When a customer in the U.S. clicks on Hewlett-Packard Co.'s Web site to purchase one of its Pavilion zd8000 laptop computers, the order quickly arrives thousands of miles away at a factory in China run by a less-familiar name, Quanta Computer Inc.

Although virtually unknown to consumers, Quanta is the world's biggest maker of laptops. As part of a sometimes-difficult symbiosis, the Taiwanese company makes roughly one-quarter of the world's portable computers, which are then sold by brands such as H-P and Dell Inc. Quanta collects components from countries around the world and assembles them at its Quanta Shanghai Manufacture City complex.

A look inside the making of a modern laptop PC shows how the process has evolved into the epitome of hyperefficient global production while also navigating a maze of corporate and geopolitical sensitivities. U.S. computer brands now farm out much of their manufacturing to Taiwanese concerns, which also are starting to design more of these products as well. The Taiwanese companies pull together parts to build the computers in China and then ship them to the purchaser, all in a matter of days.

Within that finely tuned cycle is a series of delicate balancing acts. Big U.S. brands must weigh the cost benefits of extensive outsourcing against the dangers of ceding too much control to their suppliers, a system that could devolve into creating look-alike or perform-alike products. The contract manufacturers, meanwhile, are struggling with steadily shrinking profit margins as their U.S. customers press to cut prices.

To lower labor costs, these Taiwanese assemblers have shifted almost all of their production in recent years to China, despite the continuing tensions between the two sides. Officials in Taipei and Beijing have yet to hash out a resumption of direct transportation across the Taiwan Strait. So executives traveling from Taipei to their factory must fly through Hong Kong or third destination, turning what would be a flight of less than two hours into one that can be a nearly eight-hour trip.

Taiwan and China separated in 1949 amid civil war and the Communist takeover of the mainland, but Beijing still claims sovereignty over the island and has threatened war to stop it from formalizing its de facto independence. Throughout the 1990s, Taiwan's
government banned manufacturing in China as part of broader restrictions aimed at preventing excessive economic dependence on its massive adversary.

By the early part of this decade, Quanta and other manufacturers pushed to tap China’s cheap labor. Taiwan lifted the ban in 2001, and the migration of manufacturing was swift. This year, 85% of Taiwanese notebook makers’ output is expected to come from China, compared with 4% in 2001, according to Taiwan’s government.

Quanta, which was founded in 1988 and started production in Shanghai in 2001, now has more than 90% of its output there, using more than 20,000 Chinese employees. Last year, it ended most of its remaining notebook production in Taiwan. Michael Wang, Quanta’s chief operating officer, says that manufacturing in China was “unavoidable. We had to move the production over there.”

China’s government has encouraged the trend, seeing investment by companies like Quanta as a way to provide jobs and technological know-how. As a result, the technology industry has become important to China’s economy, with foreign electronics manufacturers employing hundreds of thousands of Chinese workers. In fact, eight of China’s 10 biggest exporters by value last year were foreign ventures making PCs or other tech gadgets, according to China’s Ministry of Commerce. Quanta was No. 2.

For years, H-P and others made laptop computers, also known as notebooks, in more-advanced countries like the U.S., Japan, and Singapore. In the 1990s, to cut costs, they began outsourcing to Taiwanese companies that combined cheap labor with in-house engineering and design services. Quanta made nearly a quarter of the roughly 49 million notebooks shipped last year -- a share the company expects to grow to a third this year. Including smaller rivals like Compal Electronics Inc., Inventec Corp. and Wistron Corp., Taiwanese concerns now produce as much as 80% of the world’s laptops.

Outsourcing to low-cost, high-quality Taiwanese manufacturers has helped make Dell and H-P the world’s top two PC companies in terms of sales. International Business Machines Corp., which outsourced less than half of its laptop production, according to Merrill Lynch, and operated its own factory in China, consistently lost money on its PCs. It sold the business this year to China’s Lenovo Group Ltd., which has used Taiwanese companies to make most of its notebooks in China.

But the relationship between U.S. computer firms and their third-party manufacturers can be tricky. In the struggle to retain an element of control over their suppliers, H-P, Dell and others play contract manufacturers against each other to keep prices falling and ensure no supplier gains too much leverage.

Roger Bahalla, director of H-P’s laptop supply-chain strategy, says H-P typically works with a half-dozen third-party manufacturers at any one time. “It’s a way to keep the business competitive,” says Mr. Bahalla, who adds that 98% of H-P’s notebooks are
made in China. "There's an optimal number of partners to deal with. We don't want any one partner to be too small or too big."

Dell says it still plays the main role in making its laptops. Lionel Menchaca, a Dell spokesman, says the Round Rock, Texas, company obtains partly built laptops from contract manufacturers, but does final assembly at its own factories in Ireland, Malaysia or China, where microprocessors, software and other key components are added. Those finished products are then shipped to Dell-operated distribution centers in the U.S., where they are packaged with other items and shipped to the customer. Mr. Menchaca says Dell assembles "about 60-70% of the overall cost of our notebooks" itself.

"There's a misperception that Dell isn't much involved in the manufacturing process [of laptops]," he says. "We're the ones who control the whole build-to-order process."

Mr. Bahalla of H-P also takes pains to emphasize that his company isn't just handing off its laptops to contract manufacturers. The Palo Alto, Calif., tech giant retains much control over the process, he says. It orders many of the key components itself, such as hard drives and display panels. And H-P provides the base design of the laptop and has established design centers in Shanghai and Taipei to collaborate with its manufacturers.

"For an informed consumer, that the laptops are made in China [by a third party] shouldn't be an issue," says H-P's Mr. Bahalla. "The key is whether H-P stands behind the products or not. And we do."

While outsourcing has helped Quanta and others grow rapidly, their profits are under constant pressure. While Quanta saw revenue more than quadruple from 1999 through last year, to about $10.4 billion, its net profit margin fell to 3.6% from 12.2% in the same period.

"This is a very lean margin area, so you've got to do everything right to make a profit," says Quanta's Mr. Wang.

Many of the laptops' most valuable components are still imported to China. H-P's Pavilion zd8000, which lists for $1,199 (after rebate) on the company's Web site, includes a microprocessor -- the computer's brain -- made by Intel Corp. of the U.S. It also comes with a graphics chip designed by ATI Technologies Inc. of Markham, Ontario, that is manufactured in Taiwan. Companies in South Korea and Taiwan typically provide the liquid-crystal-display screens for laptops, as well as much of the memory chips that store data temporarily. Hard-disk drives, for long-term storage, often come from Japan.

Within a manufacturing facility like Quanta's, there are typically two assembly lines, executives familiar with the process say. One consists of a conveyor belt where a laptop's underlying guts are put together by robots. When an order comes in, workers configure the semi-assembled laptops to a consumer's specifications on a second
assembly line, adding the desired amount of memory and a region-specific power cord, for instance.

At the end of the line, workers add an instruction manual, warranty information and promotional materials. The laptops are then boxed, grouped with other orders and put onto an air-cargo plane. At the point of entry, they are shipped to customers by an express company such as Federal Express, UPS, or DHL. Quanta’s Mr. Wang says the company ships 98% of its orders within two days.

Having moved production to China, Quanta and its competitors are finding it difficult to squeeze more costs out of PC production. To keep growing, many have expanded into new products. Quanta, for instance, also makes cellphones and flat-screen LCD televisions at the Shanghai plant.

Meanwhile, a growing share of laptop-component production is also shifting to China, which is likely to help keep PC prices falling. Seagate Technology Inc., a big U.S. hard-disk-drive maker, now produces most of its laptop drives near Shanghai. Even some of the most costly parts -- such as LCD screens and memory chips -- are starting to be made in China.

Please turn the page…
All Over the Map

When a U.S. customer orders an H-P Pavilion laptop, the request travels all the way to China in just days. A look at the process, and China’s increasing role not just as manufacturer, but supplier of more sophisticated laptop parts.

Outsourcing ratio for world’s top laptop PC brands, 2004:

- Dell: 100%*
- Apple: 100
- Gateway: 100
- Acer: 100
- H-P: 95
- NEC: 60
- Sony: 50
- IBM: 40
- Toshiba: 35

* Dell takes care of final assembly in its factories.

Source: Merrill Lynch

World-wide laptop PC production by country, 2005:

- China: 68%
- Japan: 17%
- Others: 5%
- Korea, U.S.: 1% each

Source: IDC

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