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BY WILLY C. SHIH

RISING LABOR COSTS in China and other emerging economies, high supply chain and logistics costs, and wide differentials in the costs for electricity and natural gas in different parts of the world are provoking a fresh round of relocation of manufacturing and production. While some labor-intensive jobs are moving out of China to Southeast Asia or the next emerging low-cost regions, some high-profile manufacturing work is returning to the United States, to the cheers of some who are proclaiming the beginnings of a manufacturing renaissance. Wal-Mart holds supplier conferences to promote “Made in U.S.A.,” and the retail giant encourages manufacturers to commit to producing in the United States by promising to purchase \$50 billion more in U.S. manufactured goods in the next 10 years. It is targeting the reshoring of products made for its stores by trying to



THE LEADING QUESTION

What should companies be prepared for when reshoring manufacturing work?

FINDINGS

- ▶ In the United States, many key resources, such as the manufacturing workforce, have atrophied.
- ▶ To reduce turnover, encourage workers to complete training and certification.
- ▶ Adopt a strategic view of supplier relationships, rather than a transactional view.

facilitate and accelerate reshoring efforts among its suppliers. Consultants proclaim the reemergence of the United States as a competitive place for manufacturing — and are pushing their services with reshoring conferences, reports and lots of advice.¹

While the macroeconomic data on comparative labor and factor costs may be compelling, the actual process of reshoring — bringing assembly work back from abroad — is hard work. This is especially true when the resources upon which a company draws (the supplier base, the workforce, and even the company's own internal product design capabilities) have atrophied. In an earlier paper, my Harvard colleague Gary Pisano and I documented the loss of the “industrial commons” in the United States, the shared resource base upon which manufacturers draw.² My recent research has looked at several initiatives aimed at rebuilding regional capacity, including General Electric Co.'s Appliance Park operations in Louisville, Kentucky; Google's efforts in partnership with Flextronics International Ltd. to assemble the MotoX smartphone in Fort Worth, Texas; a high-end technology product manufactured at Flextronics facilities in Austin, Texas; as well as comparison factories in Europe and Asia. (See “About the Research.”) What can we learn from these efforts to help managers prepare for reshoring?

The benefits were no surprise. Positioning manufacturing close to the market minimizes the inventory of goods in the pipeline and reduces delivery times. More importantly, the closeness reduces the length of ordering cycles, enabling companies to respond more quickly to market changes.

It was also no surprise that customers expect to pay little, if any, premium for products made domestically versus imported from abroad. Thus, it was important to pay a wage rate that was globally competitive when adjusted for productivity, and there can be no compromises on quality.

The challenges were less immediately apparent. Stabilizing the workforce, addressing organizational skills gaps, rethinking the capital/labor ratio, localizing the supply base and rethinking product design to leverage the proximity to manufacturing turned up consistently as important focus areas for managers.

In this article, I reflect on the experiences of these large reshoring projects and make recommendations for managers who are considering the United

States as a location choice for new product-assembly operations. What's more, while most of the observations in this article are specific to reshoring in the United States, they contain insights that are relevant to markets and production around the globe.

Stabilizing the Workforce

Establishing product-assembly operations means hiring people, often in large numbers. Appliance Park had a goal of hiring 2,500 new workers; the reshoring project in Fort Worth had the same target. Finding enough people with the right skills — and finding them fast enough to support the ramp-up of operations — was an enormous challenge. Appliance Park started with 10,000 applicants for an initial August 2012 job posting. Of the 6,142 who passed the initial screening, 730 were hired, but 228 were terminated in the first year (a 23% turnover rate). Fort Worth used six employment agencies to recruit job applicants, but the percentage of workers who first made it through the screening process and then continued past the first few days or weeks on the job to become a part of the regular workforce was depressingly low. “We brought them in on Monday, gave them initial training for two days and then put them out on the line Thursday for more training. By Friday, they were gone,” recounted a manager in Fort Worth. Over the course of 10 weeks, the company had to hire 6,500 workers to yield the required 2,500 employees to begin volume production.

High worker turnover is a problem on the shop floor because it injects variability and unpredictability into production schedules. A factory cannot run a manufacturing line with consistent output and quality without a stable workforce. The same people need to come to work every day and run the production processes in a repeatable and consistent way. Constantly having to replace workers who drop out is not a path to success; the expenses associated with recruiting and training new employees when so many walk out the door are substantial.

I found that this problem had two main components: worker understanding and expectations of what a modern factory production job is, and management's ability to give workers reasons to stay. The first part reflects the great advances manufacturing processes have made in modern factories over the last two decades. Lean production systems, extensive

ABOUT THE RESEARCH

As part of the U.S. Competitiveness Project at Harvard Business School, I have been studying the shifts in global production systems that have accompanied the growth in the tradable goods sector. I have been particularly interested in production shifts that exploited labor arbitrage to low-cost countries and the consequences of those shifts for innovation and product development. My earlier research focused on the negative impact of labor arbitrage-driven offshoring on complementary assets like supplier ecosystems, tool manufacturers and workforce capabilities. My colleague Gary Pisano and I drew the parallel to Garrett Hardin's "tragedy of the commons": individual actors (in this case, companies) acting in their own self-interest, but behaving contrary to the long-term interests of a wider group. In the late 1990s and

early 2000s, the economic gains from offshoring from the United States far exceeded the increased coordination and logistic costs of offshore production, so companies made a major push to move production to low-cost countries like China. The negative impact on the "industrial commons" was unpriced, so it was largely ignored.

The current research was in response to a closing of the gap that has shifted the equation, particularly vis-à-vis China and the United States. This shift has led to talk of a manufacturing renaissance and predictions of a return of manufacturing jobs to the United States. Outside the automotive sector, assembly work has been slow to return. I was interested in the extent to which this was a consequence of loss of supplier infrastructure versus a more general loss of capabilities in the workforce.

Over the past three years, I visited and/or conducted interviews at more than 35 manufacturing sites worldwide in consumer hard goods, industrial equipment, transportation equipment, food and beverage and biologics/pharmaceuticals. While almost all companies reported the urgency of finding motivated workers with the right skills, factories that were trying to substantially scale up production in traditional assembly jobs that required semi-skilled labor faced the most interesting challenges. As common as this challenge is in places like China, it is seen less frequently in developed markets such as the United States or Europe. Comprehensive interviews at several sites with large employment growth targets highlighted the challenges that managers faced, suggesting why reshoring is more challenging than the economics alone would predict.

use of measurement and information technology on the shop floor, and sophisticated quality systems have transformed the roles of frontline production and supply chain logistics workers. Yet worker perceptions of what manufacturing jobs entail have not kept pace. Many fresh recruits come to the job with inadequate preparation and an unrealistic view of what might be expected of them. "We hired people off the couch," remarked one plant manager.

As a result, it was not surprising that many workers didn't have a clear picture of what the factory environment was like. As another manager noted, the long-term unemployed represented a major pool from which companies drew. Most new hires had little idea what they had signed up to do. They were prepared neither for the expectations placed on them nor the environment in which they would be working. One Fort Worth manager commented that high attrition was an inevitable consequence. "If you looked in the trash can at the building exit, we found a lot of badges" that workers discarded on their way out the door. The investment in onboarding and initial training was lost. If a company is going to invest in training and the development of the skill base of its production workers, how can it ensure that they will stay on and help turn the investment into a long-term capability?

As for offering workers a reason to stay, Appli-ance Park managers have tackled the problem of "job abandonment" by segmenting their

remediation efforts into two phases: pre-employment and post-employment. One of the most effective pre-employment activities has been to encourage applicants to complete training and certification. Short term, this meant looking for people who had participated in training and certification programs such as Certified Production Technician or Certified Logistics Technician programs developed by the Manufacturing Skills Standards Council, an industry-led organization in the United States. Although MSSC certifications are not the only vehicle, the idea was to encourage prospective employees to make some type of co-investment in making their job work. There was a healthy measure of self-selection among participants who completed these programs.

In the programs, candidates developed proficiency in fundamental factory skills, and their personal investment in training tended to increase their level of commitment to staying. Almost two-thirds of the MSSC certification candidates received their certification in less than three months; they arrived at the factory with a better understanding of what they would face and what the work entailed.³

Flextronics managers found that thoroughly explaining the content of factory work and the expectations on the shop floor were vital to reducing turnover. For example, many new recruits didn't know how to react to fluctuating demand,

which resulted in day-to-day volatility in the level of the work. Managers across all the sites we studied also stressed the need to set clear expectations about showing up for work on time and getting work done on time. “I can’t run a 25-person line with three people late,” explained one manager. “We start on time.”

Success in reducing job dropouts post-hiring occurred most often when companies built a skills progression system that showed workers a path to more highly skilled and responsible positions. While extrinsic motivators such as compensation and benefits (especially health care benefits) contributed to retention, they appeared to be less important than intrinsic motivators focused on achievement and personal growth. This should be no surprise to those familiar with research in this area, but it is a reminder to those who think wage rate is all that matters.⁴

Appliance Park managers built a path for entry-level plastic injection molding machine employees that progressed through three “A” levels for operators, followed by three “B” levels of molding technician and three “C” levels of molding processor positions. It also gave them opportunities to move from “A” level operator into different paths in positions in quality and inspection, or conveyance and logistics. This internal skill-building and credentialing system aligned well with manufacturing needs, but more importantly, it gave workers goals to aspire to as well as an ability to gauge their own progress. Fort Worth managers were keen to publicize successes, such as an individual worker who reached a new level of achievement or successes among veterans or disabled workers. Together, these forces help build a culture of achievement on the shop floor.

Managers at other companies preferred to do training in-house, finding that schools often didn’t have a strong enough connection with current manufacturing practices to do even basic-level training. Flextronics managers in Austin had to recruit and train almost 2,000 new employees for the “Assembled in USA” technology project. But they were able to draw upon 170 different training programs that the site already offered in a wide range of production technologies — ranging from the operation of electronic component placement machines to basic quality and lean production methodologies.

Longer term, many companies are increasingly working with local community colleges to incorporate industry credential systems and/or training into the schools’ programs and to attract students. Some manufacturers, including Toyota Motor Manufacturing Kentucky in Georgetown, Kentucky, are anticipating approaching retirement cliffs as their workforce ages and are using training programs as vehicles to fill an impending need for new workers.⁵ Others, such as BMW in South Carolina, work closely with local schools in work-study arrangements and help with curriculum design. In a very real way, these are investments in the health of an important element of the industrial commons.

Addressing the Skills Gaps

The United States has a generational skills deficiency in many important technical areas, a challenge that is also evident in many other countries that have experienced significant offshoring. In contrast to China, which has developed vast pools of technical resources, the United States and Europe haven’t trained enough young people in these areas. In the United States, there is still strength in the automotive, construction equipment and aerospace sectors (although far less than there was 20 years ago). However, the gaps in metalworking and metallurgy — welding, machining, forging and casting, metal finishing and plating, precision machining and operating sophisticated machine tools — are acute. The offshoring of high-volume assembly jobs over the last two decades means there also aren’t enough automation engineers and other specialists to support the setup of extensive new assembly operations. This was painfully evident in Austin, where Flextronics had to pull automation engineers in from a sister factory in Guadalajara, Mexico.

For some products for which much of the manufacturing has moved offshore, there are generational skills gaps in both product development and the shop floor. It’s hard to find Americans who can operate a modern printed circuit board line, let alone program the automatic placement or advanced optical inspection tools that populate it. Simply hiring a capable workforce doesn’t translate into restoring manufacturing capabilities; frequently, the basic *processes* have to be rebuilt or transplanted back from offshore. “Our operations management

leadership program ended up becoming training of procurement agents,” explained one of the Appliance Park leaders. “We didn’t even have a pipeline of emerging manufacturing talent, because it had become all about sourcing goods.” Rather than having a focus on design for manufacture and efficient assembly and processing, companies had concentrated on low-cost, competitive sourcing. They built new skills in offshore purchasing, reverse auctions and global logistics, but forgot how to do the basics of putting products into production onshore.

In Fort Worth, Flextronics management flew in a team of 150 manufacturing leaders from around the world — including a skilled manufacturing manager from Hong Kong who years earlier had built a Nokia handset factory on the same site — to establish basic processes. Over a 10-week period, the team established all the basic assembly, test and logistics processes for inbound and outbound supply chains, as well as training the initial production workforce, an engineering support organization and support organizations like the “moonshine shop,” which built and modified production fixtures. They left behind five experienced managers who then continued to train and oversee the workforce.

Perhaps the greatest challenge was building shop floor leadership — the team leaders who would oversee the production operators on the floor after the temporary team left. “When we were hiring directors, senior managers and managers, we could not find anyone under the age of 40,” explained the plant manager at Fort Worth. “The United States has abandoned that part of the industry with all of the offshoring, and we will need to rebuild this base for electronic manufacturing if we want it to come back.” This meant urgent investments in training and mentoring. It also meant recruiting talent from other local industries or abroad or training new hires with the most promise. But this was a long process that required a lot of patient mentoring.

Flextronics was able to draw on a global resource pool because it frequently established new facilities or moved existing manufacturing operations as part of routine consolidations. Appliance Park faced a similar skills challenge, and while it could draw upon some existing resources, it couldn’t simply fly in an experienced team. Instead, it mounted an intensive recruiting campaign to identify experienced

manufacturing engineers from adjacent industries. “We had to build up a critical process-engineering group,” explained the head of the injection-molding center of excellence. “We went out and hired about 15 to 20 graybeards and put them out into the organization. We doubled the size of our operations leadership program, and had those people shadow the graybeards to build up the knowledge.”

The key challenge in both cases was to establish shop floor leadership that could not only launch production but could also quickly engage in process-improvement projects to drive quality and production yield improvements. “The workforce is brand new, the equipment is brand new, you have to have the workforce to pull it all together,” explained one of the GE managers.

Filling the capabilities gap takes time. “Nobody coming out of college these days is knowledgeable or excited about doing this kind of work,” commented a manager at Fort Worth. “We can’t afford to only hire people who are over 40 or bring people in from abroad.” This problem was a long time in the making, and it can’t be solved overnight.

Rethinking the Capital/Labor Ratio

When choosing a location for assembly operations, it is natural to assume that higher wage rates will justify a greater use of automation. When work was offshored from the United States or Europe to Asia over the last two decades, the principal driver was labor arbitrage. With that offshoring came substantial substitution of labor for capital — the replacement of “hard” automation using expensive capital equipment with manual processes. Manual processes were less expensive, and human operators were far more flexible than machines that had to be reprogrammed with every model change. So when work comes back, most people assume that we will simply go back to using more automation.

But that is not necessarily the case. Manufacturing in China enabled rapid product changeovers, and we trained consumer markets worldwide to expect this kind of flexibility. If you want to have five million new smartphones on hand to sell on the first weekend after a new phone model launches, you will need a lot of people, not automation. While the latest automation technologies often have reduced setup or changeover times, managers

should not assume that we should necessarily use more robots.

The key considerations are length of product run and frequency of changeover. The Fort Worth lines were heavily manual, although automation was substituted in some highly repetitive tasks. Investments were expected to have a one-year payback for unique tools and a two-year payback for tools that could be reused.

In Austin, Flextronics managers built several “no-touch” electronic printed circuit board lines. In this particular case, the sophistication of the boards, the exacting quality level and the very low mix of product types to be produced justified investment in a higher level of automation. Direct labor content was therefore comparatively low. In Austin, a supervisor could oversee two no-touch lines; in China, a supervisor oversaw one line staffed with 13 dedicated operators.

I recently visited a medical products factory in Denmark where the production engineers were continually experimenting with the balance between manual and automated processing. Having a slightly higher mix of manual operations promoted significantly more flexibility, and as the production engineers configured processing equipment for locations in eastern Europe and the Far East, they adjusted the labor mix in accordance with the labor costs. Even in high-labor-cost Denmark, the engineers were careful to avoid over-automating. Striking the right balance between capital and labor can benefit from an open mind and some experimentation. The mix may change over time with production experience and learning.

The more important management issue is how to redeploy workers who are freed by process improvements or the substitution of automation. How does one translate these gains into sustaining growth?

Recognizing the critical link to workforce stability, Appliance Park managers established a strategy that would increase the amount of vertical integration — bringing work back in-house to utilize labor freed up from productivity improvements. That has risks, of course, because it means less flexibility in adjusting to demand variability. But if production operators are secure in the knowledge that improving productivity will translate into

growth and not job losses, their goals will be aligned with management’s.

Localizing the Supply Base

When manufacturing went through the first big waves of offshoring to China, companies often used “kitting” of parts to keep assembly lines supplied. A decade ago, I visited a Japanese-owned factory in China that used a logistics operation in Hong Kong to procure all the parts on the global market needed for DVD players, assemble them into kits based on daily production volumes, and then ship them daily or several times a day to the factory, which was located in an export-processing zone across the border in China.

Over time, China-based manufacturers localized their supply chains, inviting key suppliers to set up near them to reduce costs and shorten replenishment times. They also replaced suppliers who didn’t move. This lowered costs and had the ancillary benefit of lowering duties for sales to the Chinese domestic market. For industries such as electronics, that has meant a global shift of the supply base toward China.

In such industries, moving production back to a country such as the United States therefore often means a manager will face a hollowed-out supply base. This is certainly the case for many electronic devices — for example, almost all of the parts for the MotoX came from China, Korea or elsewhere in Asia. In the United States, there are no domestic suppliers of touchscreen displays or batteries, and most of the circuit boards and components had to come from abroad as well. Ironically, the fragile components had to be kitted and carefully packed, and the physical volume of material that had to be moved meant higher logistics costs than if the phone had simply been assembled in Asia. The “value density” of the parts was much lower than that of completed phones. Thus, the economic benefits of customization and nearness to market had to substantially exceed the increased transportation and supply chain logistics costs.

Appliance Park faced less of an issue, as parts of the supply base still existed, albeit with reduced capacity. Managers there realized that they had to take a more strategic view of their suppliers than in the past. They recognized that, internally, they had lost a



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whole generation of manufacturing engineers, so they had to pick the areas where they wanted to focus and rebuild core competencies. For the rest, they would have to rely on those suppliers. “Pick where you want to invest in core competencies, and acknowledge where you want to have strategic suppliers — where you aren’t going to make the deep investment yourselves,” explained a manager there.

Rebuilding a supplier ecosystem takes commitment. It means adopting a strategic view of supply relationships, rather than a transactional view. The long-term development of capabilities becomes far more important than short-term haggling over price. Some have described the new model as “co-innovation” — a cooperative, tight partnership between an original equipment manufacturer and its suppliers that entails a much higher level of information sharing and collaboration to solve design and production problems.

At Appliance Park, the attitude has changed dramatically. It used to be, “we need you to make this part to print” — in other words, here are the instructions; just follow them. Today, that attitude has changed to, “you need to be in here innovating with us.”

How Customers Can Help

The key premise behind reshoring is that closeness to product design, reduced order cycles and lower costs of carrying inventory in the pipeline should offset higher absolute production costs. Companies should not expect customers like Wal-Mart to pay more for a product that is made in the United States. So how can corporate customers help?

A retailer such as Wal-Mart (or a manufacturer supplied by U.S. factories) can actually do a great deal to improve the efficiency of the overall supply chain by active partnering and by providing greater transparency to demand. This doesn’t necessarily mean rock-solid forecasts and orders that are finalized earlier; rather, it means earlier and more

frequent sharing of demand signals, as well as a commitment to work together to improve overall supply chain efficiency for the longer term.

Manufacturing partners that have more visibility to what is coming, whether demand will move up or down, can better react to changes. This isn’t a surprise to experienced supply chain managers, who know that communications is key to efficiency: It’s what we teach in supply chain classes. Toyota has lived by this principle since its first day in the United States. Yet many of us have not yet learned this lesson — or have yet to recognize that the requirement to communicate extends beyond the walls of one’s own organization. Any supply chain will perform better with open communication and visibility across all its segments, but a supply chain centered on a fast-response local production factory will benefit much more than one that has weeks or months of inventory in ocean containers coming from China.

Leveraging the New Proximity of Manufacturing

The generational skills gap created by offshoring also increased the distance between product designers and those who did the actual assembly work on the shop floor. When companies first moved production offshore, the production processes were well understood, so the linkages could be maintained. But as product designs changed and new advanced technologies evolved and were incorporated, the difficulties in reimagining production have increased.

Reestablishing close links between R&D and production offers a significant opportunity to improve products. “Having the work in-house is important for our learning. Having that design piece of this thing on-site, having the design team interact with the operators who actually make it, and seeing the tools open up on the bench, how the tool works, the thought process — learning that and how that cycles back into the design — there is a

value to that,” explained the head of the plastics competency center at Appliance Park. Flextronics managers characterized this linkage as a competitive edge for R&D teams, as incremental innovations most often come when teams “get their hands dirty in the production environment.” This was much more difficult in the sterile office or lab environment housing many R&D teams.

Appliance Park launched “Mission One” at the start of its transformation. The goal of this program was to redesign every product line that was going to be made in Kentucky to take advantage of the close proximity to product design and tight integration with manufacturing. That meant moving more value-add components and parts critical to the differentiation of the final product in-house or into the hands of a strategic supply partner. Fort Worth developed a similar late customization capability — the ability to rapidly deliver a customized color and inscription patterns for consumers who wanted a unique product.

Positioning manufacturing close to R&D thus can translate into even shorter lead times and more rapid product cycles, over and above the time gained by moving production back onshore. The combination of the two can produce sustainable advantages that can keep production onshore and close to the market beyond the current favorable economic environment.

Toward a Global Location Strategy

Offshoring from the United States and other high-cost economies to low-cost emerging market countries was a dominant theme of manufacturing in the late 1990s and 2000s. Now reshoring offers the promise of reestablishing the link between product design and manufacturing, between original equipment manufacturers and strategic supplier ecosystems. As managers work through the challenges described in this article, the big picture is shifting away from the centrality of labor-cost arbitrage as a driver of location decisions. Instead, it is moving to the supplier ecosystems as a key complementary asset and the importance of developing people, skills and organizational capabilities that make the most of closeness to the market.

These changes have broad implications for not

just the United States, but other markets as well. Rising demand for manufactured products in emerging markets means that managers must design supply chains for the production of goods that balance proximity to diverse markets with the locations of their capabilities and their supply ecosystems. In many ways, the challenges of reshoring to the United States are the challenges of establishing production and supply to serve any market in the world. Doing that well will always be a source of competitive advantage.

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