Implementation of CMMI Framework in Small Projects in Small Organizations (An Example of Implementation in Education Domain)

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Abstract—Software Quality frameworks like CMMI and Standards like ISO 9000 are understood mostly as applicable for large development projects in large organizations. One reason for this misconception is the amount of documentation that is demanded by these frameworks/standards.

Education (especially Engineering Colleges) is one area where practices of software quality processes have not yet gained any foothold and offers a highly hostile environment for implementation of any quality framework, even though all the processes/procedures laid down in CMMI or ISO are equally applicable for them.

An attempt is made to bring paradigm shift of developing simple software tools and deploy them in Engineering Colleges to meet certain mandatory requirements. Attempt is made to use the CMMI specific practices and some ISO 9001 specified practices and bring-in the necessary process change management into the education system.

Index Terms—CMMI, education, ISO 9000, SARU.

I. INTRODUCTION

The different standards in technical education in India are set by different agencies like University Grants Commission (UGC), State Technical Education Boards and All India Council of Technical Education (AICTE) through numerous standards like affiliations to universities, recognitions, certifications like NBA (National Board of Accreditation) and National Assessment and Accreditation Council (NAAC) etc. But most of these standards concentrate on infrastructure of the institutes, faculty qualifications and experience, student intake ranks and placements etc as well as on aspects like improvements in faculty qualifications, research, support staff status etc. None of these standards concentrate on the processes practiced or defined in the colleges where as frameworks like CMMI [1] or Standards like ISO 9000 [2] deal with processes and procedures to be followed in day to day activities. Definition and Implementation of such processes/procedures can greatly improve the educational standards, efficiency of teaching, and in maintaining the standards that are demanded by different agencies as listed above.

Jawaharlal Nehru Technological University (JNTU) [3] is one of the world’s largest technological universities providing opportunities for technical education in India and catering to the needs of the state of Andhra Pradesh. JNTU has several hundreds of Engineering Colleges under its affiliation out which more than 90% colleges are run by Private Managements. Most of these colleges are owned by non-academics and run as purely commercial business rather than with any academic interests or with the aim of providing quality education. Hence, manipulations to meet the requirements of the various regulatory bodies are compromised and wide scale manipulations are the usual practices.

Hence, any attempt to standardize any process or practice that is seen as threat to the manipulative power at different levels is considered as a threat to the profit and highly is discouraged by the college managements. There are however few exceptions to these general perceptions where the managements are professional and committed for providing quality education. Ramakrishna [4] describes the challenges posed by some of the hostile environments for process implementation.

As a part of meeting educational standards the university requires two important parameters that need to be measured and satisfied for qualifying students for the next semester are minimum 75% of the attendance of classes held which are relaxed up to a maximum of 10% in case of severe health problems where applicable and the coverage of specified syllabus. The colleges are required to maintain the physical attendance registers of students and report the attendance periodically to the university to determine the eligibility of students for promoting next semester/year. The second requirement of syllabus coverage is met by monitoring the topics covered as per lesson plans prepared at the beginning of semesters and monitored by comparing them with the day to day topics covered in the classes that are recorded in the attendance registers.

To meet this requirement most of the colleges maintain physical records of the students’ attendance which are prone to high level of manipulations at faculty end, data consolidation end and college management level. Even for sincere managements, it is very difficult to monitor the correctness of the attendance maintained by faculty due to the availability of physical records with faculty that are scattered across different departments and located in different rooms or buildings within the college campus. Most of the honest college managements wish to overcome the menace of manipulations and look for cheap solutions as both initial cost and up-gradation cost is of prime consideration due to the limited income from fee and mounting expenses of maintaining the colleges.

An attempt is made in this direction by bringing in some changes in the practices and practiced processes by employing CMMI framework and ISO 9000 standards by
taking up a small project that includes development of simple in-house developed MS Excel Based tool and deploying it across all sections of all classes of all departments through process change management practices of CMMI.

The project of developing such tools qualifies to be a small project and the organization (Engineering College) can be qualified to be a small organization [5], [6]. Implementation of CMMI Framework in such environment is shown to be feasible with some changes/adoptions of practices which highlight the need to tailor these frameworks/standards.

Implementation of simple tools and minor process changes demonstrate the rich gains reaped in the hitherto unexplored domain of education by the quality frameworks.

II. THE PROJECT

The project is to develop a simple tool that can capture the attendance of students and topics covered in each class and make available the information to all stake holders in real time. The tool has to be simple and easy to use by all faculties, especially those who do not have IT exposure, as well as the Data Entry Operators (DEOs). Further, it should be easy to use by the Head of the Departments, Principals and Deans, most of whom were never exposed to any software tools and are not comfortable with online information access. The tool is to be developed in house without any extra resources, has to be easy to maintain and upgrade and meet the managements requirements, customer delighting factors apart from meeting mandatory requirements.

The project has six parts:
1) Requirements gathering
2) Tool Development
3) Training different kinds of stakeholders
4) Deployment of the tool across all departments
5) Data maintenance and
6) Tool updation.

A. The Tool

The tool (called “Student Attendance Record Updation,” ‘SARU’ for short) is a set of simple Microsoft Excel based spreadsheets that are password protected and populated by the different stake holders like faculty teaching the subjects/taking labs, to which others add relevant data. It is small tool expected to bring good change in the attendance process [7].

B. The Tool’s Evolution

Basic Version (V1.0): One XL spread sheet for each month for each section of a class. Each spread sheet contains one worksheet per subject to capture the attendance of students along with topics covered

Revised Version (V1.1): Section-wise Monthly Summary Report for each student is generated for all subjects and labs together.

Version 2: Captures Examination attendance data (Mid Examinations and Supplementary Examinations, each with its own set of rules)

Revised Version (V2.1) Captures Exempted attendance data and presumptive attendance data and generates overall report.

Future Versions: 1) Captures Fee details and alumni information 2) College Level Consolidation and 3) Interfacing with SMS (Short Message Services) to inform parents of students about the day’s attendance

C. The Requirements

The tool has to meet three different kinds of requirements: Mandatory Requirements imposed by University rules Management Requirements and Stakeholder Delights (especially that of management).

The Details of the tool and Details of Requirements are described by Ramakrishna [8].

D. Management Constraints

Development Cost to be nil
Updation cost and tool maintenance cost to be nil
Staff training effort to be minimal
Ease of use
Data updation time not to be more than 5 minutes for each faculty for each subject. Monthly mandatory data entry to be less than 15 minutes at the beginning of each month.
DEO’s time to generate monthly templates for all sections of all classes in each department to be minimal
Availability of the tool for access from staff rooms using intranet.

E. The Stake Holders

- Faculty
- Data Entry Operators
- Principal, Heads of Departments
- Examination Branch
- Accounts
- Student Discipline Committee Members
- Deans
- Computer Science Department

F. Process Changes

Existing Practice: Manual Practices of extracting data from physical registers and generating the report

Proposed Practice:
1) Every faculty has to enter the details in the tool soon after the class is over. DEOs generates the monthly templates for each section
2) Examination branch enters the examination attendance (mid as well as supplementary)
3) Exempted data (Medical and special occasions) is entered by Head of each department Examination Branch also enters presumptive attendance just before the end of each semester as it is common across all sections of all classes of all departments in the college
4) Faculty enters any incident involving students that needs disciplinary action and
5) Student Discipline committee members enter incidents involving students that attract disciplinary actions.

G. Reports

The tool generates different reports like consolidated attendance for the month (that can be directly sent to university and can be displayed for students’ information.

Ramakrishna [8] describes the steps and challenges of bringing-in the change management of acceptance of the
tool and process changes as well as beneficial fruits of successes and acceptance of the tool.

III. APPLICATION OF CMMI FRAMEWORK AND ISO 9000 STANDARDS

Observing the tool development and process change management right from conceptual stage to deployment and enhancement stages, it can be seen that almost 85% of the specific practices of CMMI Version 1.3 are utilized, except for those requiring organization wide processes definitions.

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R1: SP 2.1 of PP: Budget not applicable
R2: Applicable in future when SMS package is planned
R3: SP 2.1 of PI: Needed only when interfacing with SMS package, but interfacing within the product are identified
R4: Formal procedures not written
*A1: Activities Done #A2, A3 Refer Table-2

The Mathematical Model
Adopted in Arriving at the percentage computation of implementing the specific Practices of CMMI in small projects is:

\[ IP = \left(\frac{\text{Total Number of Specific Practices applicable upto a given level}}{\text{Total Number of Applicable Specific Practices}}\right) \times 100 \]

IP stands for Implementation Percentage.

As the implementation of CMMI in Education is attempted on single process on experimental basis the general practices are not considered in the model which are applicable if the implementation is adopted for all the applicable processes.

Table I shows the application status of different specific practices in this project spanning across all the 22 process areas in all the 4 different levels of 2 to 5 of CMMI-Dev V 1.3. Out of total 167 specific practices (SPs), the 6 SPs belonging to SAM Process Area (PA) are not applicable. Out of the remaining 161 applicable SPs 137 (85% of total SPs) are adopted in this project as detailed in this table. The implementation details can be found in [4], [8]. Out of the remaining 24 SPs, 17 SPs can be practiced with some more effort and management’s commitment, covering 96% SPs, but remembering that the procedures are not documented for any of the Pas, but all support documentation like calculation sheets, metrics data captured etc is available in raw form.

Table II gives the details of the 24 specific practices that are not implemented in this project.
In addition to the application of the CMMI Framework, the audit practices as detailed in ISO 9001 standard are implemented for the physical verification of attendance registers as well as to the data entered in the tool by independent audit teams constituted for this purpose.

IV. CONCLUSIONS

Application of CMMI framework and ISO 9000 standard practices into educational field, especially engineering colleges has immense benefits. The specific practices of CMMI can be easily implemented in small projects and small organizations with suitable tailoring to these frameworks, by cutting down the documentation requirements.

REFERENCES


Ramakrishna Seemakurti was born at Visahapatnam, Andhra Pradesh, India on 20th June 1953. This author became a Member (M) of IACSIT. The author has obtained his BE degree in Electronics and Communications Engineering from Andhra University, Visakhapatnam, Andhra Pradesh, India in 1975 and his ME degree in Control Systems from the same university in 1978. Currently he is pursuing his Ph D in Computer Science Engineering from Jagadish Prasad Jahbarmal Technical University, Jhunjunu, Rajasthan, India.

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