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Applying quality tools to improve student retention supporting process: a case study from WOU

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Abstract

Purpose – Student retention is important in the management of any university especially one which is not financially independent. Administrators in such institutions need to investigate ways to improve the retention rate in order to avoid the loss of revenue. One of the methods is to ensure that students are able to follow their study pathway and complete their study on time instead of dropping out. The purpose of this paper is to establish a system that allows the university to monitor the progression of these students and highlight the need for counselling when necessary. It is also hoped that this paper helps to improve the student retention rate using quality analysis tools and add knowledge into factual-based problem-solving methodology.
Design/methodology/approach – This paper is a co-relational study based on secondary data. It is a continuous improvement method adopting the "plan-do-check-action" model. Quality analysis tools adopted are failure modes and effects analysis and process mapping, where both are the quality analysis tools commonly used in solving product design or assembly process issues in manufacturing. Using the case study of Wawasan Open University, the authors will adapt the aforesaid quality analysis tools from design and manufacturing sectors into an open distance learning education design. It is hoped that the identified process facilitates certain functions of the departments of the organisation to be more effective.
Findings – This paper provides a practical approach on the methods to improve the retention rate in a private higher education institute. Stakeholders are more willing to embrace the improvement when there is proper factual analysis to support the plans. A cross-departmental team is formed to brainstorm the various aspects of the process and the potential failure modes. In a resource-constrained environment, prioritisation is important to identify the high-impact problems. It is also important that a mechanism is available to deliver information to the area where decisions and actions can be made. The failure modes are prioritised systematically and the corresponding solutions installed. The end result is a system with the process that reduces interdepartmental inconsistency thus providing students with a clearer visibility of their study pathway so that they can complete their study on time instead of dropping out.
Research limitations/implications – This study is performed within the context of an institute. The generalisation is low. Other researchers are encouraged to explore further.
Practical implications – This paper provides some practical actions for the improvement of student retention in the university. It is hoped that other researchers will be attracted to explore further on using quality analysis tools to solve non-technical problems.
Originality/value – This paper provides a structured problem-solving method in a service-oriented organisation.

Keywords Continuous improvement, FMEA, Student retention, PDCA, Process mapping, Resource constraint
Paper type Case study

1. Introduction

Student retention is an important area that all universities hope to excel at. It contributes towards the revenue of the university by reducing the operating cost to recruit students. Wawasan Open University (WOU) is a non-profit university. Its mission is to provide affordable learning opportunities for all Malaysians. Some students are academically not

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qualified for public universities in Malaysia and cannot afford to enrol in private universities that charge higher fees. These students form the largest demographics among the WOU students. To be able to monitor their performances and to provide timely intervention are crucial to keep them in active learning mode so as to enable them to complete their study pathways. WOU has two learning modes: distance learning and full-time study. The data and processes were taken from the full-time learning mode. Nevertheless, it is expected that subsequently a similar approach can be extrapolated to the distance learning mode. This paper intends to systematically apply suitable quality tools to establish a manageable supporting process for these students.

1.1 Problem statement

WOU operates in a resource-constrained environment. Each department focuses on the tasks defined for the department and has been functioning well as such. However, when a student service process involves various departments such as the faculty member, registry, enrolment and information technology departments; the grey areas between departments are often not well addressed. Another issue with cross-department collaboration is the weakness of information sharing. Manually collected data are often stored in a file at the department and failed to be disseminated to the point of decision making. This has caused lapses in services and frustrations among the affected students. Another problem is the poor visibility of weak students thereby allowing these students to fail beyond the redemption point and subsequently drop out from the university. Figure 1 shows the percentage and count of students facing problems in their studies and having the potential of dropping out for the last six semesters in the university. These are the students that the improved process is trying to address.

1.2 Research objectives

This paper aims to apply a scientific quality analysis tool to identify issues and to find solutions in a higher education institute. This will allow the administrator to identify the students facing difficulties and alert the related departments to take action. The solution is a process that pans across departments' boundary. It is hoped that by the end of the intervention, students' retention can be improved.

2. Problem-solving method

The method used follows the plan-do-check-action (PDCA) model. This is a four-step iterative management method for continuous improvement. Another name for this method is the Deming Cycle. In this model, several quality analysis tools are applied to analyse the data and to formulate objective solutions.

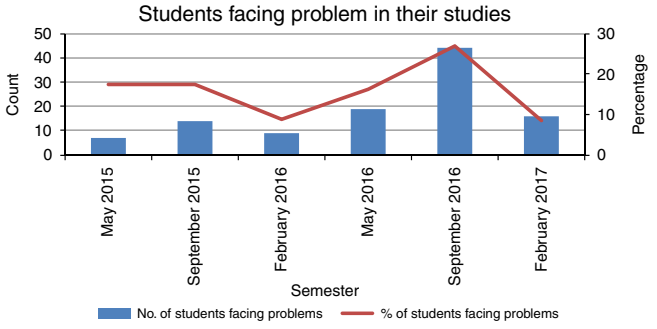

Figure 1.
Percentage and count of students facing problems in their studies who have the potential of dropping out

A cross-functional team from the various unidentified departments is established to review the student retention issue. This is to tap into the expertise of the personnel from the different departments of these different functional areas. Process mapping is done to ensure that all members understand the interaction of the various departments in supporting the process. Then, failure mode and effects analysis (FMEA) is used to identify the critical areas that need immediate attention. There are many problems in any organisation. Due to resource constraints, only problems that are critical should draw attention. FMEA is a tool that allows the prioritisation to be objectively done.

2.1 PDCA

Code of Practice for Programme Accreditation published by the Malaysian Qualification Agency (MQA) provides quality assurance guidelines for institutions of higher learning in Malaysia. The agency is asking institutes of higher learning to pursue continuous improvement in their teaching and support processes. Institutes are required to install a plan, do, check and action processes on the nine areas of operations. The guidelines incorporate the essence of PDCA as a continuous improvement method. So it is appropriate that the method is used in this paper (MQA, 2010). Suarez Barraza and Rodriguez-Gonzalez (2015) applied this method to improve the delivery of operations management in the MBA programme. Their research provides empirical evidence of how continuous improvement cycle (PDCA) enables better results in the students who took the subject of operations management in a business school.

2.2 Process mapping

Process mapping is a workflow diagram that projects a series of processes to complete a job. Process mapping allow clearer understanding among the members of a problem-solving team. The source of the problem can be easily pinpointed and an improved process is mapped.

2.3 FMEA

FMEA is a quality analysis tool commonly used for identifying all the possible failures in a design, a manufacturing or assembly process or a product. FMEA is frequently adopted in aerospace and automotive industries due to the mission critical nature of their products. FMEA has the advantage of prioritising action critical to the process. Not all failures are equally important and not all action plans can be implemented in a resource-constrained environment. FMEA helps to prioritise the action to be implemented based on the severity of the problem, probability of the problem occurring and detectability of existing control measure. These parameters are multiplied to form the risk priority number (RPN). The higher the RPN, the more critical is the problem. In a resource-constrained environment, resources should be directed to solve a critical problem with high RPN.

Since FMEA is a new concept among the team members, a clear procedure for the common understanding of the members is warranted. The process of composing the FMEA starts with the process map. Each step in the process map is identified as a check point to be reviewed by the members. Members of the team need to understand the purpose of this step. The potential failures of this step are identified. This is termed a failure mode. That particular step may need to be micro-mapped if found necessary. After that the consequence of each failure is discussed based on what the students had experienced due to the failure. This is called potential effect. The seriousness of the consequence is then recorded, which is the severity rating (S). For each failure mode, the root causes are identified. Occurrence rating (O) is assigned to each root cause. From the occurrence, one estimates the probability of failure occurring. For each root cause, one adds in the current control process. These are procedures and guidelines that are in place to prevent the failures from reaching the students. For each process control, the

detectability rating (D) is determined. This rating estimates how well the controls can detect either the cause or its failure mode after they have happened. The risk priority number, or RPN, which equals $S \times O \times D$ can be calculated. These numbers provide guidance for ranking potential failures in the order that they should be prioritised (Tague, 2004). Those with the highest RPN should be singled out for improvement. The actions taken are captured in the FMEA format too. The RPN after improvement can be calculated and recorded in the same format. A comparison can be made on the effectiveness of the actions taken.

2.4 Literature review

Student retention is a universal problem. There are numerous literatures covering this topic. Many involve using predictive model or data to improve retention. Bearman, *et al.* (2017) did a study in the Washburn University, Kansas providing evidence that good data analytics and evidence-based practice can improve student retention. One of the initiatives is the creation of a Center for Student Success and Retention. This means that if a university is serious about student retention, resources must be made available to resolve the issue. Similar point is also highlighted by the Hanova Research in 2014 in North America. One key finding is that institutions are concerned over their retention rates, but few allocate the necessary resources to affect long-term change at the institution. Another finding shows the seven variables that affect student retention are academic advising, social connectedness, student involvement, faculty and staff approachability, business procedures, learning experiences and student support services. Effective student support services can have a measurable, significant, positive impact on student retention (Hanova Research, 2014). Another research carried out in South Africa by Prinsloo *et al.* (2010) found that if students are aware of their risk profile, installing risk awareness intervention can help repeaters to complete their studies. Their study also pointed out that there is no grand theory for successful student retention and the findings are context specific. It means that actions that are good for an institution probably may not work for others. Based on these reviews, it is justified that this paper should be taken as a case study approach in WOU; focussed on using quality analysis tools to establish valid actions that provide value for students.

A resource-constrained organisation refers to an organisation with limitations on staffing, equipment and other resources that are necessary for the successful operation and running of the organisation. A resource-constrained organisation does not necessary means lower performance. In fact, research has shown that small organisation can utilise a close interrelationship and trustworthiness to produce above normal competitive advantage (Jones *et al.*, 2014). The universal fact is that for an organisation to remain competitive; the organisation has to improve the efficiency of the operations and process. While organisations find the identification of improvement projects easy, resource constraints often limit the parallel execution of the projects. That is when prioritisation becomes important. Objective prioritisation is more favourable over subjective one because it is perceived as more scientific. The tools for objective prioritisation include Pareto analysis, project ranking matrix, quality function deployment, cost-benefit analysis, analytical hierarchy process and theory of constraints (Kirkham *et al.*, 2014). FMEA and process mapping are being selected as the tools to carry out prioritisation in this case study because they are relatively easier to scale up and down according to the magnitude of the project.

Most of the articles in FMEA are associated with engineering, design process, supplier selection, material quality, project management and medical emergency (Chanamool and Naenna, 2016; Claxton and Campbell-Allen, 2017; Li and Zeng, 2016). There are relatively fewer articles related to education. Kenchakkanavar and Joshi (2010) applied the tool to improve the quality of engineering education in Bangalore (Kenchakkanavar and Joshi, 2010). Kaushik and Khanduja (2010) used the same tool as part of the Six Sigma improvement in education sector (Kaushik and Khanduja, 2010). Chaudhuri *et al.* (2013)

combined mathematical modelling and FMEA to analyse the risk in a supply chain. Mathematical model is for identifying vulnerable subsystem and supplier and FMEA is used to identify the potential failure modes associated with the vulnerable suppliers, and subsequently prioritise those failure modes to create control plans for minimising the impact associated with those failure modes. This approach is quite similar with the approach in this paper. In this paper, the processes are assumed to be equivalent to any engineering processes. The failure mode is defined as the unexpected deterioration of the criteria performance (Li and Zeng, 2016). There are also critiques that view FMEA as complex and that there are many subjective opinions that make scientific decision making impossible. As a result, there are many variants of FMEA that tie with the computing logic to make the RPN calculation more scientific (Paciarotti *et al.*, 2014; Boylan, 2009).

There are many research works that apply process mapping to improve operations. The operations are usually information technology projects, supply chain, business process, etc. It is only appropriate that similar approach is adopted in this paper.

3. Results analysis

A process mapping of student enrolment at the start of a semester until release of examination result at the end of the semester is shown in Appendix 1. Both before and after improvement maps are shown. The "before map" shows the problem points and the after map shows the improvement actions. The FMEA is shown in Appendix 2. The following paragraphs demonstrate problem solving according to the RPN number. It starts with the most critical and gradually works down the list according to available resources. Since WOU operates in a resource-constrained environment, the number of manual follow up, multiple approvals and interactions between departments should be kept at the minimum. On the other hand, information should ideally come from a single source and should be shared among the stakeholders. Part of the FMEA is reproduced in Table I to show the areas that required immediate attention.

3.1 Examination result

The examination result of the previous semester is released in the first week of the semester. This is usually the busiest period in the university. The university has to aggressively recruit new students besides administering existing students who pass the examination to reenrol. At this juncture, it is easy for weak students who fail the examination to slip through the re-enrolment because of lack of advices from appropriate parties. Secondary data taken from 2013 to 2016 are shown in Table II. The data clearly show that weak students would further slip into more disadvantageous stages if no proper intervention is given.

A process is installed where probation students or students who fail to achieve CGPA above 2.0 are called upon to meet the lecturers. Each student is paired up with a lecturer as his or her academic advisor (AA). The advisor's duty is to provide a listening ear, coach the student on proper study technique and help student plan his or her study pathway. The advice given is comprehensive covering how many subjects the weak student is allowed to enrol, when to re-sit a fail paper and the best subject combinations for the student. It is obvious that the advice given has to be uniform across the students. Students will complain if they find out that similar scenarios are given different treatments. To minimise the differences, a meeting is called among the AAs to calibrate the actions taken and to discuss any complex cases. The outcomes provide some certainty to students, and assure registrar that students do not arbitrarily drop or add subjects. As a result, the enrolment process becomes more streamlined.

The guidelines of students under probation are being reviewed too. Previously, the students under Probation 1 are allowed to take similar number of subjects as any other students.

Table I. Part of the FMEA that rank actionable areas

Process step	Potential failure mode(s)	Potential effect(s) of failure	Severity	Potential cause(s)/ mechanism(s) of failure	Probability	Current process controls	Detection	RPN	Ranking
Exam preparation	Student fail to address the requirement	Fail in exam papers	6	Students do not understand key terms in the question	6	Final exam is 60% of the overall assessment	7	252	3
Exam result release	Student fail selected papers or students score low grades	Students unable to progress according to standard study pathway	7	Students are not well versed with the procedures and the avenues for resolutions	6	RC, Registry, Programme Coordinator and lecturer individually carry out his/her task. Lack of coordinated process cause frustration among students	7	294	2
			7	Probation 1 student becomes Probation 2	6	Probation guidelines	4	168	4
		Students unable to progress according to standard study pathway	7	Students may have psychological issue	8	No control, lecturers are inadequate to address the issue. Lecturer has conflict of interest if double up as student counsellor	7	392	1
Student class attendance	Unable to detect students poor attendance	Student absence > 25%	6	Lack of means to detect student attendance	6	Manual attendance taking. Feedback by lecturer	7	252	3

Ever since the statistics in Table II is known, the guidelines are revised so that students under Probation 1 take fewer subjects to prevent them from further slipping into Probation 2 and to improve the survival rate. Since this guideline has just implemented in May 2017, one academic cycle is required to show its effectiveness.

Within the initiative of outcome-based education initiated by Malaysian Ministry of Higher Education, there are many forms of assessment. The type of assessment chosen by the lecturer should match the learning outcome to be achieved. The intention is to lower the percentage allocated to final examination and more to continuous and formative assessments. The objective is to allow proper intervention when weak students fail formative assessment. The assessment system in WOU was skewed towards final examination, tagged at 60 per cent of the overall assessment. The remaining 40 per cent was for formative and continuous assessments. In September 2016, more freedom was given to the lecturer to choose appropriate assessment allocation for their courses. The percentage for final examination was reduced to 50 per cent at February 2017. Table III shows the number of courses with no final examination before and after improvement. There is certainly room for improvement.

3.2 Class attendance

Class attendance is another indicator that allows the university to detect weak students. Weak students habitually cut classes. When attendance is taken manually, lecturers hold the extra duty to monitor the students. They either take action against these students or inform the administrator of any abnormal incidents for further action. Sometimes parents or study grant providers have to wait longer than necessary to understand the performances of their children or beneficiaries.

After the team has brainstormed, an online attendance system was introduced in September, 2016. Lecturers, the deans, registrar and examination office can acquire the attendance rate of each student online. While previously lecturers have to manually tabulate the attendance rate, the online version tabulates the summarised data instantly. Thus, more time can be spent on the actions rather than preparing the data. The various stakeholders as mentioned above share similar data on the student which means action taken are more homogenous. Students can look up their attendance rates from the student portal and take necessary actions to improve their attendance rates.

3.3 Counselling record

Examination result release and re-enrolment for weak students have to be done within seven days. This is a rather short period. AA needs to understand the situation of the students and calibrate the advice given. Then students have to arrange with their AAs for

Table II. Number of students deteriorated in their studies from 2013 to 2016

Status	Headcount (September 2013 to September 2016)
No. of students entered Probation 1	51
No. of students further entered into Probation 2	28
No. of students dropped out after Probation 1	8

Table III. Number of courses without final examination

No. of final examination	Before	After
Count	14	18
Percentage	12	15

counselling sessions. Service centre and registry have to re-enrol the students based on the outcomes of counselling. This means information sharing among the various stakeholders is important. Previously, AA has to manually fill up counselling forms and copies were distributed to the other two departments. This created a time lapse and miscommunication issues were frequent. An online counselling was added in February 2017. AA is responsible to key in the outcomes of counselling he or she have done with the student. The programme coordinator check that the suggested actions are valid and standardised among the different AAs. The information is then released to the service centre and registry for accurate re-enrolment. The information is also released into the student portal for the student to implement the needful actions.

A side advantage from this information sharing is that it allows supporting functions to pull out a student history in order to map out a more effective study approach for the student. Gone are the days where physical records were kept in the students' personal folders without being used as a valuable information source.

3.4 Outcome of the changes

After discussing the changes that have been implemented, it is time to review the results of the effort. Figure 1 that shows the number of students facing problems is plotted again by adding data for May 2017 as shown in Figure 2. It clearly shows that the number of drop out is reduced as the line chart flattens after September 2016.

3.5 Limitations

A number of articles have discussed about the shortcomings of FMEA. The RPN calculation depends on human experience and is not considered a good instrument of measurement (Boylan, 2009; Paciarotti *et al.*, 2014). The Severity, Occurrence and Detection index that have been established are more suitable for product rather than service. Nevertheless, the method is well-established to resolve the engineering issues and should be capable enough to resolve some management process issues. With the formation of a team comprising experts from different functional areas, it is believed that it should be able to resolve some of the management process issues.

The data are taken from a smaller sector in the institution. Actions taken have to be confirmed before being extrapolated to the larger sector.

FMEA is a new tool among the members of the team. It is clear that they are not comfortable with the application yet.

3.6 Institutionalise good practises to other area

Student retention is a universal problem. There are so many papers devoted to the topic; it shows that there is no single solution that fits all. The findings gained from this research add to the knowledge in this field. There are other perspectives to look at such as improving

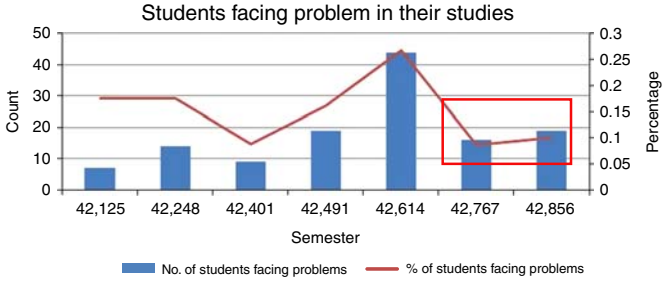

Figure 2.
Percentage of students facing problems in their studies and have the potential of dropping out

student numbers, student enrolment process or the quality of teaching and learning. These could be future research opportunities.

There are many similarities between distance learning and full-time study. Among the actions that have already been implemented for the full-time mode, class attendance is the least relevant for distance learning. Attending class is not compulsory in the distance learning mode. However, since WOU provides comprehensive discussion classes, weak students should seize the opportunities to attend as many classes as possible. The tutors will be able to monitor their study and provide timely support.

4. Conclusion

Continuous improvement is a never-ending process. PDCA is a good method to institute continuous improvement in an organisation. FMEA and process mapping are tools that can provide scientific analysis to implement improvement action plans. The FMEA should not stop here. It has to be continually updated to capture more critical areas for improvement. Action plans that have been implemented have to be monitored for effectiveness and sustainability. There is opportunity to standardise and institutionalise good practices to other areas.

Glossary

AA	Academic advisor
CGPA	Cumulative grade point average
FMEA	Failure modes and effects analysis
RC	Regional center
RPN	Risk priority number (Severity × Occurrence × Detection)
WOU	Wawasan Open University

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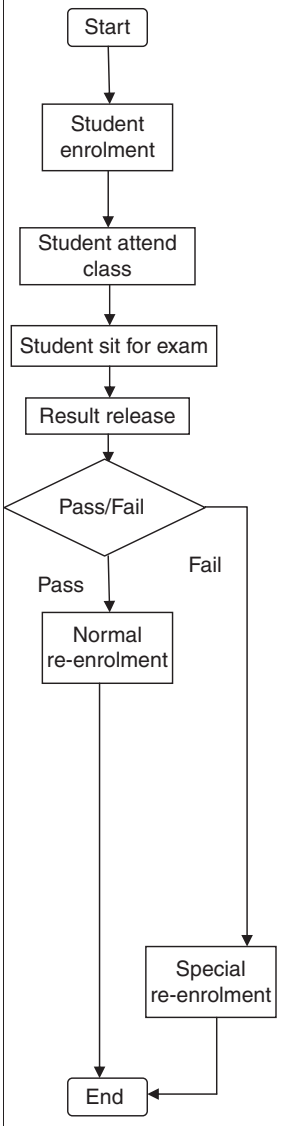
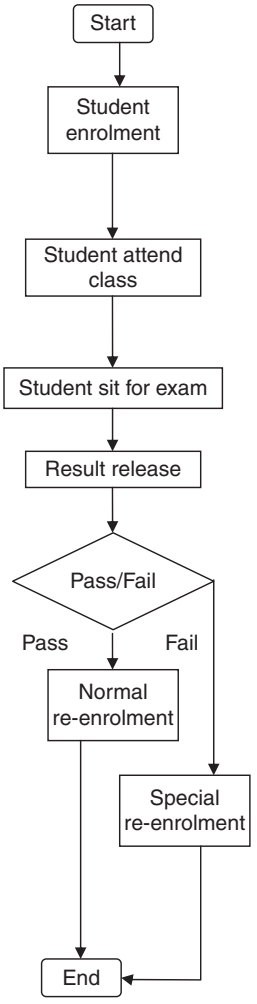
(The Appendices follow overleaf.)

Appendix 1. Process mapping of student enrolment until the release of examination results
Before

Process	Support Activities	Problems that need attention
		
	Student pick subjects from the study pathway, pay the fees at service centre. Manual registration process. Registry check the enrolment meets guidelines	
	Students attend classes. Manually monitor attendance rate, coursework results	Low attendance percentage escape detection
	Students sit for exam	Final exam is 60%
	Exam result is released, CGPA?	The time between results release and re-enrolment deadlineis about 7 days, which is short Weak students are not sure which subjects to enrol for the semester
	Pass students continue normal re-enrolment	
	Weak students need help to decide on next step	Students need advice from the academic advisors Service centre and registry need AA instruction to enrol the students Information transmission among the stakeholders is poor
	Weak students re-enrol, sign up for resit paper Registry check enrolment is correct	

After

Process	Support Activities	Added support activities
		
	Student pick subjects from the study pathway, pay the fees at service centre. Manual registration process. Registry check the enrolment meets guidelines	–
	Students attend classes. Monitor attendance rate, coursework results. Weak students are identified for extra advice	Online attendance taking Analyse attendance data to identify weak students for counselling
	Students sit for exam	Final exam is 50% or 0%
	Exam result is released, CGPA?	Improve the probation guidelines to prevent students from slipping into more disadvantageous stage
	Pass students continue normal re-enrolment	–
	Weak students need counselling to help decide next step	Added AA calibration meeting to standardise the advice given to students Added online counselling to share the information among the stakeholders
	Weak students re-enrol, sign up for resit paper Registry check enrolment is correct	–

Appendix 2. FMEA

System	Weak Student Retention	Potential Failure Mode and Effects Analysis	FMEA Number 1701
Subsystem	Nil		Prepared By Chuah Poh Lean
Component	Nil		FMEA Date 2/23/2017
Project Lead	Chuah Poh Lean		Revision Date
Core Team	Lim Peng Keat, Tan Hong Leong, Chung Mei Ling		Page 1 of

Process Step	Potential Failure Mode(s)	Potential Effect(s) of Failure	Sev	Potential Cause(s)/ Mechanism(s) of Failure	Prob	Current Process Controls	Det	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Results: Actions Taken	Nev Sev	Nev Occ	Nev Det	Nev RPN
Student class attendance	Unable to detect sudentspoor attendance	Student absence >25%	6	Lack of means to detect student attendance	6	Manual attendance taking. Feedback by lecturer	7	252	Establish online class attendance database						
		Student absence >25%	6	Lack of means to detect student attendance	6	Counseling by academic advisor	3	108	-	-	-				
Exam preparation	Student fail to address th requirement	Fail in exam papers	6	Students do not understand key terms in the question.	6	Revision week. Past exam papers filed at the library	3	108	-	-	-				
			6		6	Final exam is 60% of the overall assessment	7	252	Increase courses with 100% coursework. Reduce final exam to 50%						
Exam result release	Student fail selected papers or students score low grades	Students unable to progress according to standard study pathway	7	Students are not well verse with the procedures & the avenues for resolutions.	6	RC, Registry, Program Coordinator & lecturer individually carry out his/her task. Lack of coordinated process cause frustration among students.	7	294	Add a counseling database to share the content of advice given to students.	Chuah Poh Lean, Sep 2016					
			7	Probation 1 student becomes Probation 2	6	Probation guidelines	4	168	Improve probation guidelines to reduce chances of slipping into Probation 2	Chuah Poh Lean, Apr, 2017					
		Students unable to progress according to standard study pathway	7	Students may have pyschological issue	8	No control, lecturers are inadquate to address the issue. Lecturer has conflict of interest if double up as student counselor	7	392	Appoint qualified counselor from external. Preapre referal procedure. Test a real live case.	Dr Naga, 8-May-2017					
Student counseling	Data collected fail to be valueble	Inaccurate service being given to student	7	Manual records take time to be circulated	5	Emails & phone call to communicate actions to be taken.	6	210	Add a counseling database to share the content of advice given to students.						
			7		8		2	112							

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