Solutions for Operations Management Creating Value Along the Supply Chain Canadian Edition 2nd Edition by Russell

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Solutions

CHAPTER 2 – QUALITY MANAGEMENT

ANSWERS TO QUESTIONS, PROBLEMS, AND CASE PROBLEMS

Answers to Questions

2-1. Consumers perceive quality to be how well a product meets its intended use—that is, how well it does what it is supposed to do—whereas from the producer's perspective, quality is how well the product conforms to its design during the production process.

2-2.
1. Performance: operating characteristics of a product
2. Features: extra items added to basic characteristics
3. Reliability: probability that a product will operate properly
4. Conformance: the degree to which a product meets standards
5. Durability: how long the product lasts
6. Serviceability: ease and speed of repair and courtesy of repair person
7. Aesthetics: how a product looks, feels, sounds, smells, or tastes
8. Safety: Assurance that the customer will not suffer harm; especially important for autos.
9. Other: subjective perceptions based on brand name or advertising

2-3. Quality of design is the degree to which quality characteristics are designed into a product, whereas quality of conformance is how effectively the production process is able to conform to the specifications required by design.

2-4. The cost of quality assurance is the cost of maintaining an effective quality program and includes prevention and appraisal costs. The cost of nonconformance, or poor quality, is the result of internal and external failures. These two costs react oppositely to each other; as the cost of quality assurance increases, the cost of poor quality decreases.

2-5. Internal failure costs are incurred when poor quality is discovered before the product is delivered to the customer, whereas external failure costs are incurred after a customer receives a poor-quality product. Internal failure costs include scrap, rework, process failure, and downtime, whereas external failure costs include customer complaints, product returns, warranty claims, product liability, and lost sales.

2-6. The contractor could be experiencing low productivity yields and have extensive internal failure costs, including scrap, rework, process failure, and downtime costs.

2-7. a. From the consumer's (e.g., student or parent) perspective, quality is probably determined by whether the college education provides the job opportunity expected and whether the graduate perceives he or she has acquired an anticipated level of knowledge that will enable the graduate to perform the job effectively. From the producer's (e.g., university) perspective, quality is how effectively it is able to deliver knowledge (i.e., required courses) and provide the quality of life experience expected by the student.

b. The education achieved by the student provides the job opportunities expected and a level of knowledge that enables the graduate effectively to perform the job achieved.
c. Quality-assurance costs include the cost of hiring the best faculty, administrators, and support personnel, the cost of designing and redesigning courses and curriculum to meet changing needs, the cost of providing a good physical and mental environment (i.e., housing, food, entertainment, security, etc.), the cost of modern technical teaching equipment, the cost of information systems, and the cost of assessing alumni satisfaction with their education. Costs of poor quality include students who fail or drop out, reduced funding from the province or private donors, and fewer enrolments.
d. Quality circles could be developed within administrative and operational units and academic departments. Circles might include both faculty or administrators and classified employees. The normal quality circle stages of training, problem identification, analysis, solution, and presentation could be followed.

2-8. Improving quality will increase product yield—that is, the number of acceptable units—thus increasing productivity.

2-9. The cost of poor quality could include external failure costs for customer complaints, returned media players to be repaired under warranty, lost future sales, and liability costs if someone is hurt because of the problem. Costs of quality improvement might include improved design costs for the media player, process costs, and inspection costs for the final product and at various stages of the production process.

2-10. *Media player:* Visual attractiveness, size, weight, clarity of sound and picture, and features for rewind and fast-forward, program search, programming, playback, etc.
Pizza: Size, ingredients, taste, smell, service in delivery, temperature.
Running shoes: Size, weight, comfort, visual attractiveness, durability.

2-11. The input is customer inquiries and the final product is responses that result in customer satisfaction. Associated quality costs might include prevention costs, such as designing a telephone system to ensure prompt connections without waiting and a properly designed computer system to provide accurate customer account information, and training costs to make certain service operators are courteous and knowledgeable. Appraisal costs might include the cost of monitoring service calls to ascertain response rates and operator courtesy. Poor quality might result in complaints from customers and lost accounts.
A quality management program could incorporate a system to monitor calls to ensure prompt, courteous, and knowledgeable service. An employee-involvement program, wherein operators might identify problems, would be beneficial.

2-12. Prevention costs are directed at preventing poor quality products from reaching the customer, thus avoiding the various internal and external failure costs associated with poor quality.

2-13. It is important to have a means for assessing the impact of quality improvement programs on the organization's profitability and productivity.

2-14. *W.E. Deming:* Introduced the Japanese to quality management principles and philosophy, embodied in his 14 points.
Joseph Juran: A major contributor to the Japanese quality movement.
Phillip Crosby: Changed general perceptions of cost of quality and promoted zero defects.
Armand Feigenbaum: Introduced the concept of total quality control, a total company-wide approach to quality management.
Kaoru Ishikawa: Introduced quality circles and cause and effect diagrams.

2-15. The Canada Awards for Excellence (CAE) have become the aura and reputation for quality that awaits the winners. Award participants and winners also experience decreased costs and increased profits. CAE provide widely used sets of guidelines to help companies implement and effective quality management system.

2-16. This should be a student project.

2-17. The student could provide many reasons for failure including lack of total commitment, ineffective planning, goals too easy or too difficult to achieve, improper measurement techniques, ineffective leadership, not enough employee training, etc. See G. Salegra and Farzaneh, "Obstacles to Implementing Quality," *Quality Progress*, 33, no. 7 (July 2000): 53–57.

2-18. The dimensions of quality for a service company are located in the text. The student should identify these or similar ones for the company they select.

2-19. The two service companies should be in the community and the quality characteristics the students will tend to focus on will include courtesy and quickness of service.

2-20. Although students in this class might suggest that grades are a quality measurement, a more realistic approach to evaluation are student evaluations of the class or surveys of students. Quality characteristics might include course organization, presentation of lectures, class environment, physical appearance of the classroom, schedule (i.e., are the lectures completed on time), the quality of supplementary material, physical appearance and demeanour of the instructor, including friendliness and courtesy, the accuracy and completeness of assignments, etc.

2-21. The answer depends on the company selected by the student. For example, there is a particular hotel that has never gotten a room reservation right for us, and, the instructions for ordering tickets at the website for the 2010 Olympics in Vancouver were littered with pitfalls. Airlines are a favourite example of a poor quality service for students who travel.

2-22. Restaurants, retail stores, and grocery stores are examples of local businesses that, in our experience, tend to vary in quality. We have never had a bad ordering experience with L.L. Bean although that's not true of some other mail order operations we have dealt with. In most cases, if a service has been identified by the student it will be because of courteous, helpful employees, while if a manufacturing product has been identified, it will be because

of superior physical traits, such as durability.

2-23. TQM tends to give some focus and structure to strategic planning. TQM provides identifiable goals, and many well-documented initiatives for quality improvement such as quality circles, employee training, empowerment, etc. TQM also provides a means for measuring success which is essential in a strategic planning process.

2-24. Many Canadian suppliers cannot do business with companies overseas unless they have ISO certification. In addition, many Canadian companies also desire or request their suppliers to comply with ISO 9001 standards.

2-25. Common characteristics that the students will discover include strong leadership at the top, total company commitment, employee training, involvement and empowerment, challenging goals for quality achievement, focus on customer satisfaction, and extensive use of statistical quality control techniques, among other things.

2-26. Some companies believe their quality is “good enough.” However, primary reasons for not implementing a TQM program are lack of time and the cost involved; some companies do not have the resources available to undertake a TQM program.

2-27. This will depend on the website the student accesses. In general, they should adapt the attributes described for services.

2-28. This depends on the airline the student selects. Example defects they might mention are flight delays or cancellations, lost luggage or luggage mishandling, discourteous employees, wrong or misleading flight information, uncomfortable seats, etc.

2-29. This will depend on which websites the student selects. Good-quality sites might have nice visuals, lots of easily accessible information, and a simple but effective user interface. Poor-quality websites might have little information, information that is difficult to find, a poor user interface, or one that is too complicated or doesn’t run well on different platforms.

2-30. Categories of possible quality problems might be related to the ordering process, pizza construction, pizza ingredients, packaging/boxing, time to receive order, order accuracy/correctness, and pricing.

2-31. If someone purchases a residence then the dwelling is more of a product. However, renting a dormitory room or an apartment tends to fall into the service category because it is part of an ongoing process or interaction between the owner and renter. In other words, the owner retains responsibility for the product, i.e., the dwelling. As such, the quality of the living accommodation should be assessed according to the dimensions of quality for a service.

2-32. Categories of quality problems for flight delays could relate to employees (not enough to check in, problems with the check-in process, deplaning problems, insufficient maintenance personnel to accomplish plane turn-around, etc.), mechanical problems,

luggage problems, maintenance problems, weather, flight controller problems, over booking, over scheduling, etc.

2-33. This depends on the business the student selects. If for example, they selected a restaurant they eat at frequently they would need to identify the categories of quality problems which might include employees, food quality, restaurant environment, waiting time, price, service, menu, etc.

2-34. It should be obvious to the student that the most important defects are the engine problems and faulty brakes. The priority of the quality problems is almost the reverse of the frequencies; faulty brakes are clearly the most significant category of defects. This points out that when applying Pareto analysis the degree of importance must be the same for all defect categories. If not, then the categories should be weighted according to their importance in order to adjust the chart.

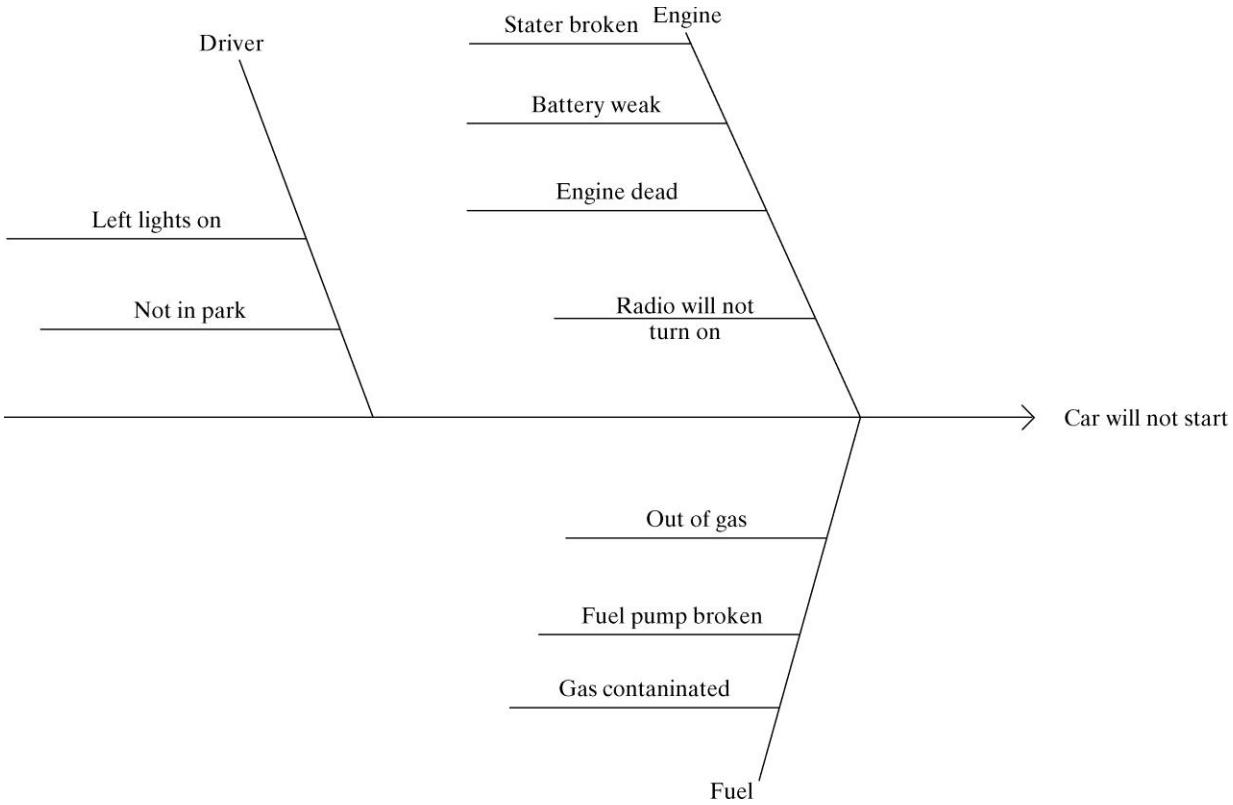
2-35. *Marketing* has direct contact with the customer. Marketing is typically responsible for the consumer research that determines the quality characteristics that customers want and need, and the price they are willing to pay for it. Marketing also informs the consumer about the quality characteristics of a product through advertising and promotion. Sales provides feedback information through its interaction with the customer, which is a determinant of product design. Research and development will explore new ideas for products and be actively involved in product innovation.
Engineering translates the product quality characteristics determined by marketing and top management into a product design, including technical specifications, material and parts requirements, equipment requirements, workplace and job design, and operator training and skills. Overdesigning the product is a drain on the company's resources and can erode profits, whereas under-designed products will generally not meet the customer's quality expectations. Genichi Taguchi, the Japanese quality expert, estimates that poor product design is the cause of as much as 80 percent of all defective items. It is much cheaper and easier to make changes at the design stage than at the production stage, so companies need to focus on quality at all stages of the design process.
Purchasing must make sure that the parts and materials required by the product design are of high quality. Quality of the final product will be only as good as the quality of the materials used to make it. Purchasing must select vendors who share the company's commitment to quality and who maintain their own quality management program for providing high-quality service, materials, and parts.
Human resources is responsible for hiring employees that have the required abilities and skills, and training them for specific job tasks. Employees not well trained in their tasks will probably contribute to poor quality or service. Personnel also have responsibility for educating employees about quality and ways to achieve quality in their tasks. TQM requires that all employees throughout the organization be responsible for quality. Employees, collectively and individually, must not only perform their tasks according to design specifications but also be responsible for identifying poor quality or problems that may lead to poor quality and taking action to correct these problems. Performance appraisal under TQM focuses more on quality improvement and group and company achievement than on individual job performance.

Distribution makes sure that high-quality products are delivered on-time and undamaged to the customer. Packaging methods and materials, storage facilities and procedures, and shipping modes must ensure that final products are protected and that customers receive them on time.

2-36. This answer depends on the award the student selects.

2-37. This answer depends on the company the student selects.

2-38. This question was adapted from: L. Fredendall, J. Patterson, C. Lenhartz and B. Mitchell," What Should Be Changed?", *Quality Progress* 35 (1; January 2002): p. 50–59. This is an excellent article about the use of cause and effect diagrams students can be referred to.



2-39. Black Belt—the leader of a quality improvement project, which is a full-time position
Green Belt—a project team member, which is a part-time position
Master Black Belt—a teacher and mentor for Black Belts which, is also a full-time position. A Black Belt would have to have led several successful projects before being certified as a Master Black belt.

2-40. Breakthrough Strategy:
1. *Define* the process including who the customers are and what their problems are.
2. *Measure* the process and collect data.

3. *Analyze* the data in order to develop information that provides insight into the process, including causes of defects.
4. *Improve* the process by making changes and measuring the results.
5. *Control* the improved process by monitoring it and making sure the desired performance level is sustained.

2-41. This answer depends on the project the student selects.

2-42. In general, the ACSI model is a set of causal equations that link customer expectations, perceived quality, and perceived value to customer satisfaction (ACSI). In turn, satisfaction is linked to consequences as defined by customer complaints and customer loyalty—measured by price tolerance and customer retention. There are two menu items on the ACSI website that describe, in general terms, how the ACSI is determined—"What it measures," and "Methodology." The student should refer to these descriptions. As an example, the student could select two fast food restaurant chains in the fast food industry and compare the company with the highest score with the lowest scoring company and explain the reasons for the difference in scores.

2-43. Answer depends on the personal health improvement project the student selects.

2-44. Answer depends on the personal improvement project the student selects.

2-45. Answer depends on the infirmary process the student selects.

2-46. Answer depends on the registration process at the student's university.

2-47. In general, the Japanese recognized that even though high quality might cost more in the "short run," in the long run it would help them gain market share, which would increase long term profits. This is something American companies did not recognize. The Japanese economic climate and business and management culture was also more conducive to quality management programs than American companies.

2-48. The student should go to the ISO website at www.iso.org to determine these steps.

2-49.Answer depends on the store the student selects.

2-50. The student should refer to the ISO website at www.iso.org and the CAE website at https://excellence.ca/canada-awards-for-excellence/to answer this question.

2-51. The answer should include references to some form of customer feedback, such as a "voice of the customer (VOC)" process and surveys. Since assessing customer satisfaction is a critical part of the CAE criteria, the summaries of CAE winning companies at https://excellence.ca/canada-awards-for-excellence/are a good source for students to learn how companies and organizations assess customer satisfaction.

Answers to Problems

(Answers may vary due to rounding)

2-1. a. Failure costs as percentage of quality costs:

Year 1: $\frac{157.7}{187.2}$ = 0.8424, or 84.24%

Year 2: $\frac{161.8}{201.7}$ = 0.8022, or 80.22%

Year 3: $\frac{153.6}{212.5}$ = 0.7228, or 72.88%

Year 4: $\frac{127.2}{193.9}$ = 0.6560, or 65.6%

Year 5: $\frac{97.3}{166.9}$ = 0.5830, or 58.3%

The failure costs decrease as a percentage of total quality costs. This may be attributed to an increase in product monitoring and inspection. Fewer defective products are reaching the consumer, as evidenced by the sharp decline in external failure costs.

b.

	Prevention costs as % of quality costs:	Appraisal costs as % of quality costs
Year 1:	$\frac{3.2}{187.2}$ = 0.0171, or 1.71%	$\frac{26.3}{187.2}$ = 0.1404, or 14.04%
Year 2:	$\frac{10.7}{201.7}$ = 0.0530, or 5.3%	$\frac{29.2}{201.7}$ = 0.1448, or 14.48%
Year 3:	$\frac{28.3}{212.5}$ = 0.1332, or 13.32%	$\frac{30.6}{212.5}$ = 0.144, or 14.4%
Year 4:	$\frac{42.6}{193.9}$ = 0.2197, or 21.97%	$\frac{24.1}{193.9}$ = 0.1243, or 12.43%
Year 5:	$\frac{50}{166.9}$ = 0.2996, or 29.96%	$\frac{19.6}{166.9}$ = 0.1174, or 11.74%

The increase in prevention costs as a percentage of total quality costs indicates that Backwoods Canada is placing more emphasis on prevention of defects rather than correction of them. Perhaps they are spending more in the areas of quality planning, product design, process, training, and information. This is contributing to a decline in the need for inspection and testing, equipment testing, and operators to test quality; thus appraisal costs decline, both absolutely and as a percentage of total costs. Prevention also contributes to the decline in external and internal failures, because fewer defective products are produced to begin with. Increases in prevention expenditures will result in a decrease in all other quality costs. c.

	Quality Sales Index	Quality-Cost Index
Year 1	6.93	44.48
Year 2	7.50	47.64
Year 3	7.85	50.04
Year 4	6.9	44.46
Year 5	5.79	38.32

These index values do not provide much information regarding the effectiveness of the quality assurance program. They are, however, useful in making comparisons from one period to the next and in showing trends in product quality over time.

d. Examples of quality-related costs:

- *Prevention:* Market research, that is, producing what consumers want; purchasing only high-quality down and other materials, designing an efficient and effective manufacturing process; training employees in making quality products.
- *Appraisal:* Inspection of raw materials, work-in-process, and finished product; equipment testing (pattern cutter, sewing machines, etc.), inspection.
- *Internal failure:* Wasted materials and labour, defective products discovered during inspection, use of inefficient processes, equipment downtime, poorly trained employees.
- *External failure:* Defective products, customer complaints, warranty costs, lost sales, loss of good will.

2-2. a. Product yield

Year 1: 20,000(0.83) + 20,000(1 – 0.83)(0.20) = 16,600 + 680 = 17,280 parkas

Year 2: 20,000(0.85) + 20,000(0.15)(0.20) = 17,000 + 600 = 17,600 parkas

Year 3: 20,000(0.87) + 20,000(0.13)(0.20) = 17,400 + 520 = 17,920 parkas

Year 4: 20,000(0.89) + 20,000(0.11)(0.20) = 17,800 + 440 = 18,240 parkas

Year 5: 20,000(0.91) + 20,000(0.09)(0.20) = 18,200 + 360 = 18,560 parkas

b. Manufacturing cost per good parka:

Year 1: $\frac{420{,}900+12(680)}{17{,}280} = \frac{429{,}060}{17{,}280}$ = $24.83

Year 2 $\frac{423{,}400+12(600)}{17{,}600} = \frac{430{,}600}{17{,}600}$ = $24.47

Year 3: $\frac{424{,}700+12(520)}{17{,}920} = \frac{430{,}940}{17{,}920}$ = $24.05

Year 4: $\frac{436{,}100+12(440)}{18{,}240} = \frac{441{,}380}{18{,}240}$ = $24.20

Year 5: $\frac{435,500+12(360)}{18,560} = \frac{439,820}{18,560} = \$23.70$

Improving the quality assurance program has resulted in fewer defective parkas, lower rework costs, and greater productivity. This has lowered the per-unit manufacturing costs without additional capital investment.

2-3. a. $y = (I)(\%G) + (I)(1 - \%G)(\%R)$
$= (150)(0.83) + (150)(1 - 0.83)(0.60)$
$= 139.8$ file cabinets

b. $145 = (150)(\%G) + (150)(1 - \%G)(0.60)$
$145 = 150G + (150 - 150G)(0.60)$
$145 = 150G + 90 - 90G$

$55 = 60G$
$G = \frac{55}{60} = 0.916 = 91.6\%$

2-4. Cabinets to be reworked: $R = 150(1 - 0.83)(0.6) = 15.3$
Yield: 139.8 cabinets (from Q2.3)
$Cost = \frac{\$27(150)+\$8(15.3)}{139.8} = \$29.85$

If quality increases to 90%:
$R = 150(1 - 0.9)(0.6) = 9$
$Y = 150 * 0.9 + R = 144$

$= \$28.63$ per cabinet if quality is 90%

2-5. Manufacturing cost per good product:

Year 1: Yield = 32,000(0.78) + 32,000(0.22)(0.25) = 26,720
Product Cost $= (278,000 + 3520) \div 26,720 = \$10.54$

In this case, total direct manufacturing $\text{cost} = \$278,000,$ and total direct rework $\text{cost} = 32,000(0.22)(0.25)(2) = \$3,520$

Year 2: Yield = 34,600(0.83) + 34,600(0.17)(0.25) = 30,188.50
Product Cost $= (291,000 + 2,941) \div 30,188.50 = \$9.74$

Year 3: Yield = 35,500(0.9) + 35,500(0.1)(0.25) = 32,837.50
Product Cost $= (305,000 + 1,775) \div 32,837.50 = \$9.34$

Percentage change:
Year 1–Year 2: –7.60%
Year 2–Year 3: –4.10%

2-6. a. Product yield $= 300(0.87)(0.91)(0.94)(0.93)(0.93)(0.96) = 185$ cabinets

b. For a yield of 300, input would have to be

$I(0.87)(0.91)(0.94)(0.93)(0.93)(0.96) = 300$

$I(0.6179) = 300$

$I = 486$ cabinets

2-7. a. Alt. 1: $300(0.93)(0.91)(0.94)(0.93)(0.93)(0.96) = 198$

Alt. 2: $300(0.87)(0.96)(0.94)(0.97)(0.93)(0.96) = 204$ Greatest yield

Alt. 3: $300(0.87)(0.91)(0.94)(0.93)(0.97)(0.98) = 197$

Alt. 4: $300(0.87)(0.97)(0.94)(0.93)(0.93)(0.96) = 198$

b. Alternative 2 will result in the highest yield and will be the most effective.

2-8. $320(1-0.12)(1-0.08)(1-0.04) = 320(0.88)(0.92)(0.96)$

$= 248$ errorless orders

2-9. a. $\text{QPR} = \dfrac{(585+16)(100)}{650(18)+16(3.75)} = 5.11$

b. $\text{QPR} = \dfrac{(720+20)(100)}{800(18)+20(3.75)} = 5.11$

c. $\text{QPR} = \dfrac{(585+16)(100)}{650(16.50)+16(3.20)} = 5.58$

d. $\text{QPR} = \dfrac{(604+11)(100)}{650(18)+11(3.75)} = 5.24$

2-10. a. $\text{QPR} = \dfrac{250(100)}{250(47)+33(16)} = 2.04$

b. $\text{QPR} = \dfrac{320(100)}{320(42)+19.2(12)} = 2.34$

2-11. a. $\text{Product cost} = \dfrac{(K_d)(I)+(K_r)(R)}{Y}$

$$= \frac{(\$6.15)(680)+(1.75)(2.72)}{655.52}$$
$$= \frac{4186.76}{655.52}$$
$$= \$6.39$$

b. $$\text{Product cost} = \frac{(\$6.20)(680)+(1.75)(0.68)}{673.88}$$
$$= \frac{4217.19}{673.88}$$
$$= \$6.26$$

$$\text{Cost savings} = \$0.13/\text{order}$$

$$\text{Annual savings} = \$0.13/\text{order} \times 680 \text{ orders/day} \times 365 \text{ days/year}$$
$$= \$32,266$$

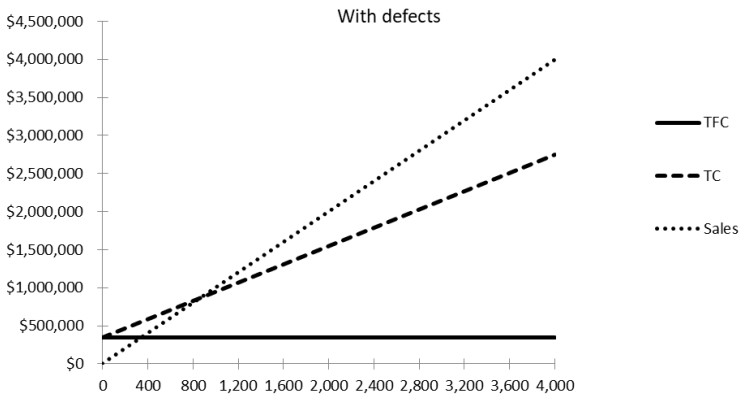
c. It is likely that some customers who receive defective orders will not return, thus, fewer defective orders will retain more customers and also increase the number of orders.

2-12. a. $$\text{QPR} = \frac{655.52}{(680)(6.15)+(2.72)(1.75)}\ (100) = 15.66$$

b. $$\text{QPR} = \frac{673.88}{(680)(6.20)+(0.68)(1.75)}\ (100) = 15.98$$

2-13. With defects:

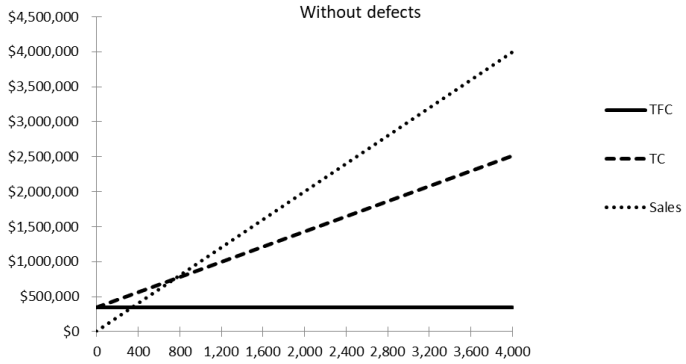
$$v = \frac{c_f}{p - c_v}$$
$$= \frac{\$350,000}{1,000 - 600}$$
$$= 875 \text{ units or } \$875{,}000 \text{ in sales}$$



Without defects (six sigma):

$$v = \frac{\$350,000}{1,000 - 540.05}$$

$= 760.952$ or \$760,952 in sales



The slope of the total cost line is less steep with a reduced break-even point; the company can make more money without selling additional units.

2-14. Variable costs per meal $\frac{61,200}{3600} = \$17$.

With an 8% defect rate

Sales	\$151,200
Variable costs	61,200
Fixed costs	31,000
Profit	\$59,000

With zero defects, savings are $\$17 * 3600 * 8\% = \$4896$ in variable costs:

Sales	\$151,200
Variable costs	56,304 (3,600 x (\$17 x 0.92%)
Fixed costs	31,695 (\$31,000 + (\$25,000 / 36 months)
Profit	63,202

Six sigma results in an 8% reduction in variable costs offset by an increase in amortized

fixed costs results in a 7.1% increase profits. The return on the six sigma investment would be:

Return =

$$\frac{100\ (4896-695)}{695}$$

= 605%

Where 695 = 25000/36 (the monthly cost of investment).

2-15. A possible version of the cause and effect matrix:

			Key Output (Y) Variables (*CTQC's*)							
			1	2	3	4	5	6		
			Clothes clean	Clothes not damaged	Colors fine	Lint free	Stains removed	Smell fresh/ no odors		Rank of X Variables/ Importance to Customer
	Key Input (X) Variables	**Customer rank**	1	3	2	5	6	4		
		Weight	*10*	*9*	*9*	*7*	*7*	*8*	**Score**	
1	Sort laundry		5	6	10	8		5	290	1
2	Cycle		7		8				142	8
3	Wash temperature		8		10		7		219	5
4	Rinse temperature		4		9				121	9
5	Stain treatment				5		10		115	10
6	Load size		9	10	6			6	282	2
7	Fabric softener		3	5		4		9	175	7
8	Detergent		10		7		5	10	278	3
9	Bleach		7		9		6	4	225	4
10	Type of washer		8	9		5			196	6

2-16:
With a 12% returned:
Weekly cost of poor quality= (18400*0.12*0.3*8) + (18400*0.12*0.7*47) + (18400*0.12*0.7*0.5*15) = $ 89,534.4

With a 2% returned:
Weekly cost of poor quality= (18400*0.02*0.3*8) + (18400*0.02*0.7*47) + (18400*0.02*0.7*0.5*15) = $14,922.4

Cost saving per week= $74612

Cost saving per year= 74612*52= $3,879,824>$800,000
The company should invest in the program.
Zero defects did not eliminate returned order as returned orders had some other reasons regarding other aspects of quality, such as quality of design.

Answers to Case Problem 2.1: Designing a Quality Management Program for the Internet at D4Q

This can be an instructive, hands-on case project. The students should first search the Internet for different websites at which retail items can be ordered. They should next develop a list of quality characteristics or dimensions to focus on. These might include the visual appearance of the website, the friendliness of the language used, the accuracy of instructions, the availability of email or telephone support, etc. An attractive website should probably include photos of the catalogue items, such as diffusers and humidifiers, instead of just item titles. Instructions for ordering should be detailed and accurate with help icons located at every step. Customer support should be easy to access by email or telephone. Responses to requests for support should be quick. Service measurement is difficult in this type of operation. If an order centre is used then the company can count the number of customers who enter the centre then abort as the result of poor instructions. Follow up surveys of customers who place orders or request hard copy catalogues is a good way to evaluate service. From the server end, the server responses to customer inquiries can be monitored for accuracy, completeness, and timeliness. These are just a few of the possible quality initiatives you might suggest to develop a high quality website ordering system.

Answers to Case Problem 2.2: Quality Management at Local University

In general the student should respond to this case by attempting to go through the chapter and to discuss each major topic in terms of a university environment. This will require that they first identify the product and the process, obviously the student, and the educational process. However, in a university environment, is the product also the customer? This is an interesting question to begin with.

An initial step should be to develop a customer definition of quality—that is, what are the dimensions of quality in an education that parents, students, and legislators expect? This step can be accomplished by surveying alumni, potential employers, parents, students, and legislators. It would also be beneficial to see what the competition (other colleges and universities) does.

The various support functions in the university should be identified in terms of a production process. For example, the admissions office is analogous to the purchasing department. A key problem here in a QM approach is that the university has little, if any, control over suppliers (high schools). As a result, admissions must institute inspection and process control procedures to ensure high-quality raw material (i.e., students), is admitted.

The product-design function, or curriculum design, is typically decentralized in a university among various colleges and departments. In some cases, the university administration will design a core curriculum for the first two years and college and departments will design the curriculum for the last two years.

The production process is the movement of students through the curriculum to graduation. Discussion should focus on how to institute process control in order to avoid final product "defects." This obviously requires a definition as to what a defective item is—a student who enters but fails to graduate, a student who graduates but does not gain employment, or a graduate who indicates disappointment with his or her education five years from now. An area on which to focus is the degree to which quality control tools such as brainstorming, quality circles, histograms, check sheets, and fishbone diagrams can be used to evaluate the process.

Customer service would seem to be an integral part of a QM approach in the university. This service would focus on support services such as dining, recreation, housing, advising, counselling, extracurricular activities, entertainment, placement, alumni services, etc.

Depending on the time designated to spend on this case, students might interview various administrators at their own university to determine where QM can be applied in the university and obstacles to a TQM approach.

Answers to Case Problem 2.3: Quality Problems at the Tech Bookstores

a. Mr. Gandhi's organization of the customer survey categorized the two bookstores and types of customer, i.e., students and non-students. He differentiated between the two stores because they carried different products, and it also was likely that a different population of customers visited the two stores since they were in different locations. Also, the two stores had different managers, staff, and employees; in effect they were separate entities. He differentiated between the two customer groups because he knew they likely had different characteristics and different service expectations. Also, it was probable that they shopped for different items. Students would be primarily interested in textbooks, school supplies, computer items, and apparel, whereas non-students would not have been as interested in textbooks and school supplies, and they would have had a higher interest in trade books. A customer survey was probably the best way to start in order to see if there was a quality problem and its extent. He might also analyze different processes in the store, such as employee floor service, checkout, etc. He could have probably gotten the help of an OM class on campus to help him analyze various service processes in the store. He could also benchmark other "successful" college bookstores.

b. It is possible to develop 9 different Pareto charts—a chart each for students and non-students at the campus store, and a chart each for students and non-students at the off-campus store; a combined chart for students at both stores and a combined chart for non-students at both stores; a chart for each store combining the two customer groups at each one; and a summary chart combining all the data for both stores and both customer categories. Following is a summary of the survey data:

	Campus Store				Off-Campus Store					
	Student		Non-student		Student		Non-student		Total	
	Yes %	No %	Yes %	No %	Yes %	No %	Yes %	No %	Yes %	No %
Were employees courteous and friendly?	86	14	67	33	75	25	52	48	73	27
Were employees knowledgeable and helpful?	79	21	52	48	77	23	41	59	65	35
Was the overall service good?	86	14	63	37	71	29	55	45	71	29
Did you have to wait long for service?	11	89	45	55	11	89	46	54	25	75
Did you have to wait long to checkout?	12	88	46	54	16	84	45	55	27	73
Was the item you wanted available?	92	8	84	16	90	10	90	10	89	11
Was the cost of your	58	42	90	10	60	40	92	8	72	28

purchase(s) reasonable?										
Have you visited the store website?	50	50	12	88	58	42	5	95	41	59

c. Using a fitness for use definition, quality should be prompt, knowledgeable, and courteous customer service; a pleasant shopping environment with prompt and courteous customer checkout; and quality products at a competitive (or lower) price.

d. The most pronounced problem is the discrepancy between the student and non-student groups in their perception of service. This is likely due to the different expectations of the two groups. Non-students are likely to be older and less patient. The student employees' attitude and demeanour is probably more familiar to other students, i.e., what they are used to, and they are probably more patient with the student employees than the non-student group. Also it is less likely that students will ask questions than the non-student group so the problem of not being helpful or knowledgeable does not come up as much with students as with non-students. It also may be that students visit the bookstores more often and know where to find items, and they may also be more familiar with bookstore policies. Many of the non-student customers could be visitors.
However, this discrepancy does not hide two other potential quality problems—that the off-campus store has poorer quality service across all categories than the on-campus store, and there seems to be a significant problem with employee training at both stores. The relatively low percentage of customers who think employees are knowledgeable and helpful, reinforced by the graduate student evaluators and the complaint incidents to the Board, clearly indicates that the student employees are not adequately prepared to do their job. They are probably in need of more training, however it is likely the bookstore has been hesitant to provide additional training because of the high turnover rate, i.e., the return on training investment might be perceived by management to be low when student employees leave after a semester or two. The off-campus store may have poorer quality service, in general, because of the management staff, and the fact that the Executive Director resides at the on-campus store.
The much lower percentage of students who think that the cost of purchases at the bookstores is reasonable is probably due to the fact that students purchase textbooks, which are expensive. The bookstore probably does not do a very good job of publicizing the fact that it has a very low mark up on textbooks. This is something that could be highlighted on the store website, which the students access more than non-students.

e. Since this is a service, several of the costs of poor quality that relate to manufactured products such as scrap, product rework, returned products, etc., do not apply. Thus, the two primary costs of poor quality are lost sales and customer complaint costs. The costs the bookstore is incurring to conduct the customer survey, hire the graduate student evaluators, and analyze the results are all costs of poor quality. From the limited information provided it is difficult to address the question of lost sales. However, it is noted that the town and university have been growing while sales have remained steady. Given the ideal location of the on-campus store in particular, and the fact that the football team is very successful, should mean much higher sales of licensed apparel. It could be that the quality problems are having a very negative impact on sales.

f. While the bookstores would benefit from a complete QM program, the most immediate need is for a more extensive employee training program. The bookstore needs to establish a plan for improving its quality that includes employee training as a top priority. The plan needs tangible objectives. For example, every customer question should be answered as promptly as possible. Some form of reward system for employees might be beneficial. They likely would benefit from a set of guidelines for employees for addressing customer questions. Having a resource person available that has intimate knowledge of all aspects of store policies, and knows where all items are in the store, that the student employees could contact at any time would be a good personnel investment. In addition, management needs to establish a process for monitoring employee performance on a routine, daily basis. Benchmarking other college bookstores could provide insight into ways to solve quality problems. A process for measuring customer *and* employee satisfaction on a regular basis needs to be put into effect, and performance measures could be tied to these surveys.

g. Because the bookstores are quasi non-profit, government-type entities, the revenue pressures that a business might feel are not present. Thus, the motivation for improved quality is primarily the store's reputation. Another factor is the university-invoked policy of hiring students on a part-time basis. This means that to solve the quality problems associated with part-time students, bookstore management must look to other solutions besides hiring more-experienced, full-time employees. The fact that students will be serving adults is a situation that cannot be changed.

h. The most probable benefit would be an increase in sales and revenue. However, employee satisfaction would also likely increase as a result of a quality management program. Also, the Board of Directors would likely receive fewer complaints.

Answers to Case Problem 2.4: Product Yield at Continental Luggage Company

Average Weekly Yield

Stage 1 yield: $Y_1 = (I)(\%G) + I(1-\%G)(\%R)$

$= 500(0.94) + 500(0.06)(0.23)$

$= 470 + 6.9$

$Y_1 = 476.9$

Stage 2 yield: $Y_2 = (476.9)(0.96) + 476.9(0.04)(0.91)$

$= 457.82 + 17.36$

$Y_2 = 475.2$

Stage 3 yield: $Y_3 = 475.2(.95) + (475.2)(.05)(.67)$

$= 451.44 + 15.92$

$= 467.6$

Stage 4 yield: $Y_4 = 467.6(.97) + (467.6)(.03)(.89)$

$= 453.57 + 12.48$

$= 466.1$

Stage 5 yield: $Y_5 = 466.1(.98) + 466.1(.02)(.72)$

$= 456.78 + 6.71$

$= 463.5$

Increasing Good Quality Yield by 1% at Each Stage

Stage 1 yield: $Y_1 = 500(0.95) + 500(0.05)(0.23)$

$Y_1 = 480.75$

Stage 2 yield: $Y_2 = 480.75(0.97) + 480.75(0.03)(0.91)$

$Y_2 = 479.45$

Stage 3 yield: $Y_3 = 479.45(0.96) + 479.45(0.04)(0.67)$

$Y_3 = 473.12$

Stage 4 yield: $Y_4 = 473.11(0.98) + 473.11(0.02)(0.89)$

$Y_4 = 472.07$

Stage 5 yield: $Y_5 = 472.07(0.99) + 472.07(0.01)(0.72)$

$Y_5 = 470.75$

Difference in yields $= 470.75 - 463.5 = 7.25$ units

Percentage increase $= \frac{7.25}{463.5} = 1.56\%$

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