A Small Change in Process: Big Leap in Adoption of Software Quality Standards in Education (SARU – An Example)

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Abstract

The paper highlights the need for processes improvements in education, by developing and deploying a small MS Excel based database tool called "Student Attendance Record System (SARU). The tool describes how the existing manual processes having severe limitations of data availability and prone to manipulations are eliminated by a simple tool developed in-house that meets the requirements of the regulating body and high expectations of engineering college managements. Further it highlights how a small process change can bring about excellent improvements in the education system that is usually run on manual processes.

Keywords: Process Improvement, SARU, Software tool in education.

Introduction

Jawaharlal Nehru Technological University (JNTU)[1] is one of the world's largest universities providing opportunities for technical education in India and catering o the needs of the state of Andhra Pradesh. The university has grown so huge that it was split into three universities with the same name affixing the place of its headquarters to each of these universities.

The JNTUH has nearly 300 engineering colleges affiliated to it. More than 90% of these engineering colleges are run by private managements on commercial basis. Hence, maximization of profit and reduction of expenses is the prime concern of the most of these colleges. There are unconfirmed apprehensions among parents and students about manipulations of meeting the different requirements of the affiliating university. One such prime requirement is the physical attendance of students in the classes. The university requires the student to attend minimum 75% of the classes held which are relaxed upto a maximum of 10% in case of severe health problems where applicable. The colleges are required to maintain the physical registers of students' attendance and report the attendance periodically to the university to determine the eligibility of students for promoting to next semester/year. 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 a sincere management, it is very difficult to monitor the correctness of the attendance maintained by faculty due to the non-availability of physical records at one place any time. Another important factor that is required to be captured is the amount of syllabus that is covered at different stages with in a semester and monitor it against lesson plans drawn at the beginning of the semester. 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 which is further compounded by location of the colleges.

Attendance and Syllabus Status Requirements: Mandatory Requirements prescribed by the university: i. Physical attendance of students in every period is to be taken. ii. Syllabus is to be covered as per the norms at different points of time in a semester

Requirements from Management: i. The physical attendance registers are to be taken to the class by the faculty and fill the attendance in every period held. ii. Topics covered during each class need to be written against the period (s) in a day. iii. Data to be consolidated once in a fortnight/month, verified and certified by Head of Department. iv. The attendance status to be communicated to the parents/wardens of students and sent to university as required

Customer (College Management) Delighting Factors

Ability to consolidate the data automatically and show the actual status in real time for effective monitoring. i. Total student strength in college as on date and time, ii. Capturing non-physical (exempted) attendance. iii. Access to data to all the stakeholders all the time, iv. Data security, v. Report generation, vi. Student information capturing (achievements, disciplinary actions, extracurricular activities etc), vii. Permanent Database, viii. Data loss policy, ix. Day-wise syllabus coverage status, x. Accountability by faculty for data entered, xi. Data consolidation at different levels (section wise, course year wise, department wise and college wise) (that can be extended to corporate level and university level with simple programming

techniques), xii. Minimum training effort to train the stakeholders to update the data in the tool, xiii. Minimum effort by the faculty to update the data in the tool, xiv. Data backup and recovery coupled with data loss policy, xv. Data storage, archiving and ready access at any time in the future, xvi. File naming conventions for data storage and retrieval that ensures configuration compliance as well, xv. Any change in process should not cost the management in terms of money or it should be minimum

Requirements to link with data communication channels like SMS to parents giving daily attendance status and other communications.

Data Accuracy Auditing: Existing Environment to meet the mandatory requirements: i. Faculty are instructed to carry the attendance register to the class room and fill-in the attendance and write the topics covered, ii. The physical attendance registers are collected by departmental data entry operator once in a fortnight/month and consolidated report is made by physically entering the data of all the subjects of all the semesters of all years in each department, iii. The consolidated report is verified and approved by Head of Department and sent to principal, university, iv. The attendance of each student is filled manually by DEO in a covering letter and sent to parents of students by post.

In the existing system there is no provision to meet any of the customer delight factors.

Existing Environment available to meet the University and Management Requirements: All manual processes and paper based work

Existing Environment available to meet the Customer Delight Factors: None

Problems with existing Manual System

i. There is almost one day to one month delay in consolidation of the information, ii. At any point of time it is not possible for any higher ups like Academic Coordinator/HOD/ Dean/ Principal/Management to readily verify the attendance as the physical registers are with faculty and faculty are placed in different locations, iii. It is all the more difficult if the faculty is teaching service subject as the faculty belongs to other departments, iv. There is every possibility for the attendance registers to be manipulated at any point of time as the updation and monitoring are not in near real time, v. Also, any incidents about students are not generally updated in the attendance register, v. Some Faculty have the habit of not carrying the registers to the classes, they take the absentees list on slip of paper or some other means and often forgot to update in the actual register or loose the attendance, vi. After the semester is over the attendance registers are bundled and stored in central location. It is very difficult to trace a particular register later,

especially after an year or so. vii. The physical attendance registers have a shelf life and are subject to get damaged due to weathering, pests and other affects. Mostly the physical attendance registers may not be required beyond three years as per mandatory requirements, but the data is required for much longer periods to meet the referencing requirements by industries and institutions about past students of the college and it is to be readily retrievable, viii. Faculty have to be reminded every time to submit the registers in the office for consolidation, ix. It is difficult to get attendance information before consolidation every month, x. Some faculty have the habit of carrying their attendance registers with them when they leave the college for the day, xi. Often disputes arise due to claims made by students and some faculty that are contradictory, xii. Parents/wardens may ask status of attendance of their wards on some particular days in the past (Retrieving past records and extracting the data will be difficult in such cases and cannot be done in real time), xiii. Auditing of attendance registers and corrections are very difficult, xiv. When faculty changes during a semester for a subject, proper handing over may not be possible especially if there is a gap before the new faculty is allocated, xv. It is not possible to accommodate the exempted attendance in the physical attendance records.

Alternatives Available to the managements

i. Use third party ERP packages, ii. Utilize the services of IAAS providers (Infrastructure As A Service), iii. Develop a database management system using free wares like MS Access or iv. Develop simple tools in-house utilizing the expertise and resources available internally and bring the necessary process changes.

One straight deterrent for managements to opt for any of the first two options is the cost to be incurred apart from other considerations of the managements like data security and availability.

In addition to the above considerations, the second option needs coordination among stakeholders to capture the requirements and oversee the tailoring of the ERP package and initial information loading. Moreover, the incremental costs for any feature enhancements or tailoring is a concern for the managements.

The second option has the apprehension of the managements regarding the safety and security of the data that will be kept in third party hands.

The third option needs specialized knowledge to develop and use the package and skills are required by the users to update the data and to generate the reports. Also, it is difficult to capture non-attendance aspects in such databases

The fourth option is the best and eliminates the apprehensions of the management and it will have total control on the tool and

processes. Moreover, it is easy to enhance the tool and make changes to the processes

Advantages of the tool and process change

i. The introduction of the database tool and changes implemented in the processes met all the requirements given in section 2.1 and 2.2 . In addition it met almost all the Customer Delight Factors given in section 2.3. Further it eliminated almost all the problems mentioned in section 4 that existed with the existing manual systems. ii. It made the faculty accountable for the attendance (s)he is maintaining. iii. Any time the attendance is readily available and can be monitored online and information like syllabus covered, student incidents, cumulative attendance and other details are readily available to any one any time online. iv. It can be maintained permanently and the student information is readily available at any future time, even after decades (that sometimes needed for reference or legal disputes). v. Third party errors are reduced (like data updation by DEOs) (Appropriate metrics are given in section 11). vi. It is possible to link the attendance with automatic SMS system to inform the parents/wards daily the attendance of students. vii. There will be no computation mistakes in computing the attendance. viii. Corrective actions can be taken for the backlog of syllabus coverage and to monitor faculty punctuality in taking the classes and monitoring the progress of syllabus coverage. ix. Independent audits by a task team can streamline the entire process and make the faculty accountable. x. All the student achievements and behavior can be accurately recorded day wise that becomes permanent record of student's history that can be seen any time in future. xi. Additional effort needed by each faculty after taking the class is not more than five minutes for updation. xii. The most important benefit is it does not require expertise to update the data and a very brief training of less than an hour is sufficient for faculty to use the system effectively. xiii. The consolidation effort and mistakes are minimized and effort and time needed to generate reports by DEOs is eliminated, xiv. There is no additional cost involved for the management to get all these benefits

Apart from the above expected gains, there are many unexpected gains that have resulted-in by introducing the tool:

Because the students have been informed in the class rooms and the tool is demonstrated in the classrooms, the students are aware what kind of data is recorded and its ready availability to stakeholders. A stern warning to them that any serious misconduct recorded will be reflected in their college conduct certificate has brought a sea change in the behaviour of students both in terms of attending the classes and in terms of discipline. There were many mass boycotting of classes by entire sections of students (mostly from rural back grounds) on different occasions like new cinema releases in the town, birthday parties etc. Such incidents have come down considerably.

Similarly, every month end there used to be pleading by students to the lenient faculty to give them attendance to make short-fall, just before the faculty submit the attendance registers in the department for updation. Now since the students knew that this is no more possible as the data is updated on daily basis and back-dated updation is not possible, the student attendance has improved.

Another great improvement that is seen is the regular update of the physical attendance registers by faculty in all respects like marking the attendance promptly in the registers, entering day wise topics covered in the class. In the pre-tool era, the HoD has to reject to sign the registers every month when they were submitted for signature as there were many lapses noticed in the registers. The number of such reductions have come down drastically showing great improvement in the faculty behaviour.

The tool: The tool is a set of simple XL sheets with built-in formulae and sheet level password protections. Each worksheet captures the student-wise attendance data of one subject for one month and consolidates the subject wise data with the previous months data and gives cumulative data in terms of classes attended, held and percentage attendance. Figure-1 shows part of the XL sheet giving the details captured.

After consolidating subject wise data each month, it generates summary report for the month consolidating attendance for all subjects including labs. Figure-2 gives the section wise summary of all subjects that itself is the report for display and to be sent to university and college management.

Apart from capturing the attendance in the class the XL sheets capture lot many details like:

Incidents with any students that are inserted as comments against the student against the day, Department, course year, academic year, regulations references, lateral entries details, subject, current and previous faculty details, period wise topics covered, scheduled holidays, unexpectedly declared holidays, extra working days, extra classes held, mid examination details, examination attendance details, internal marks, extra attendance entitled by each student (if any), and examination schedules etc.

Full lifecycle processes are followed in accordance with CMMI[2] framework right from capturing the requirements, design, develop, testing, deployment and enhancements to develop the tool and implement the process changes.

The Broad process lines: i. During last week of every calendar month, DEO creates the XL sheet for every section containing relevant details like student names and roll numbers, month etc and places them on the server, ii. Faculty members of each subject will lock their respective worksheet by placing a password to modify the data, iii. On the last working day of the month, each faculty copies the previous month's consolidated data into the sheet for consolidation with current month data.

During the current month, as and when data is updated, the cumulative attendance data is computed, iv. Whenever any data is updated in the attendance column of individual students, it is first reflected in that month's worksheet and then in turn in monthly consolidated sheet combining the attendance of the student in all subjects, v. The examination branch updates the students attendance for mid term examinations and supplementary examinations, vi. DEO updates the exempted data with the approval of HoD. The exempted attendance is given for a number of reasons like presumptive attendance, extra permissible activities like Attending NCC camps, Republic day parades, Workshops, seminars etc, vii. The overall summary sheet consolidates the actual data from physical summary sheet and exam branch datasheet and exempted data sheet and gives the overall attendance details. viii. The data is removed from working area the next working day and placed in another designated place not accessible to users so that no body else can modify the data post dated, ix. Once the monthly audit, based on ISO 9000 standard[3] is completed and the data is approved, then the consolidated monthly datasheets are retained in archives and daily data sheets are removed optionally. The monthly consolidated sheets are retained for future reference, x. The monthly consolidated data is taken on media like CD ROMs and preserved with appropriate marking. One CD per month for college level is sufficient. These CDs are kept under the control of Principal with hard copy signed by him for authentication, xi. At the end of semester, once the final consolidated data is sent to university, all the monthly CDs are bundled together and kept in safe custody apart from maintaining the copies in the server's secured area

While applying the CMMI to such environment, the organization is considered as small (150-200 strength), as mentioned by Andrew Brettle[4] and the project comprising of development of tool, training, deployment and universalizing across the institute are taken as small project and CMMI principles are applied. The paper by Sandra[5] was quite useful in this respect. The paper by Anne Frazier[6] is guiding spirit in developing the tool

The system requirements

i. One machine designated to host the attendance datasheet, placed in the computer lab, ii. Atleast one computer system in every staff room that is connected to the system in the computer lab through intranet, iii. Availability of the system(s) and intranet throughout the working hours of the college.

The data loss policy: At any time, not more than one day data can be lost. (Hence, at the most, the faculty may have to re-enter one day data in case of any loss of file in the central machine).

Results and Metrics

i. No. of pilots conducted: three (one at section level, second at year level and then third at department level), ii. Initial Development Effort of the tool: 15 person days for the first (basic) version, iii. Initial Training effort: 350 person hours (cumulative of all participants spanning over multiple sessions for different roles, number of participants: 190 to 200), iv. Average daily effort by faculty to update the data per subject: less than 5 minutes, v. Average one-time monthly effort to copy the relevant data of last month to the current month by faculty: less than 10 minutes, vi. Gain in DEO's effort and time: (From entering the data manually from each physical register into the system of all the registers of all subjects of all sections of all years, every month) Average: 8 to 12 hrs (based on the sections a department has), vii. Reduction in data entry errors: Average 10 per department (which used to occur due to manual entry by DEOs), viii. Reduction in Average Data entry mistakes by faculty in the attendance registers: 90% (usual mistakes were due to updation of data long after the class is held, sometimes days together)

Conclusion

"SARU', a small tool developed and deployed to bring process changes in capturing and reporting mechanisms of students attendance and syllabus coverage has brought out many benefits, both expected and unexpected. The benefits are enormous to all the stake holders compared to the efforts spent to develop, deploy and upgrade the tool both horizontally and vertically.

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College X

	Extra Working day/Compensating for another working day (Compensating for 16.08.2012, Bandh)

Acadenic Year: 2010-11
JNTU Regulations: R-09   **Department: EEE**
Month Feb-11

	Sunday

Student Attendance Subject-wise

Subject:
Network   **Course:**
Theory   **EEE**   **Year: II**   **Sem: II**   **Sec: A**

	Saturday
	Un-Scheduled Non-Instruction Day

Current Faculty's Name: Fac1

          From(Date): 06.12.2010   **To** (Date): 22.03.2011

	Holidays

Previous Faculty's Name: **From**(Date)   **To**
Notes (Pl. See Comment)   :   (Date):

	Late Entrants (Lateral Entries,promotes)

Sl. No	Name	Roll No	Cumulative upto current month			Carryfoward from Previous month			Current month			Dates									
			ATT (%)	TPH	TPA	ATT (%)	TPH	TPA	ATT (%)	TPH	TPA	1	2	3	4	5	6	7	8	9	10
1	Student1	S1	76.74	43	33	70.00	30	21	92.31	13	12							2	2		
2	Student2	S2	86.05	43	37	80.00	30	24	100.00	13	13							2	2		
3	Student3	S3	58.14	43	25	40.00	30	12	100.00	13	13							2	2		
4	Student4	S4	53.49	43	23	53.33	30	16	53.85	13	7							0	2		
5	Student5	S5	86.05	43	37	80.00	30	24	100.00	13	13							2	2		
6	Student6	S6	60.47	43	26	53.33	30	16	76.92	13	10							1	2		
7	Student7	S7	79.07	43	34	80.00	30	24	76.92	13	10							2	2		
8	Student8	S8	65.12	43	28	63.33	30	19	69.23	13	9							1	2		
9	Student9	S9	51.16	43	22	46.67	30	14	61.54	13	8							0	2		
10	Student10	S10	86.05	43	37	83.33	30	25	92.31	13	12							2	2		

Figure-1
Subject-wise Attendance Summary sheet for a calendar month (dates columns extend upto 31)

College X

Acadenic Year:	**2010-11**	**Department:** **EEE**
JNTU Regulations:	**R-09**	
Month	**Feb-11**	**Monthly Attendance Summary**

Lateral Entries and Promotees

Course: **EEE** **Year:II** **Sem:** **II** **Sec: A**

Notes (Pl. See Comment)

Sl. No	Name	Roll No	Cumulative upto current month			Carryfoward from Previous month			Current month			Subject-wise Attendance							
			ATT (%)	TPH	TPA	ATT(%)	TPH	TPA	ATT (%)	TPH	TPA	NT	MEFA	EC	EM2	STLD	PS1	EM1 Lab	ECS Lab
	Total Periods held during the month			**210**			**118**			**92**		**12**	**15**	**9**	**15**	**12**	**11**	**6**	**12**
1	Student1	S1	74.9	311	233	67.43	218	147	92.47	**93**	86	12	11	9	14	12	10	6	12
2	Student2	S2	85.2	311	265	81.19	218	177	94.62	**93**	88	13	15	8	15	9	10	6	12
3	Student3	S3	69.1	311	215	56.42	218	123	98.92	**93**	92	13	15	9	15	12	10	6	12
4	Student4	S4	59.2	311	184	60.09	218	131	56.99	**93**	53	7	11	4	9	7	9	3	3
5	Student5	S5	76.2	311	237	74.77	218	163	79.57	**93**	74	13	9	9	11	10	7	3	12
6	Student6	S6	65.3	311	203	54.13	218	118	91.4	**93**	85	10	13	9	13	11	11	6	12
7	Student7	S7	78.8	311	245	78.44	218	171	79.57	**93**	74	10	8	9	14	7	8	6	12
8	Student8	S8	68.8	311	214	68.81	218	150	68.82	**93**	64	9	7	9	9	9	6	6	9
9	Student9	S9	52.1	311	162	46.33	218	101	65.59	**93**	61	8	9	8	7	10	10	3	6
10	Student10	S10	88.4	311	275	84.86	218	185	96.77	**93**	90	12	15	9	14	12	10	6	12

Figure-2
Monthly Attendance Summary sheet for a section