

## Chapter 2

# Historical Development of Engineering Management

### DISCUSSION QUESTIONS

**2-1. Q:** What was the lasting significance of the Sumerian priests' need to maintain a permanent record of temple property (which they did on clay tablets)?

**A:** The lasting significance was that the need to account for property fostered the development of written language. However, students will come up with a variety of other answers unless this point has been emphasized in class.

**2-2. Q:** Stones for the pyramids were quarried far to the south (upstream on the Nile River) and were brought downstream on rafts only during the spring flood of the Nile. Discuss some of the planning and organizational implications of this immense logistic effort.

**A:** The depth of planning for the pyramids was certainly impressive. The stones had to be cut up to a year ahead to fit in a specific location. The manpower to quarry stone, make rafts, transport stone to and from the rafts at each end (and to bring raft material from forest to river), much less build the structure, is impressive. George (History of Management Thought, 2nd ed., p. 5) lists 8,386 people in one expedition to quarry stone: "110 [army] officers of each rank, 50 civil officials and ecclesiastics, 130 stone masons, 2 painters, 4 engravers, ... 5,000 common soldiers, 200 members of the king's court, 800 barbarians, and 2,000 bondservants of the temple."

**2-3. Q:** Why was the Venetian development of double-entry bookkeeping so important to the development of management?

**A:** Obviously the entry of both a debit and a credit for each transaction permits a check on accuracy, facilitates audits, and increases security.

**2-4. Q:** The development of cotton and woolen mills in the mill cities of England, and later New England, caused tremendous sociological change as potential workers (especially women) swarmed from rural areas to the growing industrial cities. Cite examples of similar occurrences in more recent times in developing countries.

**A:** A senior/graduate class of 17 students, about half international, suggested the following:

- \* The rush of Burmese women to textile and jute mills depleted rice field workers, threatening starvation.

- \* 1000 Navaho farmers in New Mexico now work instead for General Dynamics.

- \* Mexico City and Sao Paulo, Brazil are now #1 and #3 among populated cities because of the influx from rural areas.

- \* Philippine creation of an Export Processing Zone a decade ago established an economic boom (along with overcrowding, crime, and pollution) in the area as rural people flocked in.

- \* The percentage of Taiwan's population working in agriculture has decreased "to recent low 20's from original high 80's in less than four decades," creating the same urban problems cited for the Philippines.

- \* Indian villagers have swelled Bombay and Calcutta to populations above 15 million. "A few are

successful in finding low paying jobs but a large number turn to other forms of income such as begging and crime.”

\* Even in the remote country of Bhutan (North of India) rural people are now flocking into the towns, powered looms in the “weaving centers” are replacing obsolete hand/foot driven machines, and workers from India have migrated in to provide needed trained manpower and technicians to work with unskilled Bhutanese in the factories.

**2-5. Q:** Summarize the contribution of the American Society of Mechanical Engineers to the dissemination of better methods of (production) shop management. What does this say about your need to be active in at least one professional society?

**A:** Frederick Taylor provides a good example -first he was inspired by Henry Towne’s paper in 1886, later he shared his own ideas through papers before the ASME, and still later as ASME president he funded Morris Cooke to study the administrative effectiveness of the ASME (which no doubt influenced Cooke’s career in governmental service organizations). The reasons for activity in professional organizations should be evident to any real professional, but this question can be used as a springboard for emphasizing this need to students.

**2-6. Q:** Matsushita emphasized the residual disadvantages to the United States of the teachings of Frederick Taylor. Discuss the *positive* contributions Taylor and his contemporaries in the scientific management movement made.

**A:** Taylor and his followers developed methods of work measurement and work design that provided tremendous savings in labor intensive work and led to development of much of traditional industrial engineering. These methods are still valid, but they can be strengthened if the ideas and enthusiasm of the (now much better educated) work force can complement the work of the industrial engineer using techniques such as quality circles and their derivatives.

**2-7. Q:** What was the positive value of Max Weber’s model of “bureaucracy?”

**A:** Weber’s bureaucracy provides a formal, consistent structure, staffed on the basis of training and achievement, with formal authority of position and consistent procedures. All large organizations doing routine work need much of this structure. The challenge to management is to provide a more flexible structure for those areas where innovation and creativity are more important.

**2-8. Q:** The essence of the Relay Assembly Test Room Experiments at the Hawthorne Works was that expected correlations between productivity and physical factors such as illumination and rest periods were not demonstrated. What other factors could explain the regular productivity increases observed in these experiments?

**A:** Some of the conventional explanations have included (a) the feeling their work was important, (b) development of a friendly social group and a team spirit, and (c) being able to assume more responsibility for their work in the absence of a supervisor. Other factors may have been (d) the six women may have been a picked group (one of the original six “didn’t work out” and was replaced), (e) their piecework pay was based on productivity of just those six women, so they felt they could influence their pay, and (f) during the long experimental period their productivity might be expected to increase compared with a standard group with higher turnover.

**2-9. Q:** Read at least part of *In Search of Excellence* and elaborate on one significant finding of Peters and Waterman.

**A:** Each answer will need to be evaluated separately. Peters and Waterman summarize for us: “The eight attributes that emerged to characterize most nearly the distinction of the excellent, innovative companies go as follows: 1. A bias for action ... 2. [staying] Close to the customer ... 3. [fostering] Autonomy and entrepreneurship ... 4. Productivity through people ... 5. Hands-on, value driven [philosophy] ... 6. Stick to the knitting [don’t acquire a business you don’t know how to run] ... 7. Simple form, lean staff ... 8. Simultaneous loose-tight properties [being both centralized and decentralized). One would hope a student’s reply would comment on at least one of these themes.

**2-10. Q:** As made clear in this chapter, engineers and engineer managers have made strong contributions to management theory and practice. List the engineers and engineer managers identified in this chapter, together with their contributions, and add any others you may know of.

**A:** Craftsmen inventors such as Hargreaves, Arkwright, Crompton, Cartwright, and Maudslay made the English industrial revolution possible, although these inventions are not contributions to management theory and practice directly. Smeaton and Watt in their steam engine works, Robert Owen in his mills, Henri Fayol in the French mining complex, Andrew Carnegie in the American steel industry, and Col. John Stevens in railroad construction made substantial 19th century innovations in industrial management. Frederick Taylor, Henry Gantt, Frank Gilbreth, and Morris Cooke were turn-of-the-century U.S. engineers who made great contributions to management of the shop and other enterprises; Lillian Gilbreth was educated as a psychologist but continued Frank’s work and was a member of several engineering societies. Henry Towne, Chester Barnard, Alfred Sloan, and Thomas Watson Jr. were executives in enterprises that were high technology in their time. Russell Robb and Vannevar Bush were electrical engineers who contributed to industrial management theory in the mid 20th century. The list can be extended indefinitely. However, social scientists such as Weber, Elton Mayo, and others who were neither engineers nor managers should not be considered responsive to the question.