

# DESIGNING PRODUCTS, SERVICES, AND PROCESSES

In planning the conversion system, major decisions are made concerning the design of the product or service as well as the design of conversion processes to produce the product or service. We address these decisions by first presenting the design of new products, followed by the design of manufacturing processes. After presenting each separately for manufacturing, we consider service product and process design choices together.

## NEW PRODUCT DESIGN (PRODUCT DEVELOPMENT)

### THE ORIGIN OF NEW PRODUCTS

Entrepreneurs frequently form new businesses on the basis of a unique product idea or needed service. As competitors infringe on the market, replicating products and services, or as the useful product life diminishes, firms ordinarily prepare to bring out new products or services. These new product and service ideas come from various sources, including customers, top management, and staff from marketing, research and development, production, and engineering. Once launched, even good products have limited lives and, to remain viable, the organization seeks a flow of new product possibilities. Let's examine the product's birth-to-mortality pattern.

### PRODUCT LIFE CYCLE

The demand for a product—its market acceptance—generally tends to follow a predictable pattern called the *product life cycle*.<sup>1</sup> Products go through a series of stages, beginning with low demand during market development, proceeding through growth, maturity, high-volume saturation, and finally decline. The time spans of the stages vary considerably across industries. For novelty products, the time from birth to death may be as short as a few weeks or months. For other products the life cycle may span many years or even decades. In any case the very nature of this pattern raises significant questions for operations management: When will the various stages occur, and how must operations accommodate them? What facilities, materials, labor, and management systems are optimal for meeting demand? What should be done with existing facilities and conversion processes as products proceed through their various stages? Let's look at some major operations issues arising from the product life cycle.

**Operations Issues in the Product Life Cycle** From an operations management viewpoint, the life cycle can be reconstructed into four stages, as shown in Figure 4.1, to reveal four important issue areas. As you can see, the operations strategy and conversion technology have to be adaptive throughout the life cycle because product variety, volume, industry structure, and form of competition all are changing. Consider,

*Product life cycle* Pattern of demand throughout the product's life; similar patterns and stages can be identified for the useful life of a process.

ises, required dates, and problem areas. It is only with this knowledge that program management can make the decisions and implement the actions needed for an on-time, on-budget engine development program.

Because of their complexities, the core of engine development programs is team effort; specialists from manufacturing, engineering, test, and marketing join together using a common "real time" database to identify and provide solutions to the problems. This teamwork ensures the product will be accepted in the market and yield an acceptable return on investment.

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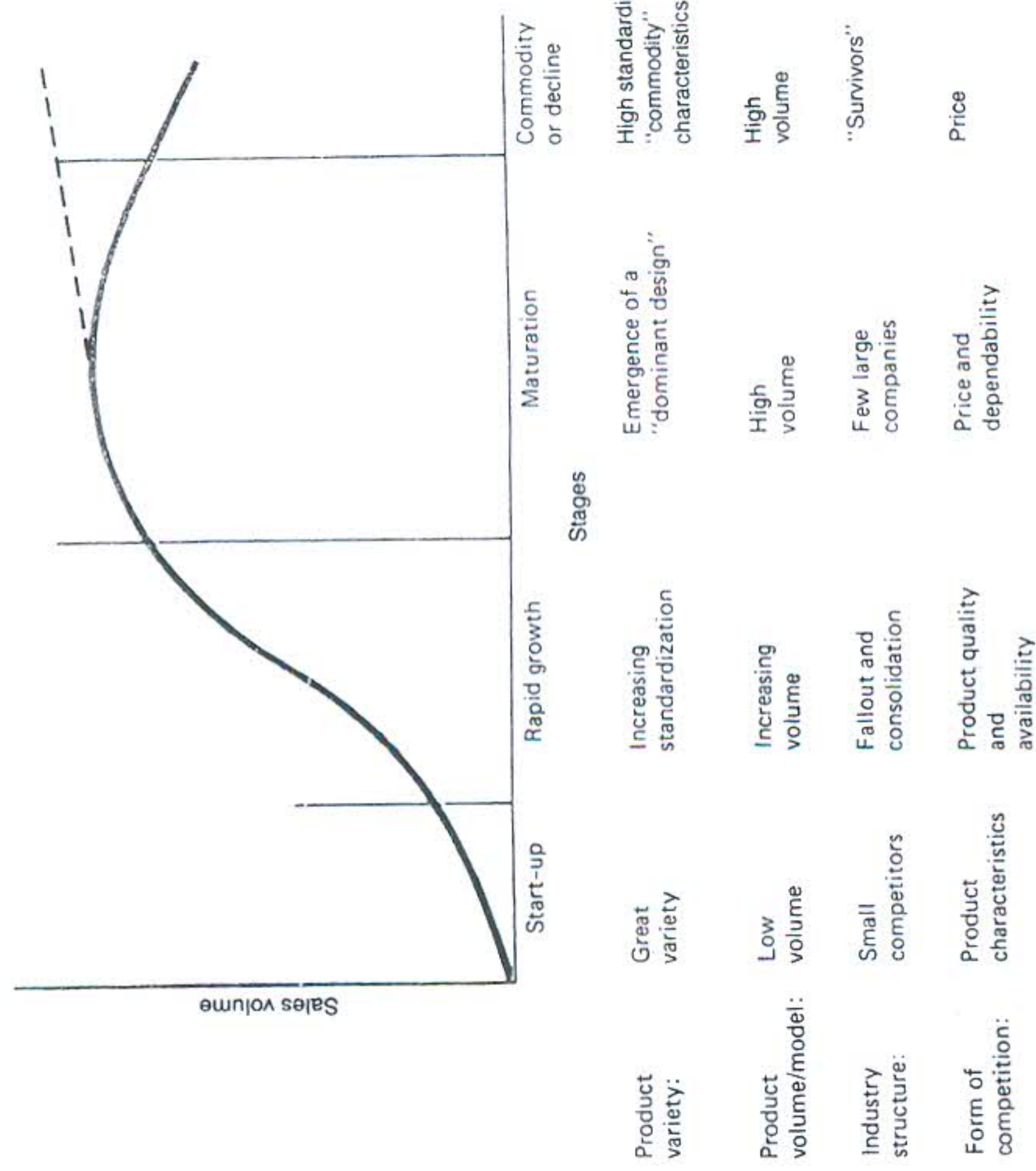
**D**eveloping a turbofan engine to power a modern commercial passenger transport requires an investment of \$1 billion and takes approximately four years of design and testing.

The investment must begin, along with the engineering effort, before the actual market is developed. As the market unfolds, the aircraft and the engine are modified to insure acceptability and profitability at the time of introduction.

During the initial design period, dialogue must be firmly established between the engineering teams and the manufacturing teams. This dialogue and the resultant team-building not only assures a "design to cost" philosophy but aids the development process when a component must be redesigned for cost, market, or reliability reasons.

Throughout the design and development phase, "real time" data allow the entire team to know the status of drawing releases, hardware prom-

<sup>1</sup>For an empirical approach to evaluating product life cycles, see Cornelis A. deKluyver, "Innovation and Industrial Product Life Cycles," *California Management Review* 20, no. 1 (Fall 1977), 21-3. Process and facility life cycles are discussed in Roger W. Schmenner, "Every Factory Has a Cycle," *Harvard Business Review* 61, no. 2 (March-April 1983), 121-29.



**FIGURE 4.1** Characteristics of the product life cycle important to manufacturing process technology  
 Source: R. H. Hayes and S. C. Wheelwright, *Restoring Our Competitive Edge* (New York: John Wiley, 1984), 203.

for example, differences in the demands on product design and production in the start-up phase, where design changes are frequent, versus the final stage where the design of the product is stable and, consequently, so is the conversion process.

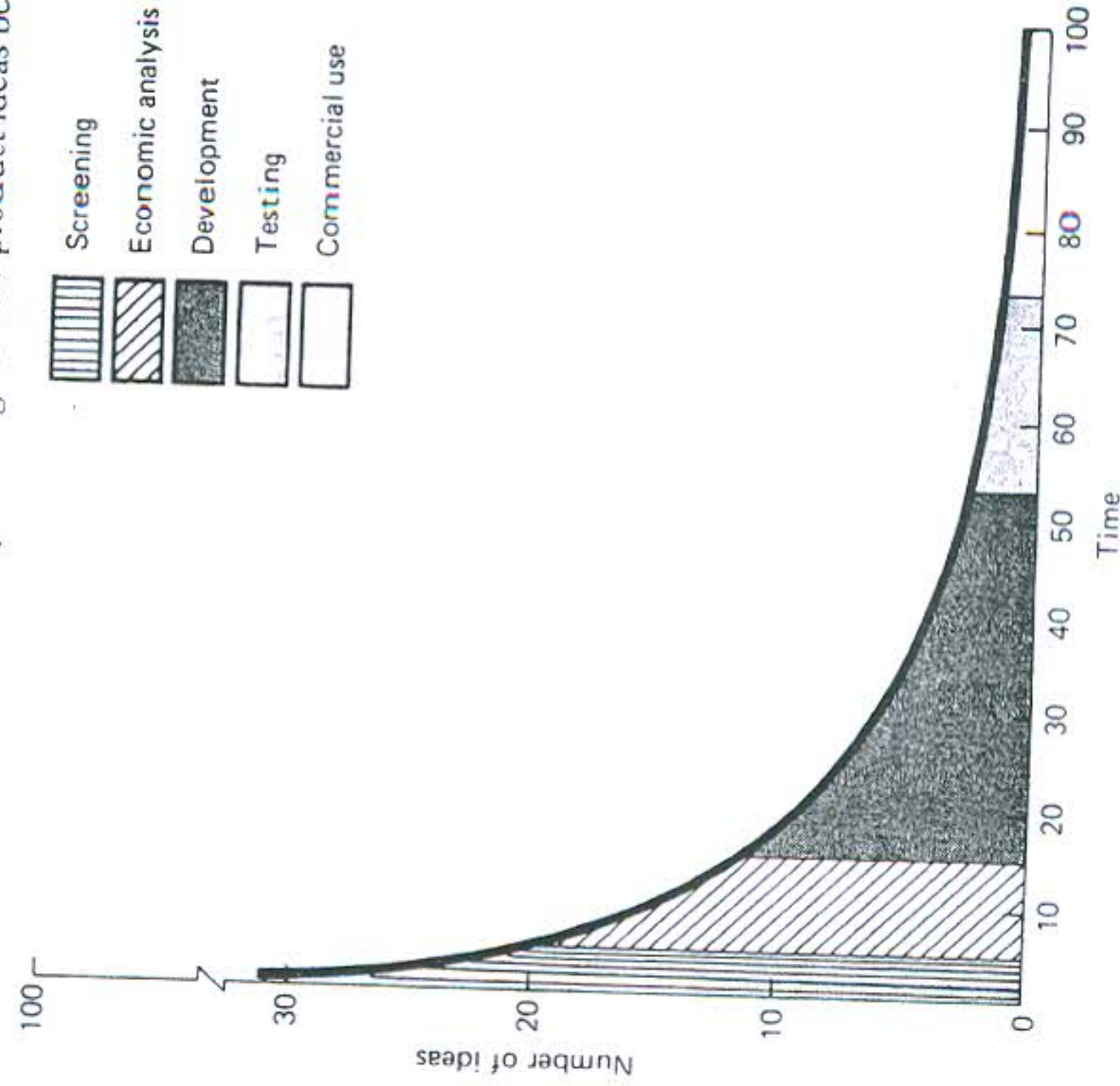
As fewer but larger competitors emerge, the form of competition shifts dramatically, requiring commensurate changes in the manufacturing competence. Whereas the early life-cycle stages emphasize the product's unique characteristics and quality, later life-cycle stages emphasize price competition and delivery capabilities. Survival in the market depends on producing a stable product with high volume in contrast to the earlier emphasis on a high product variety, low-volume conversion process. The conversion process has changed substantially, including new types of human skills and orientations, equipment and facility revisions, and planning and control systems. What can be done to prepare for and influence these adaptations? Part of the answer is to use research and development (R&D) to create new products and production processes.

**Phasing Multiple Products** A general strategy of phasing new products in and phasing old products out sustains existing processing technology: As existing products are demanded less during the later stages of their life cycles, new products are developed and produced so that output capacity can remain stable.

Of course, transitions are not always smooth; rarely does capacity remain constant. The technologies needed to produce different products are not identical, and changes are almost always necessary. Organizations do not always have a new product waiting for introduction at the precise moment that an existing product begins to decline. Furthermore, rates of growth and decline may not be predictable. Promotional efforts, however, can sometimes influence rates of growth and decline. IBM, an expert at planned change, has introduced new computer lines since the late 1950s. Phasing new computers in to and old ones out of its basic product line, IBM plans for the changes in its market.

**Research and Development (R&D)** Many organizations, especially larger ones, do not leave the development of new products and processes to chance. They devote their efforts toward creating new products, find new uses for existing products, and develop new processes that will reduce capital or manufacturing costs. These are the objectives of research and development.<sup>2</sup>

Developing a successful new product or process takes many steps and involves the talent and expertise of many people. As new-product ideas are created, they are evaluated for economic feasibility, market potential, functional testing, and so on. As shown in Figure 4.2, only a small percentage of new-product ideas become commercial



**FIGURE 4.2** Decay curve of new product ideas  
 Source: R. A. Johnson, W. T. Newell, and R. C. Vergin, *Production and Operations Management: A Systems Concept* (Boston: Houghton Mifflin Company, Copyright © 1974), 144. Used with permission.

<sup>2</sup>The role of R&D in organizational change is discussed by Neil V. Hakala, "Administration of Industrial Technology," *Business Horizons* 20, no. 5 (October 1977), 4-10.

