

The next issue is how the firm intends to acquire the technologies that it needs. For this decision, a manager should evaluate and examine the pros and cons of each option.

### Methods of Acquiring Technology 62

There are several recognised methods for the acquisition of technology: (1) using internal R&D, (2) participating in a joint venture, (3) contracting out for R&D, (4) licensing in of technology and (5) buying the technology from others. These methodologies are described briefly here:

1. *Using internal R&D:* In this method, the company relies on its own human and technical resources to develop the technology in-house. This requires the presence of a strong technical workforce and strong financial backing for R&D operations. Some large companies such as General Electric (GE), General Motors (GM), American Telephone and Telegraph (AT&T), and Du Pont were known to have their own R&D laboratories to support their efforts to create new technologies.
2. *Participating in a joint venture:* Two or more firms combine their know-how and technological resources to develop technologies. An example of this is the joint venture between International Business Machines, Motorola, and Apple to develop the Power PC chip, or the joint venture between Motorola and Toshiba, in which Motorola can use its strength in microprocessor technology and Toshiba can use its strength in memory chips.
3. *Contracting out for R&D:* By contracting out, a company can conduct R&D without having to invest heavily in an in-house R&D effort. Many companies are increasing their use of this approach to cut R&D expenditures. The popularity of this method also increased after the cold war, when many former defence- and military-oriented R&D establishments became underutilised. These laboratories have the necessary human and technical resources and have started making their services available commercially. Many companies take advantage of this opportunity and contract out their R&D projects to them.
4. *Licensing in of technology:* In this method, a company purchases the right to utilise technologies owned by someone else. In the mid-1950s, the Sony Corporation bought a licence for the transistor from AT&T and was able to widely deploy the technology in its products. Observe the number of transistor-based products that Sony produces today. In the service industry acquiring a franchise of a well-known corporation such as Burger King is a common practice. There is a premium to be paid for using the name of that corporation and for offering its products.
5. *Buying the technology:* In this method, an outright purchase of technology occurs. This is the fastest way to obtain a technology, and does not involve any resource commitment for technology development on the part of the acquirer. However, there is no control over the technology, and no real acquisition is considered to have occurred. Using this method to get access to technology requires building strong bridges with the supplier of the technology to guarantee the continued and timely support of the technology to ensure long life cycle. This method of technology acquisition is suitable for external types of technology.



Ford (1988) developed a very useful matrix that shows the applicability of different acquisition methods under different circumstances. It considers five factors upon which a company can make an acquisition decision. These are (1) the company's relative standing in the technology, (2) the urgency of acquisition, (3) the level of commitment to the acquisition or the level of investment involved, (4) the technology position on the life cycle curve, and (5) the classification of the technology as distinctive, basic, or external. The matrix is shown in Figure 10.1. Engineers and managers can use such a matrix as a guide during the decision-making process.

The matrix shows the applicability of each method of acquisition according to the criteria listed at the top of the matrix. For example, if a company's relative standing in a technology is high, it makes sense to capitalise on this strength and build new technology internally. This approach allows the company to consolidate its position in a core area of strength and helps in promoting its technology. Conversely, if a company's relative standing in a technology is low, buying the technology is the method preferred. Likewise, if the urgency of acquisition is high, buying or licensing the technology is the preferred method. Relying on R&D in this case is likely to be costly and time-consuming and to lack a guarantee of success. But if the urgency of acquisition is the lowest, the internal R&D method of acquisition is an option to be considered.

Acquisition Methods	Company's Relative Standing	Urgency of Acquisition	Commitment/ Investment Involved	Technology Life Cycle Position	Categories of Technology
Internal R&D	High	Lowest	Highest	Earliest	Most Distinctive or Critical
Joint Venture		Lowest		Early	Distinctive or Basic
Contracted-out R&D		Low		Early	Distinctive or Basic
Licence-in		High	Lowest	Later	Distinctive or Basic
Non-acquisition, i.e., buying final product or part production	Low	High	No Commitment/ Investment	All Stages	External

Fig. 10.1 Factors Affecting the Technology Acquisition Decision (Source: David Ford, 'Develop Your Technology Strategy.' Reprinted from Long Range Planning, Vol. 21, No. 5, 1988, p. 91, with permission from Elsevier Science.)



## THE S-CURVE OF TECHNOLOGICAL PROGRESS

A technology's improvement of performance follows the S-curve. When a technology-performance parameter (y-axis) is plotted against time (x-axis), the result resembles an s-shaped diagram called the *S-curve*. Technological performance can be expressed in terms of any attribute, such as density in the electronics industry (number of transistors per chip) or aircraft speed in miles per hour.

As can be seen in Figure 5.3, technology progresses through a three-stage *Technology Life Cycle (TLC)*: (1) the new invention period, also known as the embryonic stage; (2) the technology improvement period, also known as the growth stage; and (3) the mature-technology period. The technology becomes vulnerable to substitution or obsolescence when a new or better-performing technology emerges.

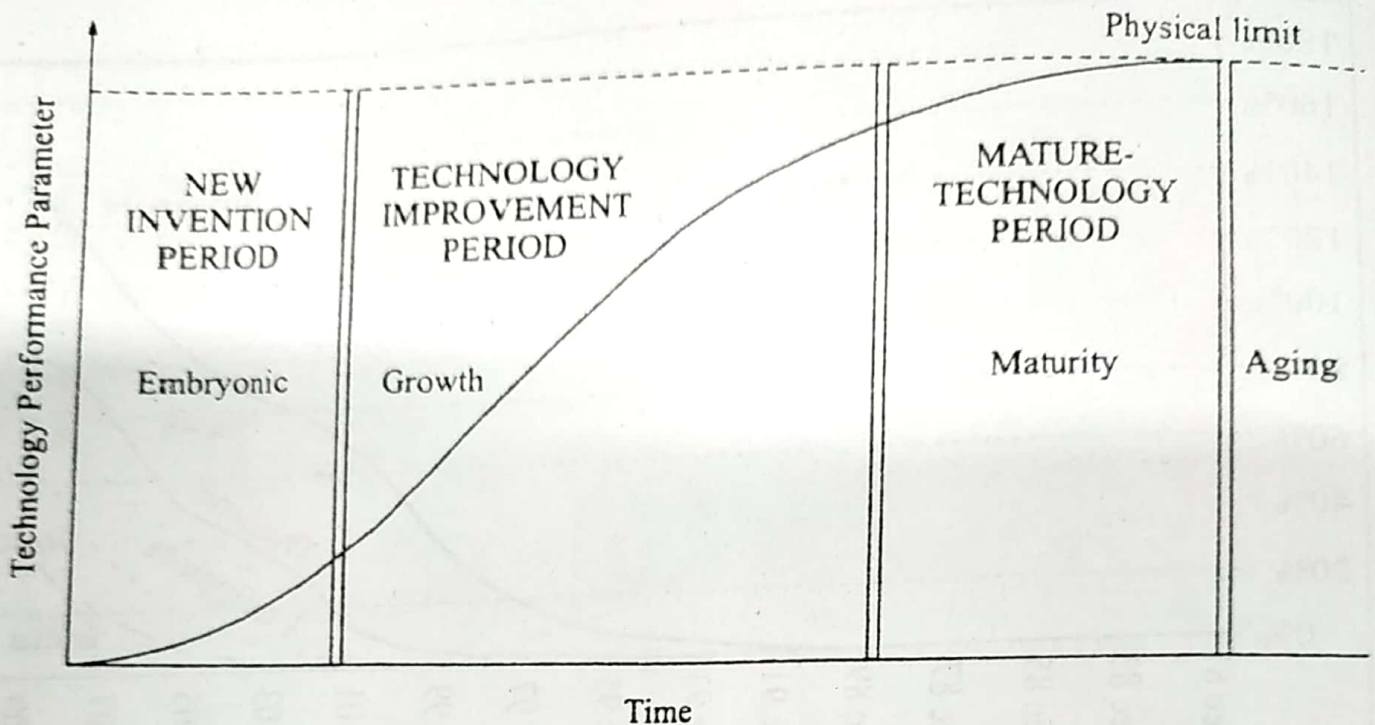


Fig. 5.3 The S-curve of technological progress

The new invention period is characterised by a period of slow initial growth. This is the time when experimentation and initial bugs are worked out of the system. The technology improvement period is characterised by rapid and sustained growth.

The mature-technology period starts when the upper limit of the technology is approached and progress in performance slows down. This is when the technology reaches its natural limits as dictated by factors such as physical limits. For example, the vacuum tube technology was limited by the tube's size and the power consumption of the heated filament. Both of these factors were natural barriers to electron conduction in a vacuum tube. Electronic engineers could not overcome these limitations. The arrival of the solid-state technology, or transistor, which permitted electron conduction in solid material, changed the physical barriers of size and power. The transistor technology started a new technology life cycle and rendered the vacuum-tube technology obsolete.

This example illustrates a very important concept in MOT: *When a technology reaches its natural limits it becomes a mature technology vulnerable to substitution or obsolescence.*