This is a situation that needs to be remedied if significant exports of her software products will be achieved.

The current study is focused on evaluating the performance of the Nigerian software industry on one of the key process areas of the Software Engineering Institute Capability Maturity Model Integration (SEI CMMI), the software requirements management. Software requirements management is the process of documenting, analyzing, tracing, prioritizing and agreeing on requirements and then controlling change and communicating to relevant stakeholders. Software requirements management is a continuous process throughout the lifetime of a project. A requirement is a capability to which a project outcome (product or service) is expected to conform. The main idea of this paper is to explore the

software requirement management practices in the Nigerian software industry.

II. Background Study

The role of requirements management in Software Development Life Cycle (SDLC) is quite significant. Therefore, requirement management (RM) is always considered an essential activity in SDLC. A change in one requirement often has significant effect on other requirements particularly when teams are functioning from different geographical locations. In such scenarios, requirement changes becomes difficult to manage, organize, categorize and track, therefore RM is often considered a challenging activity in the software development life cycle [12][13][14][15].

A number of research works have concentrated significant efforts understudying the Nigerian software industry as described in the previous section [7][16][17][8]. Software requirement management usually commences with the collection of requirements of the software systems to be developed from clients [18][19][20]. Requirement elicitation is a very important phase because it is the point at which the main resources (requirements) to be managed are entered into the requirement management process. Requirement analysis is subsequently employed to ensure that the requirements are coherently collected. Requirement specification is employed to ensure that the gathered information is presented in a technical manner useable by the software programmers. The verification phase is employed in making sure that the gathered information is accurate.

In essence, while requirements are collected from users during the elicitation phase, the analyses phase involves analyzing requirement using models from diverse viewpoints for further refinement [21]. The verification phase involves ensuring that the requirements are tested and verified. It is very important that these phases are rigorously implemented because if the source of a bug, an error or failure of software is linked to any of these early requirement stages, it then becomes very expensive and problematic to repair[22].

Although quite a number of frameworks such as customer notification, quick cost estimation, verification of implemented and unimplemented requirements and time complexity have been identified [12], software requirements management still remains a rather challenging aspect of the SDLC.

Yaseen and Ali [13] examined success factors during requirement engineering in context of global software development. They employed systematic literature review in identifying and analyzing success factors in software requirement engineering using diverse research methods such as interview, questionnaire, experiments, case study, and surveys. They performed the systematics analysis of the identified factors across different software company sizes, periods of time, and sub continents, with the aim of helping software companies to better implement requirements. Several works including that of Dehghani [23] have focused on to creating processes for managing the requirements in product development projects.

III. RESEARCH METHODOLOGY

In this section, the methodology employed in this paper is presented. Two major research methods were applied in performing the study. These methods are survey research and action research.

The software requirement management practices adopted by many of the Nigerian software companies were surveyed. The survey was conducted using an abridged version of the SEI Maturity Questionnaire [24] as the main tool for information gathering with particular focus on the requirements management key process area aspect of the instrument. Specifically, a total of thirty (30) Nigerian software companies were studied. The action research was conducted on a select few of the companies to further validate the data collected from the survey.

IV. RESULT

Results on investigation carried out on the Nigerian software industry are summarized in the Table 1 and Figure 1.

Table 1: Responses for the Requirements Management (RM) KPA

	Question (Key Practices)	Responses			
		Yes	**No**	**NA**	**DK**
A	Are system requirements allocated to software used to establish a baseline for software engineering and management use?	61.54%	15.38%	11.54%	11.54%
B	As the systems requirements allocated to software change, are the necessary adjustments to software plans, work products, and activities made?	76.92%	15.38%	0.00%	7.69%
C	Does the project follow a written organizational policy for managing the system requirements allocated to software?	26.92%	50.00%	15.38%	7.69%
D	Are the people in the project that are charged with managing the allocated requirements trained in the procedures for managing allocated requirements?	26.92%	42.31%	15.38%	15.38%
E	Are measurements used to determine the status of the activities performed for managing the allocated requirements (e.g., total number of requirements changes that are proposed, open, approved, and incorporated into the baseline)?	69.23%	7.69%	3.85%	19.23%
F	Are the activities for managing allocated requirements on the project subjected to SQA review?	11.54%	34.62%	30.77%	23.08%
	Average Overall Response	45.51%	27.56%	12.82%	14.10%

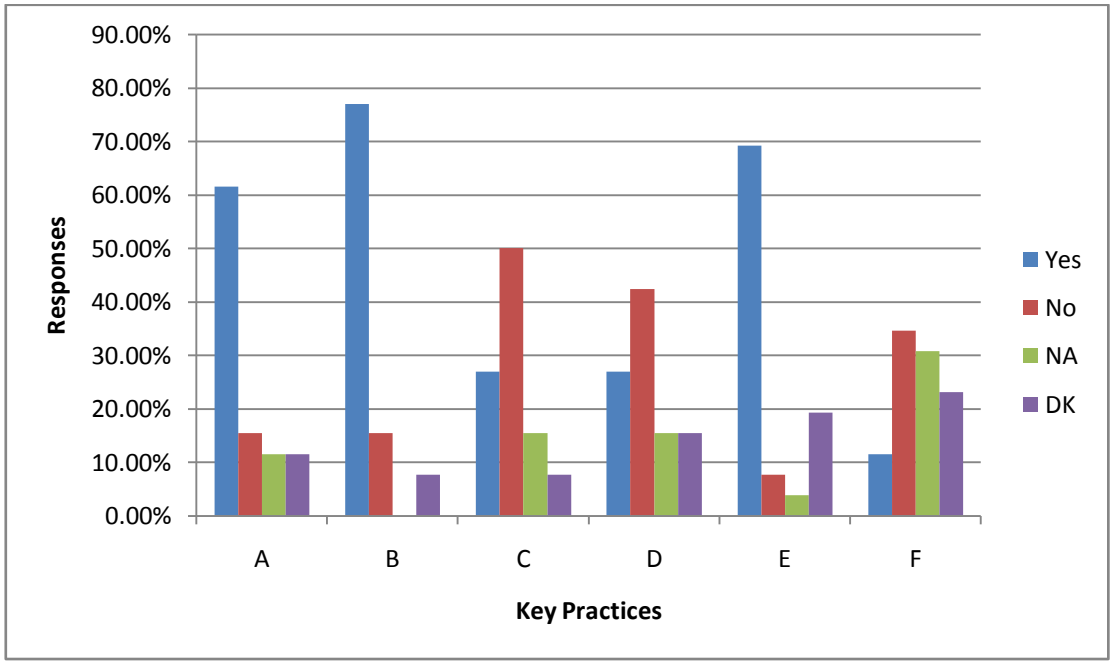

Figure 1: Bar chart of responses against key practices for the Requirements Management (RM) KPA

V. Discussion

The results in Table 1 and Figure 1 show varying degrees of awareness about the key practices of the Requirements Management (RM) KPA. The key practices labeled 'A', 'B', and 'E', i.e. "Are system requirements allocated to software used to establish a baseline for software engineering and management use?", "As the systems requirements allocated to software change, are the necessary adjustments to software plans, work products, and activities made?", and "Are measurements used to determine the status of the activities performed for managing the allocated requirements (e.g., total number of requirements changes that are proposed, open, approved, and incorporated into the baseline)?" respectively, reflect high levels of awareness and performance in the Nigerian software development community. The highest level of awareness and performance was reflected in the key practice 'B' associated with requirement change management, immediately followed by the key practice 'A'.

On the other hand, low levels of awareness and performance was seen in the the key practices labeled 'C', 'D' and 'F', i.e. "Does the project follow a written organizational policy for managing the system requirements allocated to software?", "Are the people in the project that are charged with managing the allocated requirements trained in the procedures for managing allocated requirements?", and "Are the activities for managing allocated requirements on the project subjected to SQA review?" respectively.

VI. Conclusion

Results obtained from this study shows that significant amount of improvement is required in the areas of proper inclusion of the system requirement management processes in written organizational policy. Also, there is the need for people in charge of managing the allocated requirements to be properly trained in the procedures for managing allocated requirements. Finally, there is also the need to pay more attention to subjecting the activities for managing allocated requirements on the project to SQA review to ensure proper implementations.

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