Review Questions

8.1 What is methods engineering?

Answer: As defined in the text, methods engineering is the analysis and design of work methods and systems, including the tooling, equipment, technologies, workplace layout, plant layout, and environment used in these methods and systems.

8.2 What are the principal objectives of methods engineering?

Answer: The principal objectives of methods engineering given in the text are (1) to increase productivity and efficiency, (2) to reduce cycle time, (3) to reduce product cost, and (4) to reduce labor content.

8.3 What is operations analysis?

Answer: As defined in the text, operations analysis is the study of an operation or group of related operations for the purpose of analyzing their efficiency and effectiveness so that improvements can be developed relative to objectives such as increasing productivity, reducing cost or improving safety.

8.4 What was the operation studied by Frank Gilbreth in his initial research on motion study?

Answer: Bricklaying.

8.5 What is methods analysis?

Answer: As defined in the text, methods analysis is the study of an existing method or process, usually by breaking it down into the work elements or basic operations that comprise it. Methods analysis can also be used to study a proposed new method that has not yet been implemented.

8.6 What is methods design?

Answer: As defined in the text, methods design is concerned with either (1) the design of a new method or process or (2) the redesign of an existing method or process based on a preceding methods analysis.

8.7 What are the six steps of the systematic approach in methods engineering?

Answer: As outlined in the text, the six steps of the systematic approach in methods engineering are the following: (1) Define the problem and the objectives. (2) Analyze the problem. (3) Formulate alternatives. (4) Evaluate alternatives and select the best. (5) Implement the best method. (6) Audit the study.

8.8 The procedure offered in the text for selecting among alternatives divides the technical features of proposed equipment alternatives into two categories. What are the two categories?

Answer: The two categories are (1) must features, which must be satisfied by the proposal and (2) desirable features that are desirable but not required.

8.9 What is a histogram?

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Answer: A histogram is a statistical graph consisting of bars representing different values or ranges of values, in which the length of each bar is proportional to the frequency or relative frequency of the value or range.

8.10 What is a Pareto chart?

Answer: A Pareto chart is a special form of histogram, in which attribute data are arranged according to some criteria such as cost or value. It provides a graphical display of the tendency for a small proportion of a given population to be more valuable than the much larger majority.

8.11 What is a check sheet?

Answer: The check sheet is defined in the text as a data gathering tool generally used in the preliminary stages of the study of a problem.

8.12 What is a defect concentration diagram?

Answer: The defect concentration diagram is a drawing of the product (or other item of interest), with all relevant views displayed, onto which are sketched the various types of defects or other problems of interest at the locations where they each occurred.

8.13 What is a scatter diagram?

Answer: A scatter diagram is an x-y plot of the data taken of two variables of interest.

8.14 What is a cause and effect diagram?

Answer: The cause and effect diagram, also known as a fishbone diagram, is a graphical-tabular chart used to list and analyze the potential causes of a given problem. The diagram consists of a central stem leading to the effect (the problem), with multiple branches coming off the stem listing the various groups of possible causes of the problem.

8.15 What does "USA" stand for in the USA principle?

Answer: USA stands for (1) understand the process, (2) simplify the process, and (3) automate the process.

8.16 What are the three phases in the automation migration strategy?

Answer: The three phases in the automation migration strategy described in the text are: Phase 1 is manual production to get into production as quickly as possible, Phase 2 is automated production in which the individual workstations are automated but not the material flow between stations, and Phase 3 is automated integrated production using a multi-station automated system with automated work flow between stations.

8.17 Why would a company want to use manual production methods instead of automated methods at the beginning of production of a new product?

Answer: A company would want to use manual production methods instead of automated methods at the beginning of production of a new product because it could start production sooner with manual methods. Designing automated equipment takes time, and the window of opportunity in the market for the product may be small.

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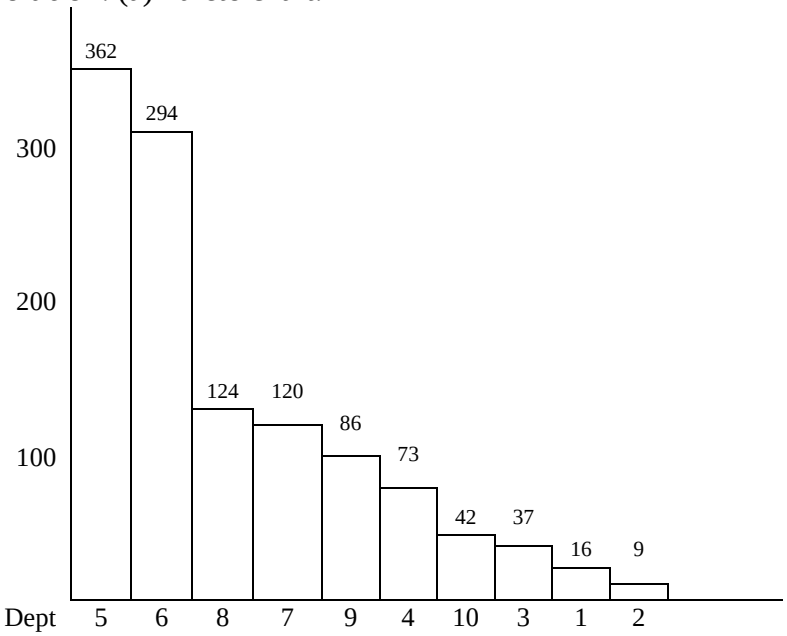
Problems

8.1 A factory has 10 departments, all of which have quality problems leading to delays in shipping products to customers. A breakdown of the number of quality problems for each department (listed alphabetically) is as follows: (1) assembly, 16; (2) final packaging, 9; (3) finishing, 37; (4) forging, 73; (5) foundry, 362; (6) machine shop, 294; (7) plastic molding, 120; (8) receiving inspection, 124; (9) sheet metalworking, 86; and (10) tool-making, 42. (a) Construct a Pareto chart for this data. (b) Assuming that all quality problems are of equal value, in which department would you start to take corrective action to reduce the quality problems? (c) Determine the percentage of total quality problems that are attributable to the two departments (20% of the departments) with the most quality problems.

Solution: (a) Pareto chart.



(b) Begin taking corrective action in Dept 5.

(c) Departments 5 and 6 account for 362 + 294 = 656 of the total quality problems. With the total number of quality problems in all departments summing to 1163, departments 5 and 6 account for 56.4% of the total number of quality problems.

8.2 Using your answer to part (c) of the preceding problem, (a) determine the parameter A in Eq. (8.1) representing the Pareto cumulative distribution. Use 20% of the departments as the x value in your computations. (b) Construct the idealized Pareto chart based on your answer to part (a) and discuss the comparison between this idealized chart and the actual data in the previous problem. Use a spreadsheet program to calculate the data for part (b).

Solution: (a) Given $y = 0.564$ and $x = 0.20$
$A = x(1\text{-}y)/(y\text{-}x) = 0.20(1 - 0.564)/(0.564 - 0.20) = 0.2396$

(b) A spreadsheet calculator was used to compare the calculated values with the values given in Problem 8.1. The following table lists the values.

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x	Calculated *y*	Actual data	Cum data	Actual *y*	Difference
0.1	0.365	362	362	0.311	-0.054
0.2	0.564	294	656	0.564	0.000
0.3	0.689	124	780	0.671	-0.019
0.4	0.775	120	900	0.774	-0.001
0.5	0.838	86	986	0.848	0.010
0.6	0.886	73	1059	0.911	0.025
0.7	0.924	42	1101	0.947	0.023
0.8	0.954	37	1138	0.979	0.025
0.9	0.979	16	1154	0.992	0.013
1.0	1.000	9	1163	1.000	0.000

The differences between calculated *y* (second column) and the actual *y* values (fifth column) are small (last column). The maximum difference is –0.054 for department 5. This is because the number of quality problems in departments 5 and 6 are so close to each other. In an ideal Pareto distribution, the differences would be greater. Also note that all of the differences after $x = 0.4$ are positive. This is because of the large drop in quality problems beyond the top two departments (5 and 6). In an ideal Pareto distribution, the differences would trail off more gradually.

8.3 Assume that 75% of the sales in a retail company are accounted for by 25% of the customers. (a) Determine the parameter *A* in the Pareto cumulative distribution equation. (b) Given that the relationship is valid for the remaining sales, how much of the sales value is accounted for by 50% of the customers?

Solution: (a) $A = x(1-y)/(y-x) = 0.25(1-0.75)/(0.75-0.25) = 0.125$

(b) At $x = 0.50$, $y = x(1+A)/(A+x) = 0.50(1+0.125)/(0.125+0.5) = 0.90 = 90\%$

8.4 The inventory policy of a retail company is to hold only the highest sales volume items in its distribution center and to ship the remaining lower sales volume items direct from the respective manufacturers to its stores. This policy is intended to reduce transportation costs. Total annual sales of the company are $1 billion. It is known that half of this amount is accounted for by only 15% of the items. In addition, it is assumed that equation (8.1) in the text can be used to model the Pareto cumulative distribution. (a) If the company wants to stock the top selling 35% of the items in the distribution center, what is the expected value of these items in terms of annual sales? (b) On the other hand, if the company wants to stock only those items accounting for the top 75% of annual sales, what proportion of the items corresponds to this sales volume?

Solution: (a) $A = x(1-y)/(y-x) = 0.15(1-0.50)/(0.50-0.15) = 0.2143$

At $x = 0.35$, $y = x(1+A)/(A+x) = 0.35(1+0.2143)/(0.2143+0.35) = 0.753 = 75.3\%$ is the expected percentage of the $1 billion total sales value that will be accounted for by the top selling 35% of the items. This amounts to $753 million.

(b) $y = 0.75$, find x
$y = x(1+A)/(A+x)$
$yA + yx = x + xA$
$yA = x + xA - yx = x(1 + A - y)$

$x = yA/(1 + A – y)$
For $y = 0.75$, $x = 0.75(0.2143)/(1 + 0.2143 – 0.75) = 0.346 = 34.6\%$ of the items corresponds to 75% of the sales volume. Note that the results in (a) and (b) are very close to each other.

8.5 The marketing research department for the Stitch Clothing Company has determined that 22% of the items stocked account for 70% of the dollar sales. A typical outlet store carries 1000 items. The items accounting for the top 60% of sales are replenished from the company's distribution center. The rest are shipped directly from the supplier (manufacturer) to the stores. How many items are represented by the top 60%?

Solution: (a) $A = x(1-y)/(y-x) = 0.22(1-0.70)/(0.70-0.22) = 0.1375$
For y = 60% = 0.60, $x = yA/(1 + A – y)$
$x = 0.\ 60\ (0.\ 1375)/(1 + 0.\ 1375 – 0.\ 60) = 0.1535 = 15.35\%$
Out of 1000 items, this represents about 154 of the items.

8.6 Consider some process or procedure with which you are familiar that manifests some chronic problem. Develop a cause-and-effect diagram that identifies the possible causes of the problem. This is a project that lends itself to a team activity.

No solution: Student exercise.

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