PGDM/ (IB), 2018-20

TQM –Manufacturing & Services

DM-444/IB-516

Trimester –V, End-Term Examination: December 2018

Time allowed: 2 Hours 30 mins. **Max Marks:50**

Roll No: _____

Instruction: Students are required to write Roll No on every page of the question paper, writing anything except the Roll No will be treated as **Unfair Means.** In case of rough work please use answer sheet.

Sections	No. of Questions to attempt	Marks	Marks
A	3 out of 5 (Short Questions)	5 Marks each	3*5 = 15
B	2 out of 3 (Long Questions)	10 Marks each	3*10 = 20
C	Compulsory Case Study	15 Marks	15
		Total Marks	**50**

SECTION A

Q1. What is Juran's Quality trilogy? How does the quality of spiral emphasize the role of the quality function in TQM?

Q2. Mention the five deadly diseases propounded by Deming?

Q3. What is the cost of poor quality (COPQ)? Explain the concept of defects per million opportunities (DPMO) by taking some example?

Q4. What are the 5 Steps of "5S – Concept"? Explain each step in 15~20 words.

Q5. Explain 3 differences between Affinity diagram and Arrow diagram?

SECTION B

Q1.

a. Assume you are a mess coordinator of an institution. You have been asked to reduce the daily waste of mess by 5%.
   i. Create a cause & effect diagram to identify the causes of waste generation.
   ii. Create a Tree diagram to identify the solutions to reduce the waste to achieve the desired result.

b. Identify one problem area in present Indian manufacturing or service industrial environment on which TQM concept can be applied for improvement. Explain the reason of selection in 100~150 words.

Q2.

a. Fifteen samples of size 100 units each are taken from a consignment of integrated circuits (ICs) manufactured by Elen Electronics based at Ghaziabad. The following table shows the results of the inspection of these fifteen samples

Sample no.	No. of defective (ICs)	Sample no.	No. of defective (ICs)
1	9	9	4
2	11	10	17
3	4	11	15
4	1	12	8
5	0	13	5
6	9	14	3
7	12	15	2
8	10		

Prepare the stable tolerance chart for the above data. Also instruct them on the CTQs (possible) they should focus,for reducing the probable white noise?

b. A restaurant conducts a survey to find reason for dissatisfaction of their cust15omers. The following results were obtained

Reason for dissatisfaction	Frequency
Misbehavior on part of waiter	214
Delay in processing the bill	163
Order mixed up	92
Taste of dishes not up to the mark	71
Unaesthetic ambiance of the restaurant	58

Construct a Pareto chart.

Q3.

a. Management is trying to decide whether Part A, which is produced with a consistent 3 percent defective rate, should be inspected. If it is not inspected, the 3 percent defective will go through a product assembly phase and have to be replaced later. If all part A's are inspected, one third of the defectives will be found, thus raising the quality to 2 percent defective.

i. Should the inspection be done, if the cost of inspecting is Rupee .01 per unit and the cost of replacing a defective in the final assembly is Rs.4?

ii. Suppose the cost of inspecting is Rupee .05 per unit rather than Rupee .01. Would this change your answer for part 1?

b. In an agreement between a supplier and a customer, the supplier must ensure that all parts are within tolerance before shipment to the customer. What, is the effect on the cost of quality to the customer? Also if customer is looking for improved tolerance for next cycle of production year, what are the possible practices the supplier should resort to, for improving the tolerance of their produce?

SECTION C

Educational Testing Service (ETS) is a not-for-profit organization whose mission is to provide leadership in educational assessment through testing, research, and related services that contribute to improving learning and teaching, individual and institutional decision-making, access and equity, and public information. By far, the biggest part of its work is to provide admissions tests for colleges and universities. These include the Scholastic Aptitude Test (SAT), the Graduate Record Examination (GRE), the Graduate Management Admissions Test (GMAT), and Test of English as a Foreign Language (TOEFL). Its world of testing has begun to change rapidly. Pencil-and-paper tests are quickly becoming obsolete and are being replaced with computer-delivered versions. Its customers have new expectations. In a world where a customer can place an order for clothing over the telephone and receive his or her order in less than a week, test takers expect rapid service.

The traditional requirement of registering to take a test a month before the test administration and then receiving test scores six to eight weeks after taking the test seems quite unreasonable. Recognizing that it is in a time of rapid change, ETS has, in the last two years, begun to work on a 'corporate self-renewal' effort. As part of the renewal effort, it begun to learn quality improvement, quality planning, and strategic quality planning methodologies.

At the time it began to study the 'cost of quality', it had initiated three pilot quality projects. Although its President had named a Council for Strategic Renewal (consisting of company officers and six high-level staff) to provide direction for the renewal effort, the council had not completed its strategic quality goals. It seemed clear, however, that one of the goals would involve decreasing the costs of providing services to its customers. The cost-of-quality methodology was viewed as a tool to identify projects that would reduce the cost of doing their work. Conducting cost-of-quality studies as a prerequisite to selecting improvement projects is one way to focus efforts on those areas that make the largest contribution to a company's financial performance. Most companies use a set of financial controls to monitor the cost of producing products and providing services, and to determine the efficiency of the production processes. The traditional accounting methods to determine the cost of goods and services produced and sold, fall short in measuring the true cost of producing quality goods and services. Quality-cost measurement provides a yardstick for measuring the cost of processes and the resulting products and services, and for identifying opportunities to reduce costs. Quality costs consist of all costs associated with planning the quality system, those associated with verifying requisite quality, and those associated with failures resulting from inadequate systems. Typical cost studies show woefully low amounts allocated to prevention (0.5- 5.0%), disproportionately high amounts provided for appraisal (10-50%), and failure costs, surprisingly, several times the appraisal costs. Of course, external failures have an exponentially negative impact because of the ripple effect dissatisfied, angry, or poorly served customers can have on a company's bottom line. For the first offering of the 'cost-of- quality' course, the primary objective was to learn the methodology and to identify individuals who might continue offering the course at ETS. As a secondary objective, ETS wanted to identify potential quality improvement projects. The people it selected for the course came from a

number of vice presidential areas and included people who could be future instructors. Its initial 'cost-of-quality' class was offered over a four-month period. There were four half-day classes with homework in between each class. The class proceeded through seven steps- identifying a process, preparing a process flowchart, preparing a step procedure (identifying the steps in the process), classifying the steps in the process, estimating quality costs, preparing a quality-cost report, and identifying process areas for improvement. In order to provide a case study of how these seven steps were actually followed, we shall follow the history of one process that was studied: answer-sheet processing. An answer-sheet is a computer scan able document that the test taker uses to record the answers to test questions when taking a pencil-and- paper test. The answer-sheets are then shipped to ETS to be read by a scanner, matched to the test taker's order (or, 'registration form'), and scored. More details about each of the steps followed in the class are provided below.

IDENTIFY THE PROCESS TO BE STUDIED

Each participant was to select a process to study over which they had responsibility. The business process was to include no more than about ten full-time people (in order to make it about the right order of magnitude to study during the course of the class). Educational Testing Service also wanted the process to be one that occurred during the time period of the course, so that data about cost would be collected. Before the classes began, participants met with the instructor to discuss the process selected for study, keeping the initial course objectives in mind. Twelve different processes were selected for study. The answer-sheet-processing process was selected after considering a high-level flowchart of the processes involved in the test processing. Test processing involves many sub-processes, including, for example, conduction of test administrations, processing of answer sheets, processing of registration forms, and providing score reports. Within all these processes there are quality inspection and control steps that might represent major commitments of staff time and expense. Although ETS has relatively few quality problems with test delivery and score reporting, whenever a problem occurs, its first impulse has been to add a quality inspection step. Consequently, ETS has a highly complex quality control system that evolved incrementally over many years. Answer-sheet processing is known to involve inspection activities and seemed a good place to start.

PREPARE A PROCESS FLOWCHART

Class participants were first instructed in flowchart preparation and then asked to prepare a flowchart of the process they were studying. The flowchart at this stage was still at a macro level but detailed enough to identify all the areas involved in the processing- the sequence of document and data flows, the nature and extent of rework loops, and of course, the supporting quality inspection steps involved in controlling the sub-process. The participants were then given the following instructions: 'During this stage, it is essential to involve the staff doing and supervising the work in order to ensure that all of the important steps have been identified and to establish a rapport with the staff members you will be working with to obtain the detailed procedural, volume, and cost information. Based on experience, we would offer a caveat here: be mindful that most flowcharts focus on the document, information flows, and processing, and may omit the preparation or preliminary activities that must occur before the work can begin. Many quality system prevention activities will be unaccounted for if you do not consider the necessary work preceding the actual processing. For example, procedure documentation, employee training, and machine setup and testing are all quality system prevention activities that should be included in the process flowchart for the process to be correctly depicted. Because the flowcharts prepared did not include these activities, ETS had to go back after it had completed much of the study to determine what type of prevention activities, if any, preceded the work. If it is awkward to include these prevention activities in the flowchart, they can be included in the step procedure described below.

PREPARE A STEP PROCEDURE BASED ON THE PROCESS FLOWCHART

Developing a step procedure requires listing the tasks involved in completing a step, at an appropriate level of detail. Here it is important to keep the basic objective of the study in mind: ETS was looking to identify costs associated with prevention, appraisal, and failures inherent in the quality system. The details should enable the categorization of steps as production or as those related to the quality system in place. More detail is unnecessary and complicates the cost-of-quality study. At the time the tasks are listed, it is also important to identify the position type and level of the staff members) accomplishing the task. This information is a prerequisite for estimating the direct and indirect labour costs associated with the quality system. The team was able to get to the appropriate level of detail after it began looking at cost data. Consequently, its step procedure was revised several times during the study.

CLASSIFY THE STEPS: PRODUCTION OR QUALITY SYSTEM?

The initial categorization differentiates production steps from those involved in managing or maintaining the quality system. This was not an easy step for the team to accomplish. All work associated with producing the product or providing the service is a part of the production steps. All work related to ensuring that the work is done correctly the first time, or checking that it was done correctly, or ensuring that all work is accomplished that should be (input/output controls), or correcting work are all part of the quality system. For each task, the team had to ask why the step was performed and what would result from it. Also, because of the complexity of the work processes, some steps, even at their least common denominator level, included both production and quality-system components. In these cases, the team used its best estimate of the breakdown. It concluded that the cost-of-quality study was a management tool for the purpose of making relative assessments, and that the data did not have to be precise to be useful. Once the initial categorization was complete, it was necessary to classify the components within the quality system steps as prevention, appraisal, internal failure, or external failure. There may be times when it is not clear in which cost-of-quality category a step or task should be placed. A general rule of thumb is to place the quality cost component into the higher-order category if the step is a consequence of that category. For example, if quality inspection is done on a repaired product that was returned or rejected by a customer, the quality inspection step is part of the external failure and not an appraisal step. Involving the employees at this step in discussing the appropriate classification can be helpful. One interesting outcome of this work was that employees began to realize that they spent as much or more time checking the work as they did in doing it. They felt that there was something wrong with the way the work procedures were set up. This revelation laid the groundwork for the welcome procedural changes. Participants did not have experience in designing data collection and had to learn that skill. Once the data was collected, it was summarized in direct labour dollars. To assure comparability of the cost-of-quality results, the team used 1.5 for each direct labour dollar to reflect the indirect costs of benefits. The team did not include what it calls 'cost-centre load'-an accounting process that generates numbers that can vary from department to department. The use of a standard rate ensured that it could use the same yardstick when it compared its study results to determine the opportunity for quality improvement projects.

COLLECT VOLUME, HOURS, AND COST DATA

In the case of the answer-sheet process, the team was fortunate to have much of the data needed available in production reports for one test administration. The team was able to extrapolate full-year data from this. However, it still had to estimate volumes, labour hours, and the cost of each employee performing work for each quality-related task in the step procedures. Other class participants had to collect data as work was being performed. Designing and piloting of data collection forms was another positive opportunity to involve employees. This step turned out to be more difficult for class participants than anticipated. Since costs had not historically been collected in this way, new data collection often had to be initiated many class.

PREPARE THE QUALITY COST REPORT

Data was then collated into a quality cost report, which is summarized in Table 11.3. In the case of the answer-sheet processing example, the report took four pages. Table 11.3 includes only the shell of the report and the summary. In the full version of the report, each of the work steps is listed in the left- hand column, indicating the cost of work, that is, prevention, appraisal, internal failure, or external failure. The total cost of the process (including the production costs) is also calculated. For answer-sheet processing of this one testing program, 5% of the quality costs were due to prevention, 37% due to appraisal, 42% due to internal failure, and 15% due to external failure. In terms of total expense, about 56% of the costs were cost-of-quality costs. This data raised many questions. Could the team improve the internal and external failure rates by increasing the prevention activities? Would the team be able to reduce the appraisal costs if it could improve its prevention activities and preclude errors from happening in the first instance? Could it reduce the 56% costs for the quality system activities, increase its production, and lower total costs?

In another case, ETS was spending 50% of its quality system costs on appraisal and 50% on prevention. Since there was very little internal error and no external error, could ETS reduce the internal appraisal cost and the total overall costs?

Table 11.3 *Extract of the cost-of-quality report (answer-sheet*

Operation step	*Prevention*	*Appraisal*	*Internal Failure*	*External Failure*	*Total*
°Procedure Writing	2.029				2,029
00 Training	978				978
5 Check *NS* with SRF		72			72
7 Key batch header		753			753
21 Perform QC		144			144
Total cost-of-quality	$3,007	$20,904	$23,741	$8,216	$55,868
Cost-of-quality as a					
% of total quality cost	5.4%	34.7%	42.5%	14.7%	100.0%
Cost-of-quality as a					
% of total net expense	3.0%	20.9%	23.8%	8.2%	55.9%

The key point was that ETS was, relatively speaking, spending a great deal on the quality system and, in at least one case, more than it needed to. If it spent more on prevention it could probably lower the total cost and increase the production. The results led the team to suspect that it would find similar situations in the rest of its test processing sub-processes, and that a more coordinated and integrated quality system for processing would yield great benefit.

IDENTIFY AREAS FOR IMPROVEMENT

At the end of the class, each participant summarized his/her findings. The team then did an analysis of all processes that included more than $10,000 in appraisal and failure (See Fig. 11.8). In most cases, participants had studied a process specific to a test program (such as SAT, GRE, or TOEFL). In Fig. 11.8, the asterisks beside some of the projects indicate that a solution to eliminate the costs of poor quality in one program could be transferred to other programs and probably result in savings as much as ten times the number estimated in the class. Based on the results, several projects were selected to be included in the next round of quality improvement projects. One major project was, of course, the quality inspection and control system in place for answer-sheet processing. Educational Testing Service expects an improved quality system to be put in place when the quality improvement team has finished its work. However, identifying areas of improvement really goes much beyond the identification of quality improvement projects. Even when the processes studied were too small to be proposed for quality improvement projects, class participants were able to identify

ways of improving how they did their work. For example, one individual found that 60% of the cost of the process was for inspection and that no internal or external failure was ever found. The inspections were put in when the computer system to do this work was new and being beta tested. Once the 'bugs' were all out of the system, no one ever went back to re-think what quality control measures needed to be followed now that the system was improved. The individual was able to go back and eliminate a number of checks in the process, just from having thought about the process differently. At the end of the class ETS did a survey of participants. It found that 90% of the class indicated that they benefited from taking the class. Ninety per cent also recommended that others take the class.

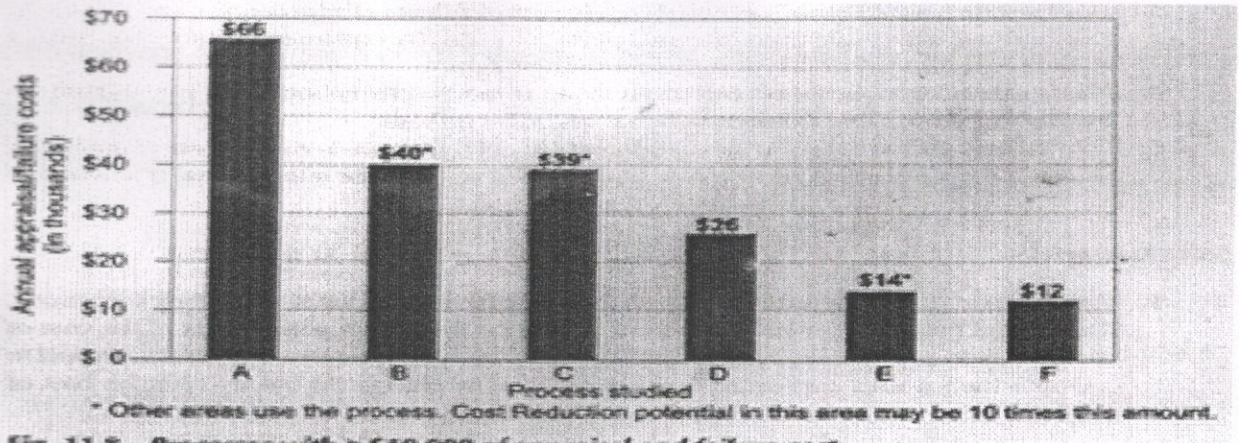

Fig. 11.8 ***Processes with >$10,000 of appraisal and failure cost***

Q1. Why is it difficult to differentiate production steps from those involved in managing or maintaining the quality system?

Q2. A general rule of thumb is to place the quality cost component into the higher-order category if the step is a consequence of that category Do you agree with this rule of thumb? If yes, why?

Q3. Do you think that the application of the cost-of-quality concept has helped ETS to improve their processes and reduce defects?