

Breaking the Barriers to Technological Innovations

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Introduction

A recent survey conducted by Booz-Allen and Hamilton reports that business executives in all sectors of the U.S. economy believe that innovation will be the major source of corporate growth and profitability in the coming decades.¹ In fact, product and service innovations are expected to generate a third of business growth and 40 percent of business profits in the United States. Innovation is also likely to be the key success factor for developing nations such as China, Brazil, and India in their desire to industrialize their economies. New products and services will continue to be an important mechanism by which corporations cope with changing customer needs, changing governmental regulations, and increasing competition. As in the past, most of these innovations will be based on technological advances. Our objective, though, is not to praise the significant role of high-tech innovations, but to explain why corporations and customers resist innovations even though they are considered necessary and desirable. We will briefly examine the role of technology in the innovation process, identify the major corporate and customer barriers to innovations, and suggest strategies to hurdle these barriers.

The Role of Technology

To fully appreciate how technological breakthroughs have had a dramatic impact on society in general and business corporations in particular, it is necessary to review the role of technology in the innovation process. Fundamentally, technology performs two functions. First, it increases the efficiency of natural and manmade resources. This is achieved by enabling the

For a discussion of these barriers in the context of innovations in consumer durables, consumer durables, industrial products, and services, see Sheth, J.N., and Ram, S., "Bringing Innovation to Market: Breaking the Corporate and Customer Barriers," John Wiley & Sons Inc. (1987).

resources to perform tasks faster and to their fullest capacity. This function of technology is commonly referred to as the economy of scale. Second, technology increases the versatility of resources by enabling them to perform newer tasks or in newer settings or both. This property is commonly referred to as the economy of scope. The greater the efficiency and versatility of resources created by a new technology, the greater its impact on society and business.

From a historical perspective, it is easy to identify the several technological ages that have triggered an explosion of new products and services. First came the *mechanical age*, based on the scientific concepts of physics and mechanics. It dramatically increased the productivity of the agricultural sector, and led to the industrial revolution. Factories and railroads were the major developments of this period, allowing for separation in distance and time between the point of production and the point of consumption.

With the discovery of electricity, the *mechanical age* gave way to the *electromechanical age*. Telephones, radios, automobiles, and appliances were the innovations of this era. These innovations broadened the geographical scope of markets that could be reached. The *electromechanical age* was supplanted by the *chemical age*, which provided breakthroughs in chemistry and biology. Innovations in pharmaceuticals, industrial chemicals, and natural resources were developed at this time and contributed to increased productivity of the industrial society.

Today, we are witnessing similar technological breakthroughs as we shift from the *chemical* to the *biogenetic age* and from the *electromechanical* to the *electronics age*. These two new technological bases may be unparalleled, because they have the scope to generate innovations that not only enhance resource efficiency but also add resource versatility. Semiconductors, represented by the chip, are now regarded as a national strategic resource comparable to minerals and oil in the earlier technological ages. Electronic communications and computers have made feasible the instant transfer of information across vast geographical distances. Laser technology has found applications as diverse as surgery and fiber optics. Biogenetic experiments are aimed at generating such innovations as the superseed, which has its own pesticide, fertilizer, and herbicide, and super plants and super animals, which are free of genetic defects.

In short, technological advances have always enabled business to develop new products and service, which are both superior in performance and lower in cost as compared to existing alternatives. In fact, nine out of ten executives surveyed by Booz-Allen and Hamilton attributed technological progress as the primary reason for innovation in corporations.

Innovation Resistance

Ironically, as the scope for innovating increases with technological advances, so does the resistance to innovate. Innovation resistance comes from two

sources. On the one hand, corporations resist innovation even though survival may be at stake. On the other hand, customers resist innovation even though it could mean improved products and services. The purpose of this chapter is to illustrate why corporations and customers resist innovations. Once sources of corporate resistance and customer resistance are identified, it is possible to design strategies to overcome resistance.

Both corporate managers and consumers, especially in industrialized nations, are favorably disposed toward innovations. They believe technology can be harnessed for the benefit of mankind. Hence, the resistance to innovations is not a *cultural* problem. The resistance arises because of numerous *structural* barriers, which paralyze the desire of corporations and customers to innovate. The more radical the innovation, the greater the structural barriers, and therefore the greater the resistance.⁴

Five corporate barriers and five customer barriers may impede the success of an innovation. We shall now examine each of these barriers, and provide solutions to overcome each barrier, illustrating with examples of technological innovations.

Corporate Barriers

Most managers are aware that corporate growth and survival depends on innovation, and are pro-innovation in their values, perceptions, and attitudes. Yet, the task of innovating often becomes difficult because of one or more of five major barriers: Expertise Barrier, Operations Barrier, Resources Barrier, Regulation Barrier, and Market Access Barrier.

Expertise Barrier

As technology continues to be the primary source of innovative products and services, one would expect technological specialization to be the key to successful innovation. However, this is not the case. With the exception of giants such as Bell Laboratories and Arthur D. Little, most organizations have a high degree of technical specialization. Unfortunately, the specialized knowledge is simply not versatile enough to be used for newer products. For example, when IBM attempted to move one of its immediate areas of specialization—computers—into the copying machine business, it did not succeed. Similarly, Xerox had a hard time in the computer industry. It has been extremely difficult for many central office and PBX switch makers to shift from analog to digital switches. In fact, the recent success of Northern Telecom against such strong competitors as AT&T, ITT, and Siemens is attributed to the inability of these big firms to produce good quality switches.

The reluctance and/or inability of highly specialized companies to employ a breadth of technological expertise often leads them to introduce prod-

ucts based on their current technological knowledge rather than on the needs of potential customers. This tendency to generate technology-driven, and not market-driven, innovations is the most dangerous consequence of the expert barrier.⁴ An innovative company must be flexible enough to change its established patterns of research and development to meet the demands of the market place, but this may be extremely difficult for a highly specialized company.

Operational Barrier

The operations barrier is closely related to the expertise barrier, and is also a consequence of overspecialization. It simply occurs farther down the line in production and assembly, rather than in research and development, as in the case of the expertise barrier. A company that is highly specialized in its technology is often specialized in its operation as well. This is but a natural result of the experience curve. Innovating in such a company often involves changes in materials procurement, manufacturing, and worker training—all of which require tremendous adaptation from well-established routines.

A recent innovation in the telecommunications industry illustrates the problems posed by the operations barrier. The Integrated Services Digital Network (ISDN) is capable of integrating several types of information over the same communication network. While the telephone is capable of switching, transporting, and signaling with voice communications, the ISDN extends these capabilities to communications with data, pictures, and text with ease. However, the ISDN imposes severe operational barriers. The ISDN operation, especially at the telephone company level, is not compatible with older technologies. It requires the development of a totally new central office switch, a new PBX system, and new desktop phone sets instead of the traditional phone sets. In addition, higher capacity transport channels may be required to fully exploit ISDN's potential, in which case it may often be desirable to replace existing copper wires with fiber optics. The ISDN is thus an innovation that creates tremendous structural changes from existing modes of operation. It must be noted that the ISDN has also created expertise barriers for corporations, since it requires a high degree of integration between computer and telecommunication technologies. Firms typically excel in one of these technologies and not the other and thus have to cope with bridging the expertise gap.

Resource Barrier

Nothing discourages a business more effectively than insufficient funds. Adequate financial resources are especially influential in determining whether an innovation will ever see the light of day. Few organizations have deep

pockets and can therefore ignore money as a significant factor for innovating. The resource barrier is thus a major corporate barrier that needs to be overcome.

The height of the resource barrier is determined by the borrowing power of the corporation, or in other words, its debt-to-equity ratio. Indeed, many international business experts attribute Japan's extremely successful innovation drive to the three-to-one debt-to-equity ratio that Japanese firms enjoy, as compared to the one-to-one ratio generally observed in U.S. companies. Japanese banks are not unduly worried about interest costs because the government provides low-cost capital as an incentive for firms to enter certain target industries such as automobiles and consumer electronics. The U.S. investment bankers, on the other hand, are reluctant to cross the fifty-fifty debt-to-equity ratio, because they fear the margins of the products may not be adequate to cover the interest costs. In any case, the lower the borrowing power, the lower the financial capital available, and the higher the resource barriers.

In the world of high-tech, a number of telecommunication suppliers are experiencing financial difficulties as they try to shift from analog to digital technologies for central office and PBX markets. In fact, ITT recently abandoned its efforts to develop the digital switch since it did not have the funds or the inclination to invest in the project. Even the German giant, Siemens, has decided to join with GTE to minimize the financial risk.

Another high-tech innovation that has had to overcome financial barriers is the cellular mobile telephone.^{5,6} Unlike the regular telephone, which requires hard wires to connect with the telephone exchange, the cellular mobile phone uses airwaves to send or receive calls. It needs special, dedicated electronic switches and low-power antennae to link up with the network, and this equipment must be set up every five to ten miles. All of this requires massive capitalization. As a result, many companies that were granted permission to operate the innovative service found themselves short of capital. They, therefore, had to form joint ventures with other organizations to gain financial stability. Within a very short history of five to six years, this industry has undergone national or regional consolidation, especially among the nonwire companies.

Regulation Barrier

Regulation can take several forms, and most industries are subject to at least one of them. The first type of regulation is self-regulation, which is normally limited to codes of business practice and business ethics as expressed by the industry or trade or by a professional association. The best examples of self-regulation come from organizations such as the American Medical Association and the American Bar Association.

The second type is government regulation of a company's internal operations as well as market operations. Government regulators are concerned with product safety, occupational safety, antitrust violations, and unfair trade practices. Federal agents operate from agencies such as the Department of Justice, the Environmental Protection Agency, and the Federal Trade Commission to enforce government stipulations. The videotex service, for example, is an innovation that has been affected to some extent due to uncertainty about government regulation.²⁴ The videotex system consists of a large database of stored information, a digital network, and a computer terminal for the users. The terminal is hooked to an existing television set and to a regular telephone line via a modem. The terminal has a remote keypad with which to input instructions. The videotex is interactive: this means the user can send messages and receive responses to them through an intelligent terminal. The system can perform business transactions such as banking or electronic shopping, or can be used for interactive education and training by "atending" classes at remote locations. The videotex is not a regulated technology, although the Bell local telephone companies are banned from offering it on the regulated side of their business. However, it has raised a few regulatory issues. Newspapers are, for instance, worried about the competition for classified ads and the survival, they say, of the free press. This dispute has slowed down product development. Further, the regulatory climate is uncertain, and many suppliers are unwilling to invest in this innovation before the regulatory dust settles.

A third type of regulation is limited to utility services such as water, gas, electricity, and telephones. The fundamental threat here is rare regulation, in which prices and producers are approved by a government agency. In the case of cellular mobile phones, for example, the FCC regulates the business. Currently, two companies are allowed to operate in any one geographical area. The FCC, however, permits pricing competition between the two carriers. Similarly, following the divestiture of AT&T, the Bell operating companies were restricted from entering three lines of business: information services, long distance calls, and manufacturing telephone equipment. It is because of this restriction that the operating companies are unable to offer innovations such as electronic yellow pages and certain database and transmission services. They do not have barriers from expertise, operations, or resources, but the regulatory barrier has prevented these innovations from seeing to life.

A fourth type of regulation relates to patents and trademarks. Patent rights, granted by the federal government to an innovator, can protect the innovation from better imitations or poor-second-cousin innovations that seek to exploit a commercial opportunity. Patent protection has typically played a major role in drugs and pharmaceuticals, and is acquiring a role of major importance in the field of biogenetics. With the patent applications

being made for controversial innovations such as clones, the onus is on federal agencies to decide which innovations are morally and socially acceptable and which are not, even before deciding whether to grant a patent.

Whatever the type of regulation encountered by an innovation, the fact remains that the more regulated an industry or company, the greater the barrier to innovation.

Market Access Barrier

Market access barrier refers, in general, to all impediments that keep innovations from reaching receptive customers. It can appear because of the lack of an adequate physical distribution system or because of very strong competitors, or even customer difficulties in switching to the innovation because of the changes demanded by the new technology. The market access barrier more often creates problems for firms with low market shares than for market leaders. The smaller the market share, the greater the barrier.

A high-tech innovation that illustrates the importance of this barrier is the digital centrex. The digital centrex is designed to compete against the new generation PBX switches to handle a variety of transactions such as intercom, party-on-hold, call transfer, three-way conference calls, and the receptionist function. The centrex system requires no special equipment at the customer's office; regular telephones are adequate. All the electronic intelligence needed is located at the central office of the telephone company. Thus, unlike the PBX systems, the centrex requires little investment up front. Yet, the centrex has met with serious market access barriers. First of all, corporate customers who have already invested in a PBX system are reluctant to give up capitalized assets at or below book value, and switch to the digital centrex. Further, the switch to the local phone company's centrex could mean reconfiguring hundreds of telephone numbers and lines, a possible nightmare. Customers also have to decide whether to rent or buy terminals as a part of the centrex package, based on investment write-off that could be obtained from outright purchase. Finally, PBX manufacturers are giving a tough fight, and attempting to upgrade customers to a fourth-generation product with enhanced capabilities for data communication through an innovation called local area networking. If the upgraded PBX is as good as the digital centrex, customers who made the switch would feel foolish. The uncertainty created in evaluating the new technology has created a market access barrier for the digital centrex.

A summary list of the five corporate barriers that impede technological innovations is listed in figure 5-1.

Price Barrier:	Technical overspecialization and technology-driven innovations
Usage Barriers:	Changes required in materials procurement, manufacturing, assembly, and worker training
Access Barrier:	Low capital resources and borrowing power
Initial Barrier:	Restrictions from government or from within industry
Market Access Barrier:	Inability to reach customers because of distribution problems or competitors' strengths

Figure 5-1. Corporate Barriers to Innovation

Customer Barriers

Customer barriers to innovations are more formidable than corporate barriers. Why? Clearly because innovations cannot succeed unless the intended customers accept them. Customers do not necessarily resist an innovation because they dislike it. It is more likely that the innovation creates change in structural discontinuities; that is, disruption of established life patterns they are accustomed to. This is especially the case when an innovation is based on a radically new technology and is not just a "new and improved" version of the existing technology.

Customer resistance to innovations is generated by one of more of five barriers: Usage Barrier, Value Barrier, Risk Barrier, Tradition Barrier, and Age Barrier. We will discuss each in turn with examples of high-tech innovations.

Age Barrier

Perhaps the most common reason for customer resistance to an innovation is that it is not compatible with existing workflows, practices, and habits. Innovations that require significant changes in the daily routine require a long market development process. No wonder that even innovations such as television, automobile, and computer were invented years before their successful commercialization. Even if a new technology gains customer acceptance, the next wave of innovations may face usage barriers if it demands changes in the established routines. For instance, once IBM had successfully introduced its hardware and software technologies, efforts by other firms to produce alternative hardware and software architectures met with cus-

tomers' resistance. Hardly surprising, because once an organization had become comfortable with IBM systems, it did not want to spend resources on retaining its users on a new system.

Video teleconferencing is another high-tech innovation that has encountered significant usage barriers. This innovation does make an honest claim in that it allows people to meet without the stress and expense of travel. However, for the conference to be successful, the organization must plan ahead very carefully. Care must be taken to see that participants in different cities have to go to specific locations away from their offices, and the time of the meeting has to be synchronized. Documents for the meeting must be prepared and distributed ahead of time, and the flow of communication between the participants has to be managed. In addition, some managers who feel comfortable with face-to-face interaction in a meeting at corporate headquarters or at a resort town, feel uncomfortable in front of the camera and behave as if they were on stage!

Value Barrier

The second source of customer resistance to innovations is the value barrier. The value an innovation offers to a customer is its price-performance ratio as compared to existing alternatives. Unless the innovation offers superior performance and/or a strong price incentive, it is natural that customers will not consider switching to it.

The videodisc player is an innovation that could not surmount the value barrier. RCA invested more than \$600 million in this technology and hailed it as a major revolution in consumer electronics. Unfortunately, the customers disagreed, and considered the videodisc player inferior to the emerging VCR alternative. First of all, the videodisc could play, but not record, while videocassettes could do both. Second, programming for disc players was restricted to only what the disc producers could offer, thus limiting its potential. Videocassettes could be reused for different purposes. Despite these drawbacks, the videodisc might have succeeded if it had been positioned by RCA as a high-quality device for serious programming: just as the hi-fi stereo was superior to the run-of-the-mill cassette player, the videodisc would be better than the videocassette. Unfortunately, RCA did not adopt this strategy. Soon the Japanese VCR producers began to drop their prices, and RCA's product had no price value either. The value barrier for the innovation was too high, hence its failure.

Risk Barrier

The risk barrier arises because all innovations, to some extent, represent uncertainty and pose side effects that cannot be anticipated completely. Cus-

lancers know there are possible risks and postpone adopting the innovation till they learn more about it.

The first type of risk perceived by a customer is economic risk. If the customer has to make a considerable amount of financial investment in the new product or service, and fears he may lose it, he is reluctant to adopt the innovation. The best examples are innovations such as personal computers and video cameras, which constantly undergo improvements with technological advances. Many interested consumers postpone their purchases because they know that if they wait, a much better product with a lower price tag will be on the market. As companies dealing in these technologies learn faster and faster, their experience curves drop rapidly. The marketplace gets improved products at lower prices. Ironically, it is improved firm efficiency that creates the economic risk.

The second type of risk is physical risk: harm to persons or property that may be inherent in the innovation. For example, innovations based on microwave technology and nuclear technology have met with resistance because of possible adverse effects on the human body.

A third type of risk is performance uncertainty. A customer worries that he technology may not be fully tested and developed and therefore the new product or service may not function properly. A good illustration for this risk barrier is electronic mail. Electronic mail refers to nonvoice, two-way communication between two parties using a computer terminal and a modem. It is equivalent to mail because the sender and the receiver need not be physically present or connected to the terminal at the same time to communicate with each other. To first-time users, this new technology posed some degree of performance uncertainty. The users were afraid of sending the wrong message to the wrong party, of having messages not reach the intended party, of failure to cope with sophisticated changes in the system, and of being considered incompetent. The difficulty was further compounded by the relatively risk-free character of existing alternatives such as the telephone, mail, or face-to-face communication.

Tradition Barrier

An innovation is resisted when it requires customers to make changes in the cultural traditions established by a society. The greater the change, the higher the tradition barriers, and greater the resistance.

The videotex service, an innovation we discussed earlier, had to face this barrier. Because Americans love gadgets, new technologies, and modern ways of doing things, one would have expected no tradition barrier for the videotex. Yet, a vast percentage of the mass market is culturally resistant to high-tech innovations such as computers and view them as disruptive to life. The SDN system is another innovation that has faced tradition barriers. Cor-

porate users have to be trained to use a single terminal for all their voice, data, and video information. The telecommunications department and the data processing department, which are typically autonomous, need to be integrated into one new department. The reporting relationships change, as will the workflow and work practices. The SDN thus creates severe disincentives for the users from the established corporate procedures.

Image Barrier

Innovations acquire an identity solely from their origins: product class, industry, and country. If these associations are unfavorable as a result of stereotyped thinking, they create barriers to adoption. Image is by definition more perceptual than real. Image barriers are typically built from violated social taboos, from enigmas associated with new technologies, or from deep-seated psychological forces that may be aroused by the innovation.

An innovation that has encountered image barriers is the lifeline telephone service. The lifeline service is primarily designed for the poor who can no longer afford the rising costs for the basic telephone service. Part of the problem is caused by regulation, which has eliminated most of the subsidies from long distance calls and from business customers. The lifeline service allows each residential customer a minimum number of calls, which includes emergency calls for police, fire, and ambulance. The customer must pay for each local call beyond this minimum. In some states such as California, this service is mandated by law to ensure that no one is deprived of the basic telephone facility because they can't afford it. The basic problem, though, is that customers have to declare themselves poor to become eligible for the service. Admitting poverty has negative connotations in our society. It suggests a defensive attitude and a lack of motivation. It creates suspicions of fraud. Using the lifeline service creates a sense of guilt and shame that has been associated with other socially subsidized services such as welfare, food stamps, and public housing. Hence, the image barrier to the innovative telephone service.

A summary list of the five customer barriers is in figure 5-2.

Breaking the Barriers

Having identified the corporate and customer barriers that thwart technological innovations, we will now identify strategies to overcome each barrier.

Crashing Corporate Barriers

Let us examine each of the five corporate barriers in turn.

Usage Barrier:	Disruption of existing workflows, practices, and habits
Value Barrier:	Low performance-price ratio
Risk Barrier:	Possible monetary loss, physical damage, or performance uncertainty
Timeline Barrier:	Cloning against social norms and cultural values
Image Barrier:	Taboos, stereotyping, and negative associations

Figure 5-2. Customer Barriers to Innovation

Strategies for the Expertise Barrier

The expertise barrier is created because of technical overspecialization. There are three strategies that can be used to overcome this barrier:

Use Skunk Works. As Peters and Waterman discovered in a survey of excellent companies, one highly efficient way of encouraging innovative thinking is to organize technically talented people into an autonomous task force that is completely free from the corporation.¹⁰ This technique succeeds because it provides creative people with the freedom to experiment outside the constricting influence of established corporate thought and behavior. Such autonomous task forces, known as skunk works, have been a prime avenue of successful innovations.

A good example is IBM's success in the personal computer business. IBM was a company revolving around mainframe computer technology and big-business customers. The PC was based on a new technology and catered to a different customer base. Hence, the development of the PC met with a lot of corporate resistance. IBM therefore created an autonomous product team and gave it the freedom to do whatever was necessary for the product to succeed. The force broke some of the respected traditions in attaining success.¹¹

First, the team bought the microprocessor chip from outside the company rather than developing it within. Second, it decided to sell the product through third-party distributors, which was contrary to IBM's policy of direct sales to end users. Third, the team designed the PC to be less a system and more a set of modular components, so that customers could mix and match other manufacturers' peripherals. Finally, it encouraged small entrepreneurs to develop applications software, an unprecedented departure from IBM culture. But all these creative maneuvers of the skunk works paid off for IBM.

Form Research Alliances. It is becoming increasingly common for innovative companies to form strategic alliances with individuals and organizations that wish to share their expertise for mutual profit. Recently, Whirlpool, AT&T, RCA, General Electric, American Home Builders Association, 3M, and the AMP Corporation have formed a strategic alliance to develop a new technology called the smart house technology. The alliance is exploring the possibility of wiring homes on the inside such that the same outlet can be used interchangeably for telephones, computers, television, cable, and home appliances. Unlike skunk works, research alliances allow each company to maintain its established patterns of R&D. The alliances just allow these firms to share their expertise to develop successful innovations.

Pursue Acquisitions. Another popular way of overcoming the expertise barrier is by acquiring or merging with another organization that has the technical know-how. For example, when IBM wanted expertise in the telecommunications industry, it acquired ROLM Corporation. Unfortunately, unwise acquisitions and mergers often create problems, especially if the corporate cultures of the two newcomers clash. This can simply generate new barriers to the innovation, rather than eliminate the expertise barrier.

Strategies for the Operations Barrier

The strategies for overcoming the operations barrier are naturally aimed at overcoming overspecialization in the production and assembly functions of a corporation.

Use Separate Operations. One effective strategy is to start a new, separate operations facility divorced from current physical facilities, workers, and even management. This alternative functions just like skunk works and permits innovative activities to flourish outside the constricting influence of established operational routines. The strategy used by IBM in personal computers is again a good example.

Use Modified Operations. A second strategy, most useful in those industries where physical plant and land resources are of a significant size and scope, is the modification of existing resources to facilitate innovation. The integration of new operational procedures must, however, be performed with extreme care to avoid lowering the efficiency of current operations. The modification can be done on an organization-wide basis, or might be focused specifically on that part of the organization where the technology has become outdated and needs to be rejuvenated. For example, telephone companies are upgrading their central offices with digital switches and their local loops with fiber optics.

Strategies for the Resource Barrier

There are three strategies available to finance an innovation and break through the resource barrier.

Licensing Agreements. The first and perhaps the most common strategy is to license the innovation to other manufacturers. Sony Corporation learned this through the hard way. It pioneered the VCR technology and established the beta format. Unfortunately, the beta format, which is technically superior to VHS, was not blessed by the Ministry of International Trade and Industry (MITI). Most other Japanese companies decided to manufacture and market the VHS format to make it more affordable to the mass market. As a result, Sony lost the VCR market even though it had a better quality product. Sony, however, has recently changed its strategy. Rather than take on the full responsibility for producing and marketing its 8-mm video-cameras, it has decided to license the technology to more than 150 companies on a worldwide basis. Thereby, Sony has reduced its financial risk and cut down on the resources needed for market development and manufacturing.

Consortiums. A consortium is a joint venture in which several potentially competitive, yet interdependent, companies get together to develop an innovative technology. The smart home project we referred to earlier is a very good example of a consortium. The objective of this consortium is to develop new wiring technology in homes that allows appliances, electronic goods, telephones and cable television to be accessed from the same electrical outlet. This high-tech project is too expensive for any one company to undertake. In order, the expertise of different companies is required—Whitpool for appliances, AT&T for telephones, RCA for television, and so on. The consortium reduces the financial outlay required of each of these companies, and assures that the capital raised is used by a research group with pooled expertise. A similar consortium, called the Consultative Committee on International Telecommunications and Telegraphs (CCITT), has been organized to develop technical standards for the ISDN system.

Venture Capital. A third approach to breaking down the resource barrier for a technological innovation is to invite venture capital. In recent years, it has become a very attractive solution to generate adequate financing. Usually individuals are constantly on the lookout for projects that offer attractive returns on their capital. Unfortunately, this strategy does not always succeed. For one thing, venture capitalists are not committed to any one technology. They are investors merely interested in their financial returns, and are willing to take higher risks than banks. However, they know from experience that it is much better to spread risk over several ventures

rather than invest in any one venture. This tends to limit the amount of capital a single venture may generate. Even for the limited amount of capital they invest, venture capitalists tend to impose controls that may not be beneficial to the venture.

Strategies for the Regulation Barrier

Remove the Barrier. The most radical solution is to abolish the regulation by legislation. This approach has been adopted effectively by one of the regional Bell companies, created from the AT&T divestiture, to obtain its freedom from local regulation in several states.

Change the Barrier. A second strategy is to shift the regulatory jurisdiction from one agency to another. For example, it is possible to transfer jurisdiction from the local government to the state government, from the state government to the federal government, or from the U.S. federal government to international governments. In the case of the ISDN system, in several countries such as the United States, supplying customer-premises equipment such as PBXs, telephone sets, and key systems is a deregulated and highly competitive business. But in European countries, customers prefer to get this equipment from local telephone companies along with the network services. Hence, other European firms wishing to compete in the business would have to change the barrier to conform to U.S. standards, the argument being the ISDN is after all an international network that should have uniform international standards.

Bypass the Barrier. A third strategy to bypass the regulatory barriers is reorganization. In many cases, this requires forming a holding company with the freedom to offer product or service innovations the regulated entity could not. Reorganization has been used effectively in the telecommunications industry. After the AT&T divestiture, the regional Bell companies created a separate corporation in charge of all nonregulated businesses. This was done to bypass the restriction that the regulated local exchange should not subsidize nonregulated businesses such as telephone equipment, cellular mobile phones, yellow pages advertising, private networks, maintenance and repair, and international businesses.

Strategies for the Market Access Barrier

Three strategies can be used to break through the market access barrier.

Align with Dominant Vendor. If a company has trouble reaching potential customers with its innovations, one strategy would be to join the dominant player in the industry. For example, many software and peripheral manufacturers have learned to align with IBM by making IBM compatible products or selling to IBM as an original equipment manufacturer.

Develop Own Distribution System. A second strategy for a blocked firm is to develop its own distribution system. Though a very costly approach, sometimes this is the only way to break the barrier to market access. For example, small innovative companies, which do not have their own dealer network, have started to use telemarketing and direct marketing programs to reach their customers. In effect, these companies have developed their own distribution system.

Use Marketing Pull. Finally, it is possible to jump over the access barrier by adopting a pull strategy; that is, tapping the power of the people on the other side of the barrier—customers. A pull strategy is especially important if the customer is unsure how to procure the product or service. Also, in the case of technological innovations, the customer needs reassurance on the product's performance and capabilities. This can be achieved through the power of advertising, promotion, and publicity.

A summary list of the strategies that can be used to break each of the separate barriers is provided in figure 5-3.

Breaking Customer Barriers

We will now identify strategies to overcome each of the five customer barriers to technological innovations.

Strategies for the Usage Barrier

Three strategies are available for handling the usage barrier.

Adopt a Systems Perspective. An innovating firm needs to look at how its innovation interacts with other products used and activities performed by its customer. Looking at the whole operation, a firm can get a better idea of how the new product will fit into the existing system. For example, the use of computers has increased tremendously since the development of the modem, which allows connection to and communication over the telephone network. In other words, computer usage (data communication) coupled with telephone use (voice communication) provided greater use to the customer as a general communication system.

The Barrier

- | The Barrier | The Strategies |
|--------------------------|---|
| 1. Expertise Barrier | A. Skunk works
B. Research alliances
C. Acquisitions |
| 2. Operations Barrier | A. New operational facility
B. Fully or selectively modified operational facility |
| 3. Resource Barrier | A. License agreements
B. Consortia
C. Venture capital |
| 4. Regulation Barrier | A. Remove the barrier
B. Change the barrier
C. Bypass the barrier |
| 5. Market Access Barrier | A. Align with dominant vendor
B. Develop distribution channels
C. Pull strategy |

Figure 5-3. Breaking Corporate Barriers

Integration. A second strategy to customer usage resistance is to integrate the innovation into the precedent activity or product. In other words, rather than selling the product directly to the end-users, it is sold to an original equipment manufacturer. For example, cellular mobile phone manufacturers are negotiating with automobile manufacturers to incorporate their product as a standard option in automobiles, just like radios, stereo systems, or air conditioners.

Force. Sometimes the usage barrier can be overcome by making the adoption of the innovation mandatory through government legislation. This strategy is risky, and can be used only in situations where it is absolutely clear to the lawmakers that the customers will benefit from the innovation. The use of lead-free gasoline was promoted by using this strategy.

Strategies for the Value Barrier

Three strategies can be used to overcome the value barrier.

Performance. The first strategy is to have the innovation provide significant performance value over existing alternatives. For example, the newer telephone sets have features such as automatic redial and memory buttons that

are now available with the basic telephones. Similarly, newer personal computers have higher memory and storage capacity.

Next, a second solution is to reduce the manufacturing costs and pass on the savings to customers. For example, in the minicomputer industry price reductions through cost savings have taken place at a tremendous speed in less than a decade. The larger minicomputers produced by Digital, Prime, and Data General have all been reduced to desktop models with more features and functions, but at much lower prices compared to the older-generation machines.

Positioning. As an alternative strategy, a firm can attempt to add value by appropriate product positioning. This approach is more difficult to implement and requires thorough analysis. The innovating firm must examine existing product substitutes, and position the innovation in a niche or application where it has a strong performance-price superiority over its alternatives. For example, AT&T has always positioned itself as the premiere utility corporation in the telecommunications industry, and promotes all its innovations using this positioning. Despite the tremendous influx of competitors, AT&T has managed to retain a majority of its customer base intact, thanks to its superior positioning strategy.

Strategies for the Risk Barrier

The customer's perception of risk can be minimized using three strategies.

Free Trials. The most practical method of overcoming the risk barrier is to offer the technological innovation on a trial basis to the customer with full guarantees and reassurances. However, it is not always possible to offer trials on a limited basis. For example, installing a computer system is often an irreversible decision for a company. IBM has made life easier for its customers by promising full service support right from the time of installation through the trial period and subsequent adoption. This is a strategic variation that does more than minimize risk—it eliminates risk. The videotext service has also been offered by AT&T to customers on a trial basis in Columbus, Ohio, and the trial has significantly decreased the risk perceived by potential customers.

Testimonials. A second strategy to reduce perceived risk is to obtain endorsements and testimonials from experts. Of course, the experts must objectively evaluate the innovation before endorsing it. This strategy is used by firms in almost every industry to generate acceptance for their innovations.

Package as a System. A third strategy is to introduce the innovation as a component in a system already well accepted by the customer. The customer will not be able to evaluate the product independently. The innovation will be offered to an original equipment manufacturer, whose reputation will be used to offset any risk perceived by the customer. Offshore manufacturers of electronic goods and office equipment sell their products through well-known corporations like General Electric and Savin, thus reducing the customer's perceived risk.

Strategies for the Tradition Barrier

Three strategies are available to grapple with tradition barriers.

Understand and Respect Traditions. Every firm must try to understand the cultural traditions honored by its customers. Most new product failures in foreign soil can be attributed to ignorance of and arrogance about other cultures. The same is true even of products marketed in the U.S. market, but targeted toward difficult subcultures. Corporate managers and executives need to understand the tenacity of cultural traditions held by their customers. For example, innovations are bound to have a difficult time in Middle East countries where Islam is the dominant religion and the Muslims believe that all innovation is the work of the devil.

Market Education. A second strategy for overcoming the tradition barriers is educating customers. For example, when computers were promoted as an educational tool in United States schools and colleges, there was resistance since it went against the traditional blackboard-and-lecture method. But, thanks to the intervention of the government and the initiative of several leading universities, computer literacy is being propagated among even the disabled. In developing nations, technological innovations that encounter traditional barriers have always needed government encouragement and support in the form of mass propaganda to pull through.

Change Agents. The third strategy in combating traditional barriers is to employ change agents.¹³ This is also referred to as opinion leadership or leading edge strategy. Change agents are the large, influential customers who endorse the innovation and encourage other customers to adopt it. IBM has consistently used its leading edge customers such as banks and brokerage and insurance firms to invest early in its new technologies and let the smaller customers be influenced by these early users. The same strategy has been used by Xerox in office automation and AT&T in the videotext service. The change agents are the right people to pursue initially because they are prone to be more innovative and find it easier to break away from tradition.

Strategies for the Image Barrier

These strategies can be used to overcome the image barrier.

1. Create the Image. The first strategy is to make fun of the image and suggest why it is silly for people to carry such stereotypes. Goldstar, the Korean billion-dollar corporation dealing in electronic goods, jokes about the negative image people have about Korean products, thus hoping to offset negative customer perception.

2. Create a Unique Image. The second strategy is to create a unique image for the product or service. Steve Jobs, the founder of Apple computers, did just this. Apple is the symbol of the small innovative firm that came through the dot-com era as a quality innovation.

3. Create an Image. The third solution to the image barrier problem is to intentionally associate the new product or service with a person or object that has a positive public image. As discussed earlier, several foreign manufacturers are selling their electronic goods under the brand names of U.S. companies such as IBM and General Electric. A summary list of the strategies to overcome each consumer barrier is shown in Figure 5-4.

Conclusion

Technological innovations will continue to be the source of corporate growth and survival worldwide. New technologies tend to disrupt established routines of the corporations that try to harness them and the customers who do not benefit from them. What we have attempted to do here is to identify five corporate barriers and five customer barriers that create structural discontinuity for high-tech innovations.⁸ We have also suggested strategies to overcome these barriers. With the life cycles of technologies becoming shorter and competition becoming more intense, successfully innovating has assumed great importance. To this end, we hope the corporation that makes it early start at identifying and breaking the major barriers to its innovations will have a valuable edge on its rivals.

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The Barrier The Strategies

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|----------------------|---|
| 1. Usage Barrier | A. Develop a systems perspective
B. Integrate into preceding activity or product
C. Mandate through legislation |
| 2. Value Barrier | A. Provide performance
B. Reduce price as costs decrease
C. Achieve positioning |
| 3. Risk Barrier | A. Free trials
B. Testimonials
C. Package as a system |
| 4. Tradition Barrier | A. Understand and respect traditions
B. Educate the customers
C. Use change agents |
| 5. Image Barrier | A. Invent a new image
B. Create a unique image
C. Borrow an image |

Figure 5-4. Breaking Customer Barriers

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