Chapter 4

Building Competitive Advantage Through Business-Level Strategy
**Functional-Level Strategies**

Functional-level strategies are strategies aimed at improving the effectiveness of a company's operations. Improves company's ability to attain superior:

1. Efficiency
2. Quality
3. Innovation
4. Customer responsiveness

Increases the utility that customers receive:

- Through differentiation
- Creating more value
- Lower cost structure than rivals

This leads to a competitive advantage and superior profitability and profit growth.

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**Achieving Superior Efficiency**

Functional steps to increasing efficiency:

1. Economies of Scale
2. Learning Effects
3. Experience Curve
4. Flexible Manufacturing and Mass Customization
5. Marketing
6. Materials Management and Supply Chain
7. R&D Strategy
8. Human Resource Strategy
9. Information Systems
10. Infrastructure

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**Achieving Superior Efficiency**

- **Economies of scale**
  - Unit cost reductions associated with a large scale of output
    - Ability to spread fixed costs over a large production volume
    - Ability of companies producing in large volumes to achieve a greater division of labor and specialization
  - Diseconomies of scale
    - Unit cost increases associated with a large scale of output

Source: Porter's Diamond, 1980s.
### Economies and Diseconomies of Scale

- **Unit cost** decreases as output increases.
- **Diseconomies of scale** occur when the unit cost increases as output increases.

![Graph showing Economies and Diseconomies of Scale](image)

### Achieving Superior Efficiency (cont'd)

- **Learning effects**
  - Cost savings that come from learning by doing
  - Labor productivity
  - Management efficiency
- **When changes occur in a company's production system, learning has to begin again.**

![Graph showing Learning Effects](image)

### Learning Effects

**Learning Effects are:**

- **Cost savings that come from learning by doing**
  - Labor productivity
  - Management efficiency
- **Realization of learning effects implies a downward shift of the entire unit cost curve**

*As labor and management become more efficient over time at every level of output.*

When changes occur in a company's production system, learning has to begin again.

### The Impact of Learning and Scale Economies on Unit Costs

- **Economies of scale** and **learning effects** underlie the experience curve phenomenon.
- **Once down the experience curve, the company is likely to have a significant cost advantage over its competitors.**

![Graph showing The Impact of Learning and Scale Economies on Unit Costs](image)

### Strategy in Action

- **Learning Effects in Cardiac Surgery**

### The Experience Curve

**The Experience Curve**

- The systematic lowering of the cost structure and consequent unit cost reductions that occur over the life of a product.
- **Economies of scale** and **learning effects** underlie the experience curve phenomenon.
- **Once down the experience curve, the company is likely to have a significant cost advantage over its competitors.**

Strategic significance of the experience curve: Increasing a company's product volume and market share will lower its cost structure relative to its rivals.
Achieving Superior Efficiency (cont’d)

- The experience curve
  - The systematic lowering of the cost structure and consequent unit cost reductions that occur over the life of a product
  - Economies of scale and learning effects underlie the experience curve

Course Pack Item

- The Experience Curve (Strategy Spotlight 5.1)

Strategy in Action

- Mass Customization at Lands End

Strategy in Action

Too Much Experience at Texas Instruments

Real World

- “Chemical and Chase Banks Merge to Realize Scale Economies”
Achieving Superior Efficiency

- Chemical and Chase

Materials management
- Getting inputs and components to a production facility, through the production process, and out through a distribution system to the end user
- Just-in-time (JIT) inventory system
- Supply chain management

R&D strategy
- Designing products that are easy to manufacture
- Process innovations

Tradeoff Between Costs and Product Variety

Running Case

- Human Resources Strategy and Productivity at WAL-MART

Marketing

- Marketing strategy
  Refers to the position that a company takes regarding
  - Pricing
  - Promotion
  - Advertising
  - Distribution
  - Product design
- Customer defection rates
  Percentage of customers who defect every year
  - Defection rates are determined by customer loyalty
  - Loyalty is a function of the ability to satisfy customers

Reducing customer defection rates and building customer loyalty can be major sources of a lower cost structure.
Relationship between Customer Loyalty and Profit per Customer

![Graph showing the relationship between customer loyalty and profit per customer.]

Achieving Superior Quality

- Attaining superior quality
  - Total quality management (TQM)
    - Improved quality means that costs decrease
    - As a result, productivity improves
    - Better quality leads to higher market share
    - Allows increased prices
    - This increases profitability
    - More jobs are created

Achieving Superior Innovation

- Innovation can
  - Result in new products that better satisfy customer needs
  - Improve the quality of existing products
  - Reduce costs
  - Innovation can be imitated so it must be continuous
  - Successful new product launches are major drivers of superior profitability

Primary Roles of Value Creation Functions in Achieving Superior Efficiency

![Table列出各种职能的主角色。]

The Role Played by Different Functions in Implementing TQM

![Table列出TQM实施中各职能的角色。]

The High Failure Rate of Innovation

- Failure rate of innovative new products is high
- with evidence suggesting that only 10 to 20% of major R&D projects give rise to a commercially viable product.
- Most common explanations for failure:
  - Uncertainty
    - Quantum innovation: radical departure with higher risk
  - Incremental innovation: extension of existing technology
  - Poor commercialization
    - Definite demand for product
  - Poor positioning strategy
    - Good product but poorly positioned in the marketplace
  - Technological myopia
    - Technological "wizardry" vs. meeting market requirements
  - Slow to market
Real World

- "Whatever Happened to the Digital Compact Cassette?"

Real World

- "Slow Cycle Time at Apollo Computer"

Course Pack Items

- Special Report Outsourcing Innovation

Strategy in Action

- Learning from Innovation Failures

Function Roles for Achieving Superior Innovation

<table>
<thead>
<tr>
<th>Value Chain Function</th>
<th>Primary Roles</th>
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<tbody>
<tr>
<td>Innovation (Innovate)</td>
<td>1. Change overall product, manage the development function. 2. Provide more functional companies. 3. Create with MOO re-deploy people that are not in innovations. 4. File the current information. 5. Produce new information in R&amp;D.</td>
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<tr>
<td>Production</td>
<td>1. Develop new products and processes. 2. Disperse with other functions, especially marketing and manufacturing.</td>
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<td>1. Use information systems to coordinate more functional and cross-functional activity. 2. Use internal databases and external.</td>
</tr>
<tr>
<td>Materials management</td>
<td>1. No primary responsibility.</td>
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<tr>
<td>R&amp;D</td>
<td>1. Develop new products and processes.</td>
</tr>
<tr>
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<td>Human Resources</td>
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The Primary Role of Different Functions in Achieving Superior Responsiveness to Customers

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Closing Case

• Coming: Learning from Innovation Failures

End of Lecture 4

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4.1 STRATEGY IN ACTION

Learning Effects in Cardiac Surgery

A study carried out by researchers at the Harvard Business School tried to estimate the importance of learning effects in the case of a specific new technology for minimally invasive heart surgery that was approved by federal regulators in 1996. The researchers looked at 16 hospitals and obtained data on the operations for 660 patients. They examined how the time required to undertake the procedure varied with cumulative experience. Across the 16 hospitals, they found that average time fell from 280 minutes for the first procedure with the new technology to 220 minutes by the time a hospital had performed 50 procedures. (Note that not all of the hospitals performed 50 procedures, and the estimates represent an extrapolation based on the data.)

Next they looked at differences across hospitals. They found evidence of very large differences in learning effects. One hospital, in particular, stood out. This hospital, which they called "Hospital M," reduced its net procedure time from 500 minutes on case 1 to 132 minutes by case 50. Hospital M's 88-minute procedure time advantage over the average hospital at case 50 translated into a cost saving of approximately $2,250 per case and allowed surgeons at the hospital to do one more revenue-generating procedure per day.

The researchers tried to find out why Hospital M was superior. They noted that all hospitals had similar state-of-the-art operating rooms and used the same set of FDA approved devices. All adopting surgeons went through the same training courses, and all surgeons came from highly respected training hospitals. Follow-up interviews, however, suggested that Hospital M differed in how it implemented the new procedure. The team was handpicked by the adopting surgeon to perform the surgery. It had significant prior experience working together (That was apparently a key criterion for team members.) The team trained together to perform the new surgery. Before undertaking a single procedure, they met with the operating room nurses and anesthesiologists to discuss the procedure. Moreover, the adopting surgeon mandated that the surgical team and surgical procedure was stable in the early cases. The initial team went through 15 procedures, and new members were added or substituted 20 cases before the procedures were modified. The adopting surgeon also insisted that the team meet prior to each of the first 10 cases, and they also met after the first 20 cases to debrief.

The picture that emerges is one of a core team that was selected and managed to maximize the gains from learning. Unlike other hospitals in which there was less stability of team members and procedures, and less attention to briefing, debriefing, and learning, surgeons at Hospital M both learned much faster, and ultimately achieved higher productivity than their peers in other institutions. Clearly, differences in the implementation of the new procedure were very important.

The Experience Curve

The experience curve, developed by the Boston Consulting Group in 1968, is a way of looking at efficiencies developed through a firm’s cumulative experience. In its basic form, the experience curve relates production costs to production output. As output doubles, costs decline by 10 percent to 30 percent. For example, if it costs $1 per unit to produce 100 units, the per unit cost will decline to between 70 to 90 cents as output increases to 200 units.

What factors account for this increased efficiency? First, the success of an experience curve strategy is dependent on the industry life cycle for the product. Early stages of a product’s life cycle are typically characterized by rapid gains in technological advances in production efficiency. Most experience curve gains come early in the product life cycle.

Second, the inherent technology of the product offers opportunities for enhancement through gained experience. High-tech products give the best opportunity for gains in production efficiencies. As technology is developed, “value engineering” of innovative production processes is implemented, driving down the per unit costs of production.

Third, a product’s sensitivity to price strongly affects a firm’s ability to exploit the experience curve. Cutting the price of a product with high demand elasticity—where demand increases when price decreases—rapidly creates consumer purchases of the new product. By cutting prices, a firm can increase demand for its product. The increased demand in turn increases product manufacture, thus increasing the firm’s experience in the manufacturing process. So by decreasing price and increasing demand, a firm gains manufacturing experience in that particular product, which drives down per unit production costs.

Fourth, the competitive landscape factors into whether or not a firm might benefit from an experience curve strategy. If other competitors are well positioned in the market, have strong capital resources, and are known to promote their product lines aggressively to gain market share, an experience curve strategy may lead to nothing more than a price war between two or more strong competitors. But if a company is the first to market with the product and has good financial backing, an experience curve strategy may be successful.

In an article in the Harvard Business Review, Pankaj Ghemawat recommended answering several questions when considering an experience curve strategy.

1. Does my industry exhibit a significant experience curve?
2. Have I defined the industry broadly enough to take into account interrelated experience?
3. What is the precise source of cost reduction?
4. Can my company keep cost reductions proprietary?
5. Is demand sufficiently stable to justify using the experience curve?
6. Is cumulated output doubling fast enough for the experience curve to provide much strategic leverage?
7. Do the returns from an experience curve strategy warrant the risks of technological obsolescence?
8. Is demand price-sensitive?
9. Are there well-financed competitors who are already following an experience curve strategy or are likely to adopt one if my company does?

Michael Porter suggested, however, that the experience curve is not useful in all situations. Whether or not to base strategy on the experience curve depends on what specifically causes the decline in costs. For example, if costs drop from efficient production facilities and not necessarily from experience, the experience curve is not helpful. But as Sharon Oster pointed out in her book on competitive analysis, the experience curve can help managers analyze costs when efficient learning, rather than efficient machinery, is the source of cost savings.

Years ago, almost all clothing was made to individual order by a tailor (a job shop production method). Then along came the 20th century and techniques for mass production, mass marketing, and mass selling. Production in the industry shifted toward larger volume and less variety based on standardized sizes. The benefits in terms of production cost reductions were enormous, but the customer did not always win. Offset against lower prices was the difficulty of finding clothes that fit as well as tailored clothes did. People come in a bewildering variety of shapes and sizes. Going into a store to purchase a shirt, you get to choose between just four sizes—small, medium, large, and extra large. It is estimated the current sizing categories in clothing fit only about one-third of the population. The rest of us wear clothes in which the fit is less than ideal.

The mass production system has drawbacks for apparel manufacturers and retailers as well. Year after year, apparel firms find themselves saddled with billions of dollars in excess inventory that is either thrown away, or put on sale, because retailers had too many items of the wrong size and color. To try and solve this problem, Lands' End has been experimenting with mass customization techniques.

To purchase customized clothes from Lands' End, the customer provides information on Lands’ End Web site by answering a series of 15 questions (for pants) or 25 questions (for shirts) covering nearly everything from waist to inseam. The process takes about 20 minutes the first time through, but once the information is saved by Lands’ End, it can be quickly accessed for repeat purchases. The customer information is then analyzed by an algorithm that pinpoints a person’s body dimensions by taking these data points and running them against a huge database of typical sizes to create a unique, customized pattern. The analysis is done automatically by a computer that transmits the order to one of five contract manufacturer plants in the United States and elsewhere; the plant cuts and sews the garment and ships the finished product directly to the customer.

Today customization is available for most categories of Lands’ End clothing. Some 40% of its online shoppers choose a customized garment over the standard-sized equivalent when they have the choice. Even though prices for customized clothes are at least $20 higher and take about three to four weeks to arrive, customized clothing reportedly accounts for a rapidly growing percentage of Lands’ End’s $500 million online business. Lands’ End states that its profit margins are roughly the same for customized clothes as regular clothes, but the reductions in inventories that come from matching demand to supply account for additional cost savings. Moreover, customers who customize appear to be more loyal, with reordering rates that are 34% higher than for buyers of standard-sized clothing.

Texas Instruments (TI) was an early user of the experience-curve concept. TI was a technological innovator, first in silicon transistors and then in semiconductors. The company discovered that with every doubling of accumulated production volume of a transistor or semiconductor, unit costs declined to 73 percent of their previous level. Building on this insight, when TI first produced a new transistor or semiconductor, it would slash the price of the product to stimulate demand. The goal was to drive up the accumulated volume of production and so drive down costs through the realization of experience-curve economies. As a result, during the 1960s and 1970s, TI hammered its competitors in transistors and moved on to prevail in semiconductors and, ultimately, in hand-held calculators and digital watches. Until 1982, TI enjoyed rapid growth, with sales quadrupling between 1977 and 1981 alone.

After 1982, things began to go wrong for TI. The company's single-minded focus on cost reductions, an outgrowth of its strategic reliance on the experience curve, left it with a poor understanding of customer needs and market trends. Competitors such as Casio and Hewlett-Packard began to make major inroads into TI's hand-held calculator business by focusing on features in addition to cost and price that customers demanded. TI was slow to react to this trend and lost substantial market share as a result. In the late 1970s, it also decided to focus on semiconductors for watches and calculators, where it had gained substantial experience-curve-based cost economies, rather than developing metal oxide semiconductors for computer memories and advanced semiconductors. As it turned out, with the growth in minicomputers and personal computers in the early 1980s, the market shifted toward high-power metal oxide semiconductors. Consequently, TI found itself outflanked by Intel and Motorola. In sum, TI's focus on realizing experience-curve economies initially benefited the company, but then it seems to have contributed toward a myopia that cost the company dearly.\(^a\)
Chemical and Chase Banks Merge to Realize Scale Economies

In August 1995, two of the world's largest banks, Chemical Bank and Chase Manhattan Bank, both of New York, announced their intention to merge. The merger was officially completed on March 31, 1996. The combined bank, which goes under the Chase name, has more than $300 billion in assets, making it the largest bank in the United States and the fourth largest in the world. The new Chase is capitalized at $20 billion and is number one or two in the United States in numerous segments of the banking business, including loan syndication, trading of derivatives, currency and securities trading, global custody services, luxury auto financing, New York City retail banking, and mortgaging services.

The prime reason given for the merger was anticipated cost savings of more than $1.7 billion per year, primarily through the realization of economies of scale. The newly merged bank had good reason for thinking that these kinds of cost savings were possible. In a 1991 merger between Chemical and Manufacturers Hanover, another New York-based bank, cost savings of $50 million per year were realized by eliminating duplicated assets, such as physical facilities, information systems, and personnel.

The cost savings in the Chase-Chemical combination had several sources. First, significant economies of scale were possible by combining the 600 retail branches of the original banks. Closing excess branches and consolidating its retail business into a smaller number of branches allowed the new bank to significantly increase the capacity utilization of its retail banking network. The combined bank was able to generate the same volume of retail business from fewer branches. The fixed costs associated with retail branches—including rents, personnel, equipment, and utility costs—dropped, which translated into a substantial reduction in the unit cost required to serve the average customer.

Another source of scale-based cost savings arose from the combination of a whole array of back-office functions. For example, the combined bank now has to operate only one computer network instead of two. By getting greater utilization out of a fixed computer infrastructure—mainframe computers, servers, and the associated software—the combined bank was able to further drive down its fixed cost structure. Combining management functions also brought substantial savings. For example, the new Chase bank has doubled the number of auto loans and mortgage originations it issues, but because of office automation it can manage the increased volume with less than twice the management staff. This saving implies a big reduction in fixed costs and a corresponding fall in the unit costs of servicing the average auto loan or mortgage customer.2
Running Case

Human Resource Strategy and Productivity at Wal-Mart

Wal-Mart has one of the most productive work forces in the retail industry. In 2002, for example, it generated $175,000 in sales for every employee, compared to $144,000 at Target and $141,000 at Sears. The roots of Wal-Mart’s high productivity go back to the company’s early days and the business philosophy of the company’s founder, Sam Walton.

Sam Walton began his career in 1940 as a management trainee at J.C. Penney. There he noticed that all employees were called associates, and moreover, that treating them with respect seemed to reap dividends in the form of high employee productivity. Twenty-two years later, when he founded Wal-Mart, Walton decided to call all employees “associates” to symbolize their importance to the company. He reinforced this policy by emphasizing that, at Wal-Mart, “our people make the difference.” Unlike many managers who have stated this mantra, Walton believed it and put it into action. He believed that if you treat people well, they will return the favor by working hard, and that if you empower them, then ordinary people can work together to achieve extraordinary things. These beliefs formed the basis for a decentralized organization that operated with an open door policy and open books, allowing associates to see how their store and the company were doing.

Consistent with the open door policy, Walton continually emphasized that management needed to listen to associates and their ideas. As he noted in his 1992 book, “The folks on the front lines—those who actually talk to the customer—are the only ones who really know what’s going on out there. You’d better find out what they know. This really is what total quality is all about. To push responsibility down in your organization, and to force good ideas to bubble up within it, you must listen to what your associates are trying to tell you.”

Despite his belief in empowerment, however, Walton was notoriously tight on salaries. Walton opposed unionization, fearing that it would lead to higher pay and restrictive work rules that would sap productivity. The culture of Wal-Mart also encouraged people to work hard. One of Walton’s favorite homilies was the “sundown rule,” which stated that one should never leave until tomorrow what can be done today. The sundown rule was enforced by senior managers, including Walton, who would drop in unannounced at a store and pepper store managers and employees with questions, at the same time praising them for a job well done and celebrating the “heroes” who took the sundown rule to heart.

The key to getting extraordinary effort out of employees while paying them meager salaries was to reward them with profit sharing plans and stock ownership schemes. Long before it became fashionable in American business, Walton was placing a chunk of Wal-Mart’s profits into a profit sharing plan for associates and the company was putting matching funds into employee stock ownership programs. The idea was simple: reward associates by giving them a stake in the company, and they will work hard for low pay because they know they will make it up in profit sharing and stock price appreciation. For years this formula worked extraordinarily well, but there are now signs that Wal-Mart’s very success is creating problems. In 2004 the company, with a staggering 1.4 million associates, was the largest private employer in the world. As the company has grown, it has become increasingly difficult to hire the kinds of people that Wal-Mart has traditionally relied on: those willing to work long hours for low pay based on the promise of advancement and reward through profit sharing and stock ownership. The company has come under attack for paying its associates low wages and pressuring them to work long hours without overtime pay. Labor unions have made a concerted but so far unsuccessful attempt to unionize stores, and the company is the target of lawsuits from employees alleging sexual discrimination. Wal-Mart claims that the negative publicity is based on faulty data, and perhaps that is right, but if the company has indeed become too big to put Walton’s principles into practice, the glory days may be over.
Whatever Happened to the Digital Compact Cassette?

The Digital Compact Cassette (DCC) was developed by Philips, the Dutch consumer electronics company. The DCC is a recordable audio digital technology that offers sound qualities superior to those of analog cassette technology. The DCC was designed to replace analog cassette tapes in much the same way that digital compact disks have replaced analog long-playing records. An attractive feature of the technology was a design that allowed users to play their analog cassette tapes on the DCC, in addition to DCC digital tapes. The thinking at Philips was that this feature would make the product very attractive to users, who would not have to replace their existing collection of analog cassette tapes when they purchased a DCC player. To try and ensure initial acceptance of the technology, Philips lined up a number of recording companies—including MCA, Polygram, EMI, and Warner—all of whom agreed to issue prerecorded DCC tapes in conjunction with the launch by Philips of the tapes players.

Brought out in 1993, the DCC was hailed in the press as the biggest new product introduction in the consumer electronics industry since the introduction of the compact disk a decade earlier. However, as initial demand failed to materialize, retailers with unsold DCC tapes and decks on their hands refused to keep devoting valuable shelf space to DCC products, and recording companies soon stopped issuing prerecorded DCC tapes. It was obvious within a year that the product was stillborn in the marketplace.

Why did the DCC fail to gain market acceptance despite its apparently attractive features? Poor positioning strategy is probably part of the explanation. Philips introduced the technology at a very high price—around $1,000 for a basic home deck—out of the reach of most consumers. Moreover, Philips failed to introduce a portable model (to compete with Sony’s Walkman) or a model for cars (most consumers still have analog tape players in their cars). To make matters worse, the original promotional advertising failed to mention one of the most attractive features of the technology—that DCC tape drives could play existing analog tapes. Finally, Philips implemented a very abstract advertising campaign, which left most consumers confused about the nature of the new technology.

Another reason for the poor market acceptance was the limited value placed on the technology by many consumers. Most consumers did not see the DCC as a big advance over CD players. True, CD technology did not have recording capability, but CD players were increasingly turning up in cars and Sony had marketed a very successful portable version of the CD (the Discman)—both market niches that were natural targets for the DCC. Consequently, few consumers valued the technology enough to pay $1,000 or so for a player. Whether Philips would have been able to build sales for the DCC had it entered the market at a lower price point, with better advertising and a broader range of models, remains an open question, but success would probably have been more likely.

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In 1980, Apollo Computer created the market for engineering computer workstations. (Workstations are high-powered freestanding minicomputers.) Apollo was rewarded with rapid growth and a virtual monopoly position. Its first real competitor, Sun Microsystems, did not introduce a competing product until 1982. However, by 1988 Apollo had lost its lead in the workstation market to Sun. While Apollo was generating revenues of $600 million in 1988, Sun’s revenues were more than $1 billion. Between 1984 and 1988, Sun’s revenues from workstations grew at an annual rate of 100 percent, compared with Apollo’s annual growth rate of 35 percent.

The cause of Apollo’s slower growth was a slow cycle time. In the computer industry, innovations in microprocessor technology are proceeding at a furious pace. In order to stay abreast of new microprocessor technology, any manufacturer of computers must be continually updating their product. However, while Sun had succeeded in introducing a new product every twelve months and in doubling the power of its workstations every eighteen months on the average, Apollo’s product development cycle had stretched out to more than two years. As a result, Apollo’s products were regularly superseded by the more technologically advanced products introduced by Sun, and Apollo was falling further and further behind. Consequently, while Sun had increased its market share from 21 percent to 33 percent between 1985 and 1988, Apollo’s fell from 41 percent to under 20 percent. In 1989, facing mounting problems, Apollo was acquired by Hewlett-Packard.
First came manufacturing. Now companies are farming out R&D to cut costs and get new products to market faster. Are they going too far?

By Pete Engardio and Bruce Einhorn

Photograph by David Hartung/Getty Images

HTC's Chou
The supplier of choice to smart-phone providers
just cell phones. Asian contract manufacturers and independent design houses have become forces in nearly every tech device, from laptops and high-definition TVs to MP3 music players and digital cameras. "Customers used to participate in design two or three years back," says Jack Hsieh, vice-president for finance at Taiwan's Premier Imaging Technology Corp., a major supplier of digital cameras to leading U.S. and Japanese brands. "But starting last year, many just take our product. Because of price competition, they have to."

While the electronics sector is furthest down this road, the search for offshore help with innovation is spreading to nearly every corner of the economy. On Feb. 8, Boeing Co. said it is working with India's HCL Technologies to co-develop software for everything from the navigation systems and landing gear to the cockpit controls for its upcoming 7E7 Dreamliner jet. Pharmaceutical giants such as GlaxoSmithKline and Eli Lilly are teaming up with Asian biotech research companies in a bid to cut the average $500 million cost of bringing a new drug to market. And Procter & Gamble Co. says it wants half of its new product ideas to be generated from outside by 2010, compared with 20% now.

Competitive Dangers

UNDERLYING THIS TREND is a growing consensus that more innovation is vital—but that current R&D spending isn’t yielding enough bang for the buck. After spending years squeezing costs out of the factory floor, back office, and warehouse, CEOs are asking tough questions about their once-cloistered R&D operations: Why are so few hit products making it out of the labs into the market? How many of those pricey engineers are really creating game-changing products or technology breakthroughs? "R&D is the biggest single remaining controllable expense to work on," says Allen J. Delattre, head of Accenture Ltd.’s high-tech consulting practice. "Companies either will have to cut costs or increase R&D productivity."

The result is a rethinking of the structure of the modern corporation. What, specifically, has to be done in-house anymore? At a minimum, most leading Western companies are turning toward a new model of innovation, one that employs global networks of partners. These can include U.S. chipmakers, Taiwanese engineers, Indian software developers, and Chinese factories. IBM is even offshoring the smarts of its famed research labs and a new global team of 1,200 engineers to help customers develop future products using next-generation technologies. When the whole chain works in sync, there can be a dramatic leap in the speed and efficiency of product development.

The downside of getting the balance wrong, however, can be steep. Start with the danger of fostering new competitors. Motorola hired Taiwan’s BenQ Corp. to design and manufacture millions of mobile phones. But then BenQ began selling phones last year in the prized China market under its own brand. That prompted Motorola to pull its contract. Another risk is that brand-name companies will lose the incentive to keep investing in new technology. "It is a slippery slope," says Boston Consulting Group Senior Vice-President Jim Andrew. "If the innovation starts residing in the suppliers, you could incrementalize yourself to the point where there isn’t much left."

Such perceptions are a big reason even companies that outsource heavily refuse to discuss what hardware designs they buy from whom and impose strict confidentiality on suppliers. "It is still taboo to talk openly about outsourced design," says Forrester Research Inc. consultant Navi Radjou, an expert on corporate innovation.

The concerns also explain why different companies are adopting widely varying approaches to this new paradigm. Dell, for example, does little of its own design for notebook PCs, digital TVs, or other products. Hewlett-Packard Co. says it contributes key technology and at least some design input to all its products but relies on outside partners to co-develop everything from servers to printers. Motorola buys complete designs for its cheapest phones but controls all of the development of high-end handsets like its hot-selling Razr. The key, execs say, is to guard some sustainable competitive advantage, whether it’s control over the latest technologies, the look and feel of new products, or the customer relationship. "You have to draw a line," says Motorola CEO
Edward J. Zander. At Motorola, “core intellectual property is above it, and commodity technology is below.” Wherever companies draw the line, there’s no question that the demarcation between mission-critical R&D and commodity work is sliding year by year. The implications for the global economy are immense. Countries such as India and China, where wages remain low and new engineering graduates are abundant, likely will continue to be the biggest gainers in tech employment and become increasingly important suppliers of intellectual property. Some analysts even see a new global division of labor emerging: The rich West will focus on the highest levels of product creation, and all the jobs of turning concepts into actual products or services can be shipped out. Consultant Daniel H. Pink, author of the new book *A Whole New Mind*, argues that the “left brain” intellectual tasks that “are routine, computer-like, and can be boiled down to a spec sheet are migrating to where it is cheaper, thanks to Asia’s rising economies and the miracle of cyberspace.” The U.S. will remain strong in “right brain” work that entails “artistry, creativity, and empathy with the customer that requires being physically close to the market.”

You can see this great divide already taking shape in global electronics. The process started in the 1990s when Taiwan emerged as the capital of PC design, largely because the critical technology was standardized, on Microsoft Corp.’s operating system software and Intel Corp.’s microprocessor. Today, Taiwanese “original-design manufacturers” (ODMs), so named because they both design and assemble products for others, supply some 65% of the world’s notebook PCs. Quanta Computer Inc. alone expects to churn out 16 million notebook PCs this year in 50 different models for buyers that include Dell, Apple Computer, and Sony.

Now, Taiwanese ODMs and other outside designers are forces in nearly every digital device on the market. Of the 700 million mobile phones expected to be sold worldwide this year, up to 20% will be the work of ODMs, estimates senior analyst Adam Pick of the El Segundo (Calif.) market research firm iSuppli Corp. About 30% of digital cameras are produced by ODMs, 65% of MP3 players, and roughly 70% of personal digital assistants (PDAs). Building on their experience with PCs, they’re increasingly creating recipes for their own gizmos, blending the latest advances in custom chips, specialized software, and state-of-the-art digital components. “There is a lot of great capability that has grown in Asia to develop complete products,” says Doug Rasor, worldwide strategic marketing manager at chipmaker Texas Instruments Inc. TI often supplies core chips, along with rudimentary designs, and the ODMs take it from there. “They can do the system integration, the plastics, the industrial design, and the low-cost manufacturing, and they are happy to put Dell’s name on it. That is a megatrend in the industry,” says Rasor.

Taiwan’s ODMs clearly don’t regard themselves as mere job

## MATTER OF

Technology companies in the U.S. have long hired manufacturers in Taiwan and other countries to make their products. Now an increasing number of tech products are being designed offshore, too.

<table>
<thead>
<tr>
<th>PDAs</th>
<th>NOTEBOOK PCs</th>
<th>DIGITAL CAMERAS</th>
<th>MOBILE PHONES</th>
<th>NETWORKING EQUIPMENT</th>
</tr>
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<tbody>
<tr>
<td>DESIGNS OUTSOURCED: 70%</td>
<td>DESIGNS OUTSOURCED: 65%</td>
<td>DESIGNS OUTSOURCED: 30%</td>
<td>DESIGNS OUTSOURCED: 20%</td>
<td>DESIGNS OUTSOURCED: Nascent</td>
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- **Personal digital assistants (PDAs) and pocket PCs:** use many evolving technologies. So even big brands like Hewlett-Packard and PalmOne collaborate with Asian ODMs on design. Other brands use their vendors’ platforms.
- **Taiwanese companies design and manufacture most laptops sold worldwide.** They also control many patents for industrial and mechanical design. Dell, Hewlett-Packard, Sony, and even Apple use designs by contract manufacturers.
- **Top brands like Nikon and Canon design most of their own cameras but now buy cheaper models from Taiwanese vendors to get into the market quickly. HP and Kodak collaborate closely on design with Asian manufacturers.**
- **Handsets by second-tier brands like Philips and Siemens and operators like T-Mobile and AT&T Wireless are based on designs by outside firms. Motorola, Nokia, Sony-Ericsson and others farm out design of low-end models.**
- **Communications equipment giants like Cisco, Lucent, and Nortel design complex switches and routers in-house. But they’re having outsiders design more low-end gear and develop key software.**

LEADING DESIGNERS: HTC (above); Compal, Inventec

LEADING DESIGNERS: Quanta, Compal (above); Wistron, Asustek, FIC

LEADING DESIGNERS: Sony, Premier (above); Apple, Primax

LEADING DESIGNERS: Compal, Cellon (above); Fujitsu; BenQ

LEADING DESIGNERS: Gemtek (above); Delta, CyberTAN, Huawei
Sweeping Overhaul

INDIA IS EMERGING AS A HEAVYWEIGHT in design, too. The top players in making the country world-class in software development, including HCL and Wipro, are expected to help India boost its contract R&D revenues from $1 billion a year now to $5 billion in three years. One of Wipro’s many labs is in a modest office off dusty, congested Hosur Road in Bangalore. There, 1,000 young engineers partitioned into brightly lit pods jammed with circuit boards, chips, and steel housings hunch over 26 development projects. Among them is a hands-free phone system that attaches to the visor of a European sports car. At another pod, designers tinker with a full dashboard of a new European model. A third pod is filled with origami beds designed with a satellite navigation system. Inside other Wipro labs in Bangalore, engineers are designing prototypes for every-thing from high-definition TVs to satellite set-top boxes.

Perhaps the most ambitious new entrant in design is Flextronics. The manufacturing behemoth already builds networking gear, printers, game consoles, and other hardware for the likes of Nortel Networks, Xerox, HP, Motorola, and Casio Computer. But three years ago, it started losing big cell-phone and PDA orders to Taiwanese ODMs. Since then, CEO Michael E. Marks has shelled out more than $800 million on acquisitions to build a 7,000-engineer force of software, chip, telecom, and mechanical designers scattered from India and Singapore to France and Ukraine. Marks’s splashiest move was to pay an estimated $30 million for frog design Inc., the pioneering Sunnyvale (Calif.) firm that helped design such Information Age icons as Apple Computer Inc.’s original Mac in 1984. So far, Flextronics has developed its own basic platforms for cell phones, routers, digital cameras, and imaging devices. His goal is to make Flextronics a low-cost, soup-to-nuts developer of consumer-electronics and tech gear.

Marks has an especially radical take on where all this is headed: He believes Western tech conglomerates are on the cusp of a sweeping overhaul of R&D that will rival the offshore shift of manufacturing. In the 1990s, companies like Flextronics “completely restructured the world’s electronics manufacturing,” says Marks. “Now we will completely restructure design.” When you get down to it, he argues, some 80% of engineers in product development do tasks that can easily be outsourced—like translating prototypes into workable designs, upgrading mature products, testing quality, writing user manuals, and qualifying parts vendors. What’s more, most of the core technologies in today’s digital gadgets are available to anyone. And circuit boards for everything from cameras to network switches are becoming simpler because more functions are embedded on semiconductors. The “really hard technology work” is migrating to chipmakers such as Texas Instruments, Qualcomm, Philips, Intel, and Broadcom, Marks says. “All electronics are on the same trajectory of becoming silicon surrounded by plastic.”

Why then, Marks asks, should Nokia, Motorola, Sony-Ericsson, Alcatel, Siemens, Samaung, and other brand-name companies all largely duplicate one another’s efforts? Why should each spend $30 million to develop a new smartphone or $200 million on a cellular base station when they can just buy the hardware designs? The ultimate result, he says: Some electronics giants will shrink their R&D forces from several thousand to a few hundred, concentrating on proprietary architecture, setting key specifications, and managing global R&D teams. “There is no doubt the product companies are going to have fewer people design stuff,” Marks predicts. “It’s going to get ugly.”

Granted, Marks’s vision is more than a tad extreme. True,
despite the tech recovery, many corporate R&D budgets have been tightening. HP's R&D spending long hovered around 6% of sales, but it's down to 4.4% now. Cisco Systems' R&D budget has dropped from its old average of 17% to 14.5%. The numbers also are falling at Motorola, Lucent Technologies, and Ericsson. In November, Nokia Corp. said it aims to trim R&D spending from 12.8% of sales in 2004 to under 10% by the end of 2006.

Close to the Heart

STILL, MOST COMPANIES INSIST they will continue to do most of the critical design work—and have no plans to take a meat ax to R&D. A Motorola spokesman says it plans to keep R&D spending at around 10% for the long term. Lucent says its R&D staff should remain at about 9,000, after several years of deep cuts. And while many Western companies are downsizing at home, they are boosting hiring at their own labs in India, China, and Eastern Europe. "Companies realize if they want a sustainable competitive advantage, they will not get it from outsourcing," says President Frank M. Armbrrecht of the Industrial Research Institute, which tracks corporate R&D spending.

Companies also worry about the message they send investors. Outsourcing manufacturing, tech support, and back-office work makes clear financial sense. But ownership of design strikes close to the heart of a corporation's intrinsic value. If a company depends on outsiders for design, investors might ask, how much intellectual property does it really own, and how much of the profit from a hit product flows back into its own coffers, rather than being paid out in licensing fees? That's one reason Apple Computer lets the world know it develops its hit products in-house, to the point of etching "Designed by Apple in California" on the back of each iPod.

Yet some outsourcing holdouts are changing their tune. Nokia long prided itself on developing almost everything itself—to the point of designing its own chips. No longer. Given the complexities of today's technologies and supply chains, "nobody can master it all," says Chief Technology Officer Pertti Korhonen. "You have to figure out what is core and what is context." Lucent says outsourcing some development makes sense so that its engineers can concentrate on next-generation technologies. "This frees us up to focus on new product lines," says Dave Ayers, vice-president for platforms and engineering. "Outsourcing isn't about moving jobs. It's about the flexibility to put resources in the right places at the right time."

It's also about brutal economics and the relentless demands of consumers. To get shelf space at a Best Buy or Circuit City often means brand-name companies need a full range of models, from a $100 point-and-shoot digital camera with 2 megapixels, say, to a $700 8-megapixel model that doubles as a videocam and is equipped with a powerful zoom lens. On top of this, superheated competition can reduce hit products to cheap commodities within months. So they must get out the

HIDDEN HANDS

Their names don't appear on the products. But a group of little-known companies are coming up with the designs for an increasing number of products sold under top brands, from Motorola and Palm to Hewlett-Packard and Dell. Some examples of the leading players:

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>DESCRIPTION</th>
<th>R&amp;D STAFF</th>
<th>KEY PRODUCTS DESIGNED</th>
</tr>
</thead>
<tbody>
<tr>
<td>CELLON</td>
<td>This independent design house, spun off from Philips' cell-phone business, has big labs in China and France.</td>
<td>800</td>
<td>Wireless handsets for Philips, Siemens, Haier, others.</td>
</tr>
<tr>
<td>COMPAI</td>
<td>A top developer of computers that now is the leading producer of mobile phones.</td>
<td>1,000*</td>
<td>Notebooks, cell phones for Motorola, Toshiba, Sony-Ericsson, others.</td>
</tr>
<tr>
<td>FLEXTRONICS</td>
<td>Manufacturing services giant bought frog design last year to beef up its global design capabilities.</td>
<td>7,000</td>
<td>Cell phones, printers, telecom equipment for undisclosed customers.</td>
</tr>
<tr>
<td>HTC</td>
<td>This contract manufacturer is a top designer of wireless digital handheld devices.</td>
<td>900</td>
<td>Smart phones for palmOne, T-Mobile, Audiovox, Verizon, others.</td>
</tr>
<tr>
<td>PREMIER</td>
<td>Like many other contract suppliers, Premier does original design. Its specialty: digital cameras and projectors.</td>
<td>450</td>
<td>Cameras, imaging devices for HP, Fuji Photo, Olympus, Konika, others.</td>
</tr>
<tr>
<td>QUANTA</td>
<td>The world's top manufacturer of laptops, expanding into cell phones and networked digital home appliances.</td>
<td>7,000</td>
<td>Notebook PCs, consumer appliances for Dell, Apple, Sony, others.</td>
</tr>
<tr>
<td>WIPRO</td>
<td>The world's largest contract R&amp;D house for telecom, auto, and electronics.</td>
<td>8,000</td>
<td>Telecom equipment, auto electronic systems, chips for undisclosed customers.</td>
</tr>
</tbody>
</table>

*Includes IC and related value-added services

CO-Pilot

India's HCL will co-develop systems for Boeing's 7E7

Date: March 21, 2005
“Consumer electronics have become almost like produce,” says Michael E. Fawkes, senior vice-president of HP’s Imaging Products Div. “They always have to be fresh.”

Such pressures explain outsourcing’s growing allure. Take cell phones, which are becoming akin to fashion items. Using a redesigned platform can shave 70% of development costs off a new model, estimates William S. Wong, a senior vice-president for marketing at Cellon. That can be a huge savings. As a rule of thumb, it takes around $10 million and up to 150 engineers to develop a new cell phone from scratch. If Motorola or Nokia guess wrong about the market trends a year into the future, they can lose big.

With most of its 800 engineers in China and France, Cellon creates several basic designs each year and spreads the costs among many buyers. It also has the technical expertise to morph that basic phone into a bewildering array of models. Want a 2-megapixel camera module instead of 1-megapixel? Want to include a music player, or change the style from a gray clamshell to a flaming-red candy-bar shape? No problem: Cellon engineers can whip up a prototype, run all the tests, and get it into mass production in a Chinese factory in months.

Moving Up the Food Chain

COMPANIES ARE STILL figuring out exactly what to outsource. PalmOne Inc.'s collaboration with Taiwan's HTC on its popular Treo 650 smart phone illustrates one approach. Palm has long hired contractors to assemble hardware from its own industrial designs. But in 2001, it decided to focus on software and shifted hardware production to Taiwanese ODMs. PalmOne designers still determine the look and feel of the product, pick key components like the display and core chips, and specify performance requirements. But HTC does much of the mechanical and electrical design. “Without a doubt, they've become a part of the innovation process,” says Angel L. Mendez, senior global operations vice-president at palmOne.

QUANTA'S LAM “It's now difficult to get good ideas from our customers”

“It's less about outsourcing and more about the collaborative way in which design comes together.” The result: PalmOne has cut months off of development times, reduced defects by 50%, and boosted gross margins by around 20%.

Hewlett-Packard, a company with such a proud history of innovation that its advertising tag line is simply “invent,” also works with design partners on all the hardware it outsources. “Our strategy is now to work with global networks to leverage the best technologies on the planet,” says Dick Conrad, HP’s senior vice-president for global operations. According to iSupply, HP is getting design help from Taiwan’s Quanta and Hon Hai Precision for PCs, Lite-On for printers, Inventec for servers and MP3 players, and Altek for digital cameras. HP won't identify specific suppliers, but it says the strategy has brought benefits. Conrad says it now takes 60% less time to get a new concept to market. Plus, the company can “redploy our assets and resources to higher value-added products” such as advanced printer inks and sophisticated corporate software, he says.

How far can outsourced design go? When does it get to the point where ODMs start driving truly breakthrough concepts and core technologies? It's not here yet. Distance is one barrier. “To be a successful product company requires intimacy with the customer,” says Azim H. Premji, chairman of India’s Wipro. “That is very hard to offshore in fast-changing markets.” Another hurdle is that R&D spending by ODMs remains relatively low. Even though Premier develops most of its own cameras and video projectors, “the really core technology,” such as the digital signal processors, is invented in the U.S., says vice-president Hsieh. Premier’s latest $2000-size video projector, for example, was based on a rough design by Texas Instruments, developer of the core chip. With margins shrinking fast in the ODM business, however, Premier and other Taiwanese companies know they need to move up the innovation food chain to reap higher profits. That's where Flextronics and its design acquisitions could get interesting. Inside frog's hip Sunnyvale office, designers are working to create a radically new multimedia device, for an unnamed corporate client, that won't hit the market until 2007. The plan, says Patricia Roller, frog's co-CEO, is to use Flextronics software engineers in Ukraine or India to develop innovative applications, and for Flextronics engineers to design the working prototype. Flextronics then would mass-produce the gadgets, probably in China.

Who will ultimately profit most from the outsourcing of innovation isn’t clear. The early evidence suggests that today’s Western titans can remain leaders by orchestrating global innovation networks. Yet if they lose their technology edge and their touch with customers, they could be tomorrow’s great shrinking conglomerates. Contractors like Quanta and Flextronics that are moving up the innovation ladder, meanwhile, have a shot at joining the world’s leading industrial players. What is clear is that an army of in-house engineers no longer means a company can control its fate. Instead, the winners will be those most adept at marshaling the creativity and skills of workers around the world. —With Manjeet Kripalani in Bangalore. Andy Reinhardt in Cannes. Bruce Nussbaum in Somers, N.Y. and Peter Burrows in San Mateo, Calif.
4.4 STRATEGY IN ACTION

Coming: Learning from Innovation Failures

In 1998, Corning, then the world’s largest supplier of fiber optic cable, decided to diversify into the development and manufacture of DNA microarrays (DNA chips). DNA chips are used to analyze the function of genes and are an important research tool in the drug development process. Corning tried to develop a DNA chip that could print all 28,000 human genes onto a set of slides. By 2000, Corning had invested more than $100 million in the project and its first chips were on the market, but the project was a failure; in 2001 it was pulled.

What went wrong? Corning was late to market—a critical mistake. The market was dominated by Affymetrix, which had been in the businesses since the early 1990s. By 2000, Affymetrix’s DNA chips were the dominant design; researchers were familiar with them, they performed well, and few people were willing to switch to chips from unproven competitors. Corning was late because it adhered to its long-established innovation processes, which were not entirely appropriate in the biological sciences. In particular, Corning’s own in-house experts in the physical sciences insisted on sticking to rigorous quality standards that customers and life scientists felt were higher than necessary. These quality standards proved to be very difficult to achieve. As a result, the product launch was delayed, giving Affymetrix time to consolidate its hold on the market. Moreover, Corning failed to give prototypes of its chips to potential customers, and, consequently, it missed incorporating some crucial features that customers wanted.

After reviewing this failure, Corning decided that going forward, it needed to bring customers into the development process earlier; it needed to hire more outside experts if it was diversifying into an area where it lacked competencies to give those experts a larger say in the development process.

The project was not a total failure, however, for through it Corning discovered a vibrant and growing market: the market for drug discovery. By combining what it had learned about drug discovery with another failed business, photonics, which manipulates data using light waves, Corning created a new product called Epic. Epic is a revolutionary technology for drug testing that uses light waves instead of fluorescent dyes (the standard industry practice). Epic promises to accelerate the process of testing potential drugs and saving pharmaceutical companies valuable R&D money. Unlike its DNA microarray project, Corning had 18 pharmaceutical companies test Epic before development was finalized. Corning used this feedback to refine Epic. The company believes that ultimately Epic could generate $500 million annually.