

Framework Assessment for Costs of Poor Quality in Higher Education Processes

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Abstract--Higher education quality costs are escalating daily and the cost of poor quality is becoming excessive. The higher education department has indicated that inefficiencies within the higher education environment are affecting the performance and the return of investments. This research uses 2011 and 2012 records retrieved on Industrial Engineering department from the Management Information System unit of Tshwane University of Technology, Pretoria, South Africa. It focuses on how cost of poor quality can be categorized within higher education environment, and identifies methods which can be used to minimize these costs with the purpose of improving the performance and return of investments. The paper established the cost of poor quality for the department using the teaching input grant, teaching output grant, research output grant, and institutional factor grants, teaching input unit, student's full credit load and among other factors. The results of this research indicated that USD94,3166.24 and USD933,431.92 were lost for the year 2011 and 2012 respectively on just one department and affirmed that failure cost and preventative costs are the main costs associated with higher education inefficiencies and shortfalls. Thus, Application of lean enterprise or lean six sigma tools is recommended to salvage the situation.

I. INTRODUCTION

Education as defined by Oxford dictionary is "The process of receiving or giving systematic instruction, especially at a school or university: a course of education. Or the act of acquiring knowledge and the theory of teaching and learning." It is the process where someone is assisted in attaining full growth of potentials and the maximum activation of instinct when necessarily needed in performing herculean task and achievement of set goals.

Reference [1] Explained that education's quality is hinged on the graduate products produced from the educational processes which is characterized by defendable mental soundness. They further stressed that when the degree of excellence in education is downward in movement, the quality of such education is said to be falling. Author [3] affirmed that quality education is a skill and knowledge that is potentially able to reflect the level of attainment. He juxtaposed this by giving an instance of standard one pupil which quality of measure requires that at the end of the programme at that level, the pupil should be able to demonstrate the attainment of reading and writing.

Cost of poor quality refers to different costs associated with nonconformity to the process specifications. Identifying these costs helps managers to direct improvement activities and to measure their quality management system [3]. In engineering education these costs are associated with a student not passing the subject when he or she should. Cost of poor quality can be classified in the following categories [3]:

- A. Internal failure costs: costs a company incurs because of the error detected before the output was accepted by the customer's company. This is the cost incurred because not everyone did the job correctly the first time. An example of this type of cost is to be found in process scrapping and reworking. In engineering education these costs would be associated with a student repeating a subject.
- B. External failure costs: these are associated with the customer receiving products or services which do not meet the specifications. These costs are incurred when the appraisal techniques fail to detect all errors before the products or services are rendered to the customers. Examples of these costs are warranty costs; complaints handling costs and product or service liability suits. In engineering education these costs could be associated with a loss of government grant opportunities and industry funding opportunities.
- C. Prevention costs: these are all costs expended to prevent errors from occurring, all costs related to helping an employee to do the job right first time. In financial terms this is not a cost but an investment in the future. In engineering education these costs can be associated with training, tutorials, mentorship and counseling.
- D. Appraisal costs: these costs arise from already completed outputs and auditing the process to measure conformance to customer requirements, in order to establish criteria and procedures. In other words these are costs expended to determine whether the activity was done right the first time or not. Examples of these costs are quality audits, proof reading of documents and moderation.

Cost of poor quality is an issue that cannot be underestimated in education at present and what institutions do to ascertain quality turns out to be most important and effective of all efforts and initiatives.

Author [4] wrote on the continuous quality improvement in higher education in which their work examines the need for continuous quality improvement in higher education; the role of academic statisticians in changes in higher education; some of the strategies and techniques colleges and universities are employing related to total quality management (TQM) at college and department levels; what individual instructors can do in terms of making improvements in higher education; and the role and importance of a personal quality vision in such an overall effort for organizational change with a view of improving quality teaching.

Reference [5] revealed that quality in higher education is an important issue that needs to be addressed due to the

increasing demand by various stakeholders. Mazumder's work integrate the use of six sigma in addressing higher education quality which has been a potent tool used in product and service improvement in the business environment. His work showcased the use of process map with SIPOC (supplier, input, process, output and control), cause and effect analysis, Failure Mode and Effects Analysis (FMEA) for higher education processes. The outcome of the higher education process showed a three sigma (3s) level quality which is an indication that significant improvement is required to achieve six sigma (6s) level.

Therefore this present work which is an illustrative study based on the available data is devoted to framework assessment for costs of poor quality in higher education processes in order to establish the losses associated in poor quality and so as to take possible measures in reducing it if not totally eliminated.

The remaining sections are organized as follows. The methodical algorithm framework of this article is illustrated in Section 2. Implementation of the framework and discussions resulting therein are presented in Section 3. Finally, conclusions drawn are presented in Section 4.

II. METHODOLOGY FOR FRAMEWORK ASSESSMENT

The general methodological framework for assessment is as listed:

Step 1: Calculate the external cost: the external cost is made up of Teaching Input Grant (TIG) and Teaching Output Grant (TOG).

- a. The contents of the TIG are as stated below:
 - i. establish the credit unit per subject, let this be (a)
 - ii. calculate the cost of 1 Full Time Equivalent (FTE) in rand value, let this be "b"
 - iii. note the number of semesters to cover, and let this be "c"

$$\text{Thus, TotalTIGcost} = a*b*c \quad \dots\dots (1)$$

- b. The contents of the TOG are calculated for thus as:
 - i. Record the amount of money received from sponsors/government for TOG, let this be "g"
 - ii. Enter the number of students graduated, let this be "h"
 - iii. Calculate the Teaching Output Unit (TOU) per student, which is h/g

Therefore, the total external costLoss, I = TotalTIGLoss + estimatedTOGLoss(2)

Step 2: Calculate the internal cost

- i. Establish the operational cost per year, "j"
 - ii. Enter number of students, "k"
- Therefore, Total internal cost lost per student, (II) = Operational cost per student per Year = (j/k)(3)

Step 3: Calculate Estimated Appraisal Cost/Student, (III). And this is equal to

$$\text{Estimated appraisal cost per student per year, "e"}$$

Step 4: Calculate the estimated Prevention Cost/Student, "IV" and this is expressed as

$$\text{Estimated prevention cost per student per year, "f"}$$

$$\text{Therefore, Total Costs Loss/Student} = I + II + III + IV$$

The above procedural steps were used in the case study considered in this research, and the cost of poor quality was calculated as presented in Table 1 using the following categories: internal failure costs, external failure costs, prevention and appraisal costs. The data used were obtained from Tshwane University of Technology Management Information System TUT's MIS section. The Department of Higher Education and Training (DHET) determines the money to be paid to the university based on the enrolment plan and actual number of students enrolled for the last two years. According to the TUT MIS, the total grant which TUT receives from DHET is determined by the Teaching Input Grant (TIG), Teaching Output Grant (TOG), Research Output Grant (ROG) and Institutional Factor Grants (IFG) with allocations of 56%, 14%, 12% and 6% respectively [6] and these allocations differ each year based on the enrolment plan. The portion of the money the university loses or opportunity loss is associated with the Teaching Input Unit (TIU) which is calculated by multiplying the weight of the programme given by the DHET guidelines by the Full Time Equivalent (FTE) which is the full load or full credit a student is expected to obtain at the end of the year. For Engineering, (funding category II) 1 FTE is equal to 2.5 TIU; the DHET paid TUT R10, 029.00 for 2011 and R10, 499.00 for 2012 per 1 FTE. Therefore, if a student does not take a full load equal to 1 FTE a department loses money. The majority of the students fail at least one subject per semester, which normally has a weight of 0.083 each. Thus, of the total number of students registered for 2011 and 2012, according to the MIS data, only 10% of the headcount are carrying a full subject load. A calculated 90% of the 380 students failed one subject per semester in the Department of Industrial Engineering which, as a consequence, lost R10,403,123.58 for the year 2011 and R10,295,754.05 for 2012 from the TIG. Details of the cost of poor quality are evidenced in Table 1 for the above mentioned department for the years 2011 and 2012.

For the TOG, the faculty graduation rate was at 14% for 2011 while the Department of Industrial Engineering undergraduate graduation rate was 9.7%, which translates to 37 graduate students in 2011 and 27 graduate students for 2012, which translates to 5.7%. For 2011, if the graduation rate had been 14% then 54 students would have graduated and in the same way, for 2012, making an assumption of a 14% graduation, 66 students would have graduated. The financial implications of this are shown in Table 1.

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TABLE 1: COST OF POOR QUALITY FOR THE DEPARTMENT OF INDUSTRIAL ENGINEERING

Types of Costs		Description	Years	
			2011	2012
External Cost	TIG	Credit unit per subject(a)	0.083	0.083
		Cost of 1 FTE in Rand Value (b)	10,029	10,499.00
		Number of semesters (c)	2	2
		Total TIG cost (a × b × c) in Rand value	1664.81	1742.834
	TOG	Amount of money received from DHET for TOG (g)	710 189	533 627
		Number of students graduated (h)	37	27
		TOU per student (h/g)	19194.30	19763.96
Total External Cost loss (I)	Total TIG loss + estimated TOG loss	20859.11	21506.79	
Internal Cost		Operational cost per year(j)	257 479.64	196 647.73
		Number of students (k)	380	479
	Total internal cost lost per student (II)	Operational cost per student per year (j/k)	677.58	413.13
Estimated Appraisal Cost/Student	(III)	Estimated appraisal cost per student per year (e)	8 381.80	7 684.62
Estimated Prevention Cost/Student	(IV)	Estimated prevention cost per student per year (f)	500	500
Total Costs Loss/Student		(I)+ (II)+ (III) +(IV)	30418.49	30104.54

III. RESULTS AND DISCUSSION

For further and explicit explanation on the cost of poor quality calculated in session 2 of this article, critical to cost metrics were taken as the cost associated with a student repeating a subject. The cost of failing a subject per student as presented in Table 1 amounted to R30,418.49 for the year 2011 and R30,104.54 for the year 2012.

Opportunity loss is calculated by the ratio of FTE and headcount data from the MIS which indicated that 90% of students fail a subject. Using this value, the cost of poor quality for 2011 was R10,403,123.58. This amount is significant but could be drastically reduced, if not completely eliminated, by increasing the quality (the throughput) in the process. It was decided not to use this metric to measure process performance because if the quality was improved then these savings would be realized. Instead, the study focused on improving throughput within the content of each subject, which in turn will increase the graduation rate, resulting in the department being profitable.

The total grant which the university receives from the Department of Higher Education and Training (DHET) is determined by TIG, TOG, Research Output Grant (ROG) and Institutional Factor Grants (IFGs) with allocations of 56%, 14%, 12% and 6% respectively. The portion of the money the university loses is associated with the TIU which is calculated by multiplying the weight of the programme given by the DHET guidelines with FTE, which is a full load or full credit a student is expected to obtain at the end of the year. A single FTE is equal to 2.5 TIU and the DHET will pay the Faculty of Engineering and Built Environment (FoEBE) R10,029.00 for 2011 and R10,499.00 for 2012 per single

FTE. Thus, if a student does not take a full load, which is equal to a single FTE, the department loses funding. The majority of the students at least fail one subject per semester, which normally has a weight of 0.083 each. The total number of students registered for 2011 and 2012 was 380. Assuming that at least half of them failed one subject per semester, the Industrial Engineering department lost R4,623,610.48 for the year 2011 and R4,575,890.69 for 2012 from TIG.

IV. CONCLUSION AND RECOMMENDATION

The results of this research indicated that USD94,3166.24 (R4,623,610.48) and USD933,431.92 (R4,575,890.69) were lost for the year 2011 and 2012 respectively on just one department and affirmed that failure cost and preventative costs are the main costs associated with higher education inefficiencies and shortfalls.

In order to enhance improvements in quality and to ensure that the faculty as a whole gains from this initiative, it is recommended that the following intervention be applied to all departments:

- A. Staff quality assessment: It is critical that the faculty must assess staff quality regularly in order to maintain the quality of the programmes it offers. Since, as remarked, academic staff operate in an environment where they are trusted to do their work with minimal supervision, it is important to do ad hoc assessments to ensure that staff quality remains on par with the expected university standard;
- B. Staff to Student ratio reduction: For lecturers or professors to be able to engage students effectively and give them attention, the lecturer to student ratio will have to be

reduced. Although studies indicated that large groups can be handled effectively through the use of technological aids and additional assistance, student contact is still a major issue where South African students are concerned;

- C. Provision of Financial aid: lack of financial support for students has been cited by many authors as a factor contributing to inadequate student academic performance. For this variable to be addressed, the faculty must seek additional financial support for students, bursaries from private organizations, and non-profit organizations, while government institutions must be solicited in order to increase bursary portions for the faculty;
- D. Change in lecturing style to involve students' engagement.

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