

CHAPTER 2 TECHNOLOGY EVOLUTION

TRUE/FALSE QUESTIONS

1. The evolution of film technology provides a good example of the discontinuous nature of technology innovation.
(False; Medium; p. 17; LO1)
2. By forecasting technology evolution, you can develop a strategy that considers the shifts in the nature of competition between firms.
(True; Medium; 18. ; LO1)
3. Many researchers view technology advance as a process that begins when commercial products are adopted by a wide range of customers.
(False; Easy; p. 18; LO1)
4. Paradigms are new advances made as researchers seek for answers to current technical problems building on prior knowledge that has accumulated.
(True; Medium; p. 19; LO1)
5. The economic environment influences the rules of the society in which the technology advance takes place.
(False; Medium; p.19 ; LO1)
6. Moore's law predicted that the number of transistors that could be packed onto an integrated circuit at the minimum cost for the component would double every 10 years.
(False; Medium; p. 19; LO1)
7. Incremental technology innovation involves small improvement to existing technologies.
(True; Medium; p. 21; LO1)
8. The Pentium computer processor is an example of a radical technology
(False; Difficult; p. 21; Reflective learning skills; LO1)
9. Technology S-curves are graphical representation of the development of a new technology.
(True; Medium; p. 22; LO2)
10. Initially performance improvements per unit of effort are great because there are many things that need to be learned while developing new technologies.
(False; Difficult; p. 22; LO2)
11. Rapid improvements in technology tend to follow the identification of key drivers of performance.
(True; Medium; p. 22; LO2)

12. Emerging firms in an industry tend to be the ones to make incremental technological improvements.
(False; Medium; p.23 ; LO2)
13. New technology is often developed to challenge the existing technology when the existing technology reaches the point of diminishing returns.
(True; Medium; p. 24; LO3)
14. When first introduced, new technology is typically superior to existing technology on key dimensions such as quality, performance, and reliability.
(False; Medium; p. 24; LO3)
15. Because new technology is a radical change from the existing technology, it has greater potential for performance improvement than the existing technology.
(True; Medium; p. 25; LO3)
16. When S-curves shift, the new curve is generally above and to the right of the existing curve.
(False; Difficult; p. 25; LO3)
17. Customers typically shift to a new technology in large numbers once the new technology improves to the point where it surpasses the old technology on the dimensions that customers' value.
(True; Easy; p. 25; LO3)
18. To introduce new technologies, incumbent firms typically have to write-off their investments in the old technology.
(True; Easy; p. 25; LO3)
19. Cannibalization occurs when a firm sells a new product that takes sales from one of more of its existing products.
(True; Easy; p. 25; LO3)
20. Managers at incumbent firms frequently create routines that obtain information about alternatives to their core technologies which lead them to view new technologies positively.
(False; Difficult; p. 26; LO3)
21. The S-curve can be used as a tool to predict when a company should invent is the development of a new technology.
(True; Easy; p. 27; LO4)
22. Plots of technology S-curves will tell you when a company needs to make changes from an old technology to new technologies.
(False; Medium; p.27 ; LO4)
23. Shifting too early to a new technology will likely saddle a company with a new technology that is inferior to the old one.
(True; Medium; p. 28; LO4)

24. Existing technologies will often reach a point of diminishing returns long after a firm can offer a viable alternative based on a new technology.
(False; Difficult; p. 28; LO4)
25. Typically, there is a high rate of new firm entry and a low rate of new firm exit in the fluid phase of the Abernathy-Utterback model.
(True; Medium; p. 28; LO5)
26. The Abernathy-Utterback model predicts the patterns of industry evolution equally well in all manufacturing industries.
(False; Medium; p. 29; LO5)
27. A radical technology is competence-destroying if it makes use of existing knowledge, skills, abilities, structure, design, production processes and plan and equipment.
(False; Medium; p. 35; LO7)
28. According to the reverse product cycle model, service industries start with incremental innovation and move to radical innovation.
(True; Medium; p. 34; LO9)
29. Eventually, new firms will invest in the development of new technologies because the potential for improvement of the new technologies is higher than the potential for improvement of the old technology.
(True; Medium; p. 39; LO9)

MULTIPLE CHOICE

30. By forecasting technology evolution, you can develop a strategy that considers:
a. the emergence of technologies
b. changes in the dominant strategies and structures of other firms
c. shifts in the nature of competition between firms
d. all of the above
(d; Easy; p. 18; LO1)
31. Which force influences the nature of incentives created for technological advance?
a. economic
b. competitive
c. political
d. social
(a; Medium; p. 19 LO1)
32. Which force is most likely to influence the rules of the society in which the technological advance takes place?
a. economic
b. competitive
c. political
d. social
(c; Medium; p. 19; LO1)

33. Fears, motivations and attitudes of people are most likely related to which force?
- a. economic
 - b. competitive
 - c. political
 - d. social
- (d; Medium; p. 19; AACSB: Reflective thinking skills; LO1)
34. Most technological innovation is:
- a. radical
 - b. incremental
 - c. fluid
 - d. specific
- (b; Medium; p. 21; LO1)
35. Which type of innovation involves fundamentally new ways of solving a problem?
- a. radical
 - b. incremental
 - c. fluid
 - d. specific
- (a; Medium; p. 21; LO1)
36. Which of the following would be considered an incremental innovation?
- a. all wheel drive vehicles
 - b. aspirin
 - c. medical diagnostic imaging
 - d. video cassette recorders
- (a; Difficult; p. 22; AACSB: Reflective thinking skills; LO1)
37. Which type of technological innovation requires fundamentally different strategies and organizational structures?
- a. radical
 - b. incremental
 - c. fluid
 - d. specific
- (a; Medium; p. 22; LO1)
38. Technology S-curves are graphic representations that compare:
- a. performance and cost
 - b. performance and effort
 - c. cost and effort
 - d. profit and effort
- (b; Medium; p. 22; LO2)
39. What is most likely to occur as you first begin to develop technology?
- a. very little performance improvement for each unit of effort
 - b. rapid improvement for each unit of effort
 - c. constant improvement for each unit of effort
 - d. decreasing improvement for
- (a; Medium; p. 22; LO2)

40. What is most likely to occur once the key drivers of performance have been identified?
- very little performance improvement for each unit of effort
 - rapid improvement for each unit of effort
 - constant improvement for each unit of effort
 - decreasing improvement for each unit of effort
- (b; Medium; p. 23; LO2)
41. What is most likely to occur once a firm has reached the upper portion of the S-curve?
- very little performance improvement for each unit of effort
 - rapid improvement for each unit of effort
 - constant improvement for each unit of effort
 - decreasing improvement for each unit of effort
- (d; Medium; p. 23; LO3)
42. How can the introduction of new technology be best depicted?
- a movement up the S-curve
 - a movement down the S-curve
 - a shift of the S-curve
 - could be any of the above
- (c; Easy; p. 24; AACSB: Reflective thinking skills; LO3)
43. What is one of the reasons incumbent firms are reluctant to introduce new technologies that shift the S-curve?
- they have very little invested in the existing technology
 - they have no incentive to introduce the new technology
 - managers at incumbent firms see the new technology as a threat
 - the incumbent firms can't improve the technology of their old technologies
- (b; Difficult; p. 25; LO3)
44. When should a firm prepare for a technology shift by investing in the development of alternative technologies?
- at the bottom of the S-curve
 - when first entering the intermediate portion of the S-curve
 - when the firm has been in the intermediate portion of the S-curve for several years
 - when the firm has reached the point of diminishing returns
- (a; Easy; p. 27; AACSB: Reflective thinking skills; LO4)
45. What typically needs to occur before a new technology can "take off"?
- supportive technologies need to be created
 - a need for the new product has to be identified
 - focus on niche segments of the market that may be less profitable
 - all of the above are required
- (d; Easy; p. 27; LO4)
46. According to the Abernathy-Utterback model, what follows radical innovation?
- product innovation
 - process innovation
 - fluid phase
 - specific phase
- (c; Medium; p. 29; LO5)

47. According to the Abernathy-Utterback model, when does only incremental innovation occur?
- a. product innovation
 - b. process innovation
 - c. fluid phase
 - d. specific phase
- (d; Medium; p. 29; LO5)
48. According to the Abernathy-Utterback model, what causes the cycle of innovation to repeat?
- a. radical innovation
 - b. incremental innovation
 - c. fluid phase
 - d. specific phase
- (a; Medium; p. 29; LO5)
49. What can be used to describe the creation of new goods and services sold to customers?
- a. process innovation
 - b. product innovation
 - c. radical innovation
 - d. incremental innovation
- (b; Medium; p. 29; LO5)
50. What is it called when technological innovation involves problem solving that improves the method of creating or delivering a product or service?
- a. process innovation
 - b. product innovation
 - c. radical innovation
 - d. incremental innovation
- (a; Medium; p. 29; LO5)
51. What type of innovation was exemplified when Boeing's engineers figured out how to make the wings of the new Dreamliner aircraft out of a composite material in place of aluminum to make the plane lighter and more fuel efficient?
- a. process
 - b. product
 - c. fluid
 - d. specific
- (a; Difficult; p. 29; AACSB: Reflective thinking skills; LO5)
52. In what phase of an industry is there generally the most risk?
- a. process
 - b. product
 - c. fluid
 - d. specific
- (c; Medium; p. 29; AACSB: Reflective thinking skills; LO5)

53. What is most descriptive of the specific phase of an industry?
- a. production is relatively inefficient
 - b. a variety of different production processes are used
 - c. a dominant design emerges
 - d. customers do not have clearly defined preferences
- (c; Difficult; p. 29; AACSB: Reflective thinking skills; LO6)
54. In which phase of an industry does competition typically shift away from design uniqueness to production costs as firms focus on achieving production efficiencies with the common design?
- a. process
 - b. product
 - c. fluid
 - d. specific
- (d; Medium; p. 30; LO6)
55. What type of innovation is most likely to occur during the specific phase?
- a. process
 - b. product
 - c. fluid
 - d. specific
- (a; Easy; p. 30; LO6)
56. The personal computer industry provides a good example of:
- a. how the dominant type of innovation changes as an industry shifts from the fluid to specific phase
 - b. how the dominant type of innovation changes as an industry shifts from the specific to fluid phase
 - c. how the dominant type of innovation changes as an industry shifts from the fluid to the specific phase
 - d. how the dominant type of innovation changes as an industry shifts from the specific to the fluid phase
- (a; Easy; p. 30; AACSB: Reflective thinking skills; LO6)
57. According to the Abernathy-Utterback model, which phase is most favorable for new firms?
- a. process
 - b. product
 - c. fluid
 - d. specific
- (c; Easy; p. 31; LO6)
58. What is most likely to happen once a dominant design has been established?
- a. new firms can operate without adopting the same product as more experienced firms
 - b. firms operate on a small scale to minimize technical uncertainty
 - c. learning curves are weak
 - d. organizational structures become more hierarchical and bureaucratic
- (d; Difficult; p. 31; LO6)

59. What is most likely to happen before a dominate design has been established?
- learning curves become pronounced
 - organization structures become more hierarchical and bureaucratic
 - firms operate on a small scale to minimize technical uncertainty
 - new firms adhere to the standard product design
- (c; Difficult; p. 31; LO6)
60. In which phase is there most likely to be the largest increase in the number of firms?
- process
 - product
 - fluid
 - specific
- (c; Easy; p. 31; LO6)
61. What is the most likely explanation why electric vehicles did not become popular in the early 1900s?
- they were lacking technical superiority
 - mechanics felt they were too easy to work on
 - gas powered cars became the dominant design
 - they were easier to refuel than gas powered vehicles
- (c; Easy; p. 33; AACSB: Reflective thinking skills; LO6)
62. Which researcher(s) modified the Abernathy and Utterback model by applying it to service businesses?
- Barras
 - Tushman
 - Christensen
 - Henderson and Clark
- (a; Easy; p. 34; LO8)
63. What model predicted that a different model of innovation operated in service industries?
- model of competence destroying and competence enhancing innovation
 - model of value networks and disruptive innovation
 - model of reverse product cycle theory
 - model of architectural innovation
- (c; Medium; p. 34; LO8)
64. What is most likely to occur in the second phase of the reverse product cycle theory?
- the adopted technology is employed to make existing services more efficient
 - incremental improvements are most likely to occur
 - the new technology is used to make the service more efficient
 - the technology is used to create new services, making changes radical
- (c; Difficult; p. 34; LO8)
65. What is most likely to occur in the third phase of the reverse product cycle theory?
- the adopted technology is employed to make existing services more efficient
 - incremental improvements are most likely to occur
 - the new technology is used to make the service more efficient
 - the technology is used to create new services, making changes radical
- (d; Difficult; p. 34; LO8)

66. Which model was developed after observing that, in some cases, incumbent firms had little trouble transitioning to new radical technologies?
- a. model of competence destroying and competence enhancing innovation
 - b. model of value networks and disruptive innovation
 - c. model of reverse product cycle theory
 - d. model of architectural innovation
- (a; Medium; p. 35; LO8)
67. A radical technology is _____ if it makes use of exiting knowledge, skills, abilities, structures, design, production processes and plant and equipment, whereas, it is _____ if it undermines the usefulness of these things.
- a. radical; stable
 - b. stable; radical
 - c. competence-enhancing; competence-destroying
 - d. competence-destroying; competence-enhancing
- (c; Medium; p. 35; LO8)
68. Which modification to the Abernathy and Utterback model was developed after noticing that incumbent firms often failed to manage the transition from one technology to another?
- a. model of competence-destroying and competence-enhancing innovation
 - b. model of value networks and disruptive-innovation
 - c. model of reverse product cycle theory
 - d. model of architectural innovation
- (d; Medium; p. 35; LO8)
69. According to Henderson and Clark, which type of innovation changes the components from which the innovation is created but not the linkage between those components?
- a. radical
 - b. stable
 - c. modular
 - d. architectural
- (c; Difficult; p. 36; AACSB: Reflective thinking skills; LO8)
70. According to Henderson and Clark, which type of innovation is one that changes the linkages between the components but leaves the components intact?
- a. radical
 - b. stable
 - c. modular
 - d. architectural
- (d; Difficult; p. 37; AACSB: Reflective thinking skills; LO9)

71. According to Henderson and Clark, which of the following is a reason why firms often fail in the face of architectural innovation?
- a. incumbent firms often lack the right external linkages to gather information about a new technology architecture emerging in an industry
 - b. firms often lack the capacity to recognize the value of information about architectural innovation that is presented to them
 - c. even when incumbent firms recognize the value of architectural innovation, they often have difficulty making use of it because adopting an architectural innovation typically requires a company to restructure.
 - d. all of the above are reasons why firms fail in the face of architectural innovation
- (d; Easy; p. 37; LO9)
72. According to Henderson and Clark, what type of innovation would occur if core concepts were reinforced and linkages were unchanged?
- a. incremental
 - b. modular
 - c. architectural
 - d. radical
- (a; Difficult; p. 37; AACSB: Reflective thinking skills; LO9)
73. According to Henderson and Clark, what type of innovation would occur if core concepts were overturned and linkages were unchanged?
- a. incremental
 - b. modular
 - c. architectural
 - d. radical
- (b; Difficult; p. 37; AACSB: Reflective thinking skills; LO9)
74. According to Henderson and Clark, what type of innovation would occur if core concepts were reinforced and linkages were changed?
- a. incremental
 - b. modular
 - c. architectural
 - d. radical
- (c; Difficult; p. 37; AACSB: Reflective thinking skills; LO9)

75. What modification to the Abernathy and Utterback model resulted after it was noticed that incumbent firms were often the very firms that invented the radical new technologies that they were unable to adopt?
- a. model of competence-destroying and competence-enhancing innovation
 - b. model of value networks and disruptive-innovation
 - c. model of reverse product cycle theory
 - d. model of architectural innovation
- (b; Medium; p. 38; LO9)
76. The case of the radical new technology used in memory chips, magnetoresistive random access memory (MRAM), is a good example to which modification to the Abernathy and Utterback model?
- a. model of competence-destroying and competence-enhancing innovation
 - b. model of value networks and disruptive-innovation
 - c. model of reverse product cycle theory
 - d. model of architectural innovation
- (b; Difficult; p. 38; AACSB: Reflective thinking skills; LO9)

ESSAY QUESTIONS

78. Describe the evolutionary pattern of technological advance and development.
(Difficult; pp. 18-21; AACSB: Reflective thinking skills; LO1)
79. Compare and contrast radical and incremental change.
(Difficult; pp. 21-22; AACSB: Reflective thinking skills; LO1)
80. Define a technology S-curve, explain why it is important, describe what leads to a shift in the S-curve, and explain the pros and cons of using technology S-curves.
(Difficult; pp. 22-29; AACSB: Reflective thinking skills; LO2-LO4)
81. Describe the Abernathy-Utterback model of technology innovation and describe the modifications that have been proposed to the model to increase its relevance.
(Difficult; pp. 29-40; AACSB: Reflective thinking skills; LO5)