Gaining Competitive Advantage Through Global Product Development

A PTC White Paper

Abstract

For a manufacturing company, product development is a mission-critical process. It can also be a very expensive process. In fact, in many manufacturing sectors, companies are reinvesting between 3% and 8% of their total revenues back into product development each year. This large investment is primarily spent on human resources, and if all resources are concentrated in a single high-cost region, most companies simply overpay for their respective level of productivity. While some companies may spend less across the board by mandate, they are just compromising on value-add and therefore achieving correspondingly lower returns as well.

Thanks to the power of modern computer-aided design (CAD), computer-aided engineering (CAE), computer-aided manufacturing (CAM), and Product Lifecycle Management (PLM) technologies, many manufacturing companies now have the tools that allow for resource portability and better alignment of cost and value-add. This global rearrangement of product development activities and personnel is what many industry experts refer to as "Global Product Development".

This paper is designed to help CEOs, CFOs, and senior Engineering executives understand how and where to leverage Global Product Development as a means to gain a dramatic increase in productivity within their product development operation. For companies pursuing growth opportunities, this productivity increase can materialize into increased capacity and capability within a constant cost structure. For companies pursuing increased profitability levels, the same productivity increase can be monetized as reduced costs and improved profits within a constant capacity. Either way, the benefit to a company and its shareholders is significant.

What Is Global Product Development?

Simply put, Global Product Development means maximizing the financial and operational productivity of the product development process by spreading product development activities across multiple regions of the world in order to better match value-add to cost. In this context, the definition of "product development" ranges from marketing activities that identify and document customer needs; to engineering activities that conceptualize, design, analyze and refine new product ideas; to activities that plan and document manufacturing, operation, and maintenance processes; to sustaining activities that make ongoing product changes and refinements. Regions with high costs include industrialized countries like the United States, United Kingdom, Germany, France, Italy, and Japan. The list of lower–cost regions is long, but major nations include India, China, Russia and various other Eastern European and Asian countries.

Domino Theory

Throughout the 1980s and 1990s, manufacturing companies in high-cost regions consistently shifted manual, blue-collar manufacturing activities to lower-cost regions simply for the advantage of lower costs. In certain market segments, this phenomenon has evolved to the point where there are now very few textile mills and almost no television factories left in the United States.

Though not a simple process, offshoring manufacturing was straightforward in the sense that the process is discrete, with crisp and clear inputs and outputs as hand-offs. For example, given a complete set of specifications, drawings, and parts lists, an offshore manufacturing site could fabricate and assemble the product and deliver finished goods directly to the customer or distribution center. Arguably, the process needed careful quality control and was slowed by the additional time required to transfer ideas to an offshore location and ship tangible products back; but still, the cost advantage was impressive. Entire new industries were born out of this trend, a great example being the massive electronics manufacturing industry that now exists in Taiwan.

As with any great business success, innovators look to migrate the core concepts to new applications in hopes that they can deliver similar successful outcomes. In the mid-1990s, thanks to the information technology (IT) revolution driven by the Internet and World Wide Web, the concept of using remote, low-cost resources to develop software and maintain information systems was launched. For the first time, software applications were available to make the work–product digital, and the Internet allowed this digital work–product to be instantaneously portable to nearly anywhere in the world.

With these important breakthroughs, companies, for the first time, had an ability to distribute select functions or subsets of a broader process, rather than transferring the process in its entirety. Seizing this cost-savings opportunity, software companies began to offshore select functions like Documentation and Quality Assurance, while companies of all types looked for opportunities to offshore major portions of their internal IT organizations as a means to cut back on this growing overhead cost. Another new crop of companies, a prime example being the Indian IT suppliers, was born in response to this trend.

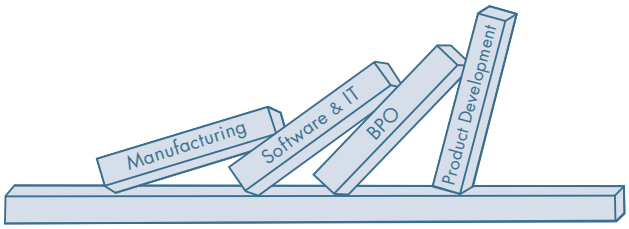


Figure 1. The Progression of Activities Offshore.

The trend didn't stop within IT, however. Companies began to realize that many other business processes, which had become IT-enabled for purposes of automation, offered the very same opportunities for realignment of cost and value-add. Claims processing, loan processing, help-desk support, and many similar functions that were performed by people sitting in front of computer screens all day offered another opportunity: why not teach offshore resources to perform the very same function at a fraction of the cost? Consequently, many of the offshore IT services companies jumped into this adjacent business opportunity, while a new class of "pure play" business process outsourcing (BPO) firms was created as well.

All of which brings us to today's opportunity in Product Development: Global Product Development.

The Basics of Global Product Development

Implementing Global Product Development requires reconfiguring product development activities across multiple regions of the world. This must be done, of course, with an eye toward maximizing productivity while mitigating risk. With a Global Product Development approach, process decomposition is used to identify and segregate high value activities and resources from lower value-add activities and resources. Those activities that add higher levels of value become candidates to remain in higher-cost regions because their critical value-add justifies their higher cost, while many of the lower value-add activities may become candidates for subsequent transfer to lower-cost regions. The ability to characterize value-add is somewhat subjective and naturally varies from industry to industry and even company to company. Further, given the need to mitigate risk within the mission-critical product development process, the move to Global Product Development should be viewed as evolutionary, not revolutionary. Most companies simply cannot switch to a highly globalized model overnight, but can migrate toward increasing levels of globalization over a period of years.

Offshoring Versus Outsourcing

Ultimately, the value of Global Product Development is unlocked when a balanced alignment of cost and value-add is achieved. "Offshoring" and "outsourcing" are fundamental tools to be appropriately used to achieve the desired balance. Offshoring, however, is the core strategy.

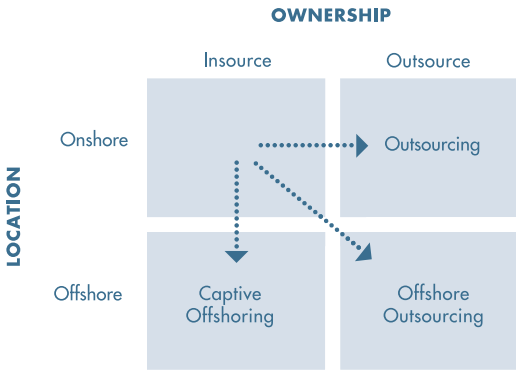


Figure 2. Defining outsourcing and offshoring.

As a rule of thumb, companies typically look at maintaining in-house (i.e., insourcing) that which is "core" to their business, and distributing to others (i.e., outsourcing) that which is "context", or less critical. Historically, manufacturing companies have done a high degree of outsourcing of components of their products to companies that specialize in their design and manufacture. Much of the outsourced work remained onshore, though some went offshore. Another form of outsourcing is the large onshore industry of "engineering services" organizations now operating within high-cost regions that offer contract engineering talent. While traditional outsourcing of manufacturing and engineering will remain a viable method to improve products while managing fixed costs, many companies have little additional room to drive incremental productivity with this technique.

As a similar rule of thumb, companies look at retaining high value-add activities onshore while offshoring low value-add activities. For example, functions that require high degrees of product or market expertise, as well as functions that require high levels of direct customer interaction, are difficult to replicate offshore. Supporting activities to those functions, however, may be good candidates for offshoring. Given the complexity, initial startup costs, and ongoing management challenges associated with managing a captive offshore facility, many companies choose to develop their offshore capacity via an outsourcing partner.

In addition, labor rates will also vary with the outsourcing and offshoring strategy deployed. Using typical US labor rates as a baseline, an in-house onshore engineer would cost $40-$60/hour fully loaded with compensation, benefits and overhead. An equivalent engineer, when contracted from an onshore engineering services firm, may cost $60-$70/hour given the need for an additional profit margin to be added to the same basic underlying cost. An equivalent engineer from an Indian offshore outsourcing firm would cost $20-$30/hour. Moving to a direct offshore employee model would subtract the necessity for the contractor's profit margin and the resulting cost would drop to the $10-$15/hour range. Obviously, the lowest steady-state cost is associated with the captive offshore model, but that model also has significant startup and ongoing management costs. To make the investment in fixed assets (e.g., real estate, building, dedicated telecommunications lines) pay off, most companies find that a captive offshore facility can be economically justified only after the scale exceeds 300 employees.

A Global Development Maturity Model

To help mitigate the risk of disruptions to their product development process, most companies evolve toward a Global Product Development model over a period of time. Even within a single company, different business units or product lines may very well be at different points in their evolution toward global distribution and balance of cost and value-add.

The Maturity Model presented in Figure 3 helps to characterize common states of evolution in the Global Product Development practices of various manufacturers. The states may be described as follows:

Figure 3. PTC's Global Product Development Maturity Model.

- Numerous companies at **Level 1–Ad Hoc** find themselves with some degree of offshore product development capability, but lack a meaningful strategy regarding how to use this capability to achieve a balance of cost and value-add. Typically, companies at Level 1 have "inherited" distributed operations through mergers and acquisitions, but this was an adjunct to some other strategy and not a primary strategy in and of itself.
- True Global Product Development begins at **Level 2–Discrete Services**, where companies deploy a relatively conservativ strategy to retain control of product development projects and core activities in-house and onshore, but "farm out" various discrete support activities to offshore locations. For example, a company may retain requirements capture and core design responsibilities in high-cost regions, but shift drafting, technical publications, and even simulation and testing activities toward lower-cost offshore resources. Companies who are at Level 2 may achieve as much as 30% portability (to low-cost regions) of their product development activities.
- At **Level 3–Co-Development**, companies become more aggressive and begin to segment their overall product portfolio in order to identify select subsets that can be "carved out" and transferred with full responsibility to their offshore counterparts. Examples of Level 3 would include transferring responsibility for a complete subassembly design for a new product effort, sustaining engineering for existing products, or a specific value-engineering project aimed at improving profitability of an existing design. Most companies in high-cost regions envision getting to Level 3 over a period of time.
- A small minority of companies envision getting to the **Level 4–Transformational Outsourcing** model as the basis for a complete reinvention of how their company does business. In Level 4, the onshore resources capture customer requirements and become the interface to the offshore operation, which in turn designs and perhaps even manufactures the final product. The risk of completely losing product development capabilities keeps most companies from seriously considering Level 4.

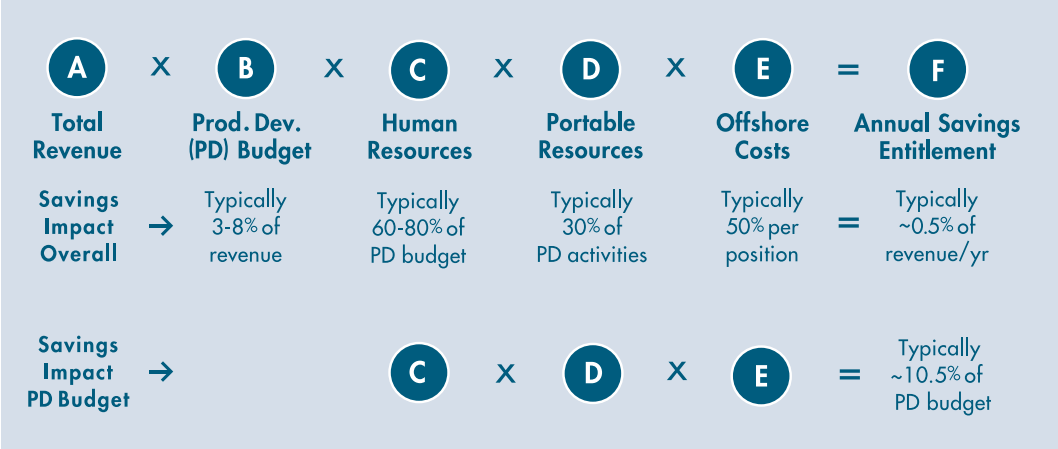


Figure 4. High-Level GPD Entitlement Model.

Value Proposition

Companies who deploy Global Product Development models can potentially gain significant financial and operational benefits.

Financial Benefits

There is a significant "hard dollar" savings entitlement available to manufacturers who implement Global Product Development strategies. The gross savings entitlement is typically in the range of 0.5% of total company revenue and 10% of the product development budget. This savings can be clearly seen by following the intuitive logic of the equation in Figure 4 (feel free to substitute your actual figures).

For companies pursuing a "reduce costs and grow profits" strategy, a total savings of 0.5% of revenue attributable to Global Product Development would translate into a 3% to 10% growth in operating profits if taken to the bottom line (assuming typical manufacturing operating profit ranges of 5% to 15%), while maintaining fixed levels of capacity. For companies pursuing a "grow revenues profitably" strategy (i.e., needing additional product development resources while monitoring costs), some or all of the Global Product Development savings entitlement could be reinvested into increased capacity and capability while continuing to maintain a fixed cost structure. Either way, the benefit to a company and its shareholders is both tangible and significant.

Operational Benefits

In addition to the tangible "hard dollar" financial savings entitlement, there are important additional "soft dollar" operational improvements that may follow the deployment of a Global Product Development model.

By conducting product development operations "around the world, around the clock", manufacturers have the opportunity to shave time-to-market and gain competitive advantage. Many manufacturers are beginning to structure their product development processes so that core design work is performed during the day in higher-cost regions, then, at the end of the day, those designs are handed off to personnel in lower-cost regions who (often via multiple shifts) perform analysis and simulation of those designs, so that the feedback is immediately available when the core design team returns to work the next morning.

Additionally, by changing their cost structure with Global Product Development and then reinvesting some of that cost savings entitlement in new resources, companies can add both general and highly specialized capacity. For example, additional resources might enable the exploration of more product alternatives, or even the development of entirely new product lines. Also, the addition of specialized resources, such as engineers who perform sophisticated computerized simulations of product behavior, can allow companies to further optimize designs for higher levels of quality, performance, and reliability. While this specialized capability was always theoretically possible, it may have been cost-prohibitive before the deployment of a Global Product Development strategy.

Companies that improve their product development infrastructure for purposes of enabling a more effective deployment of Global Product Development stand to receive benefits from this new capability across the board, not just as it relates to interaction with their offshore operations. Previously, companies have justified investments in product development infrastructure purely on the basis of returns from internal process improvements. Now, the savings accruing from Global Product Development alone provide a compelling justification for the necessary investments, and the internal process improvements come as an ancillary benefit of that investment. These additional benefits might include improved engineering change and configuration management processes, as well as improved collaborative development capabilities that could be further extended either into customer-facing operations, or upstream into the company's supply chain.

Other benefits of globalization that might prove important include access to significantly greater human resources capacity to fuel growth initiatives, improved local market presence in developing markets, further dismantling of the wall between engineering and manufacturing via co-location of design resources with existing offshore manufacturing resources, and geographic diversification.

Global Product Development – Is It Real?

The phenomenon of Global Product Development is definitely real and gaining momentum. A previous study commissioned by PTC found that, among those manufacturing customers who were likely candidates for Global Product Development (i.e., with a concentration of resources in high-cost regions and with no regulatory barriers such as the U.S. State Department's International Traffic in Arms Regulations or ITAR), 35% had already begun active offshore development (typically on a small scale), an additional 18% were "piloting" the concept, and more than 80% overall felt they would have Global Product Development operations in the next few years.

Manufacturing Leaders Deploy Global Product Development

General Electric (GE), United Technologies Corporation (UTC), Siemens, and Cummins Engine represent a very small sampling of worldwide manufacturing leaders who are aggressively adopting the principles of Global Product Development.

GE, a $170B U.S. diversified technology, media and financial services company, is widely recognized as one of the founders of India's Business Process Outsourcing (BPO) industry. GE installed its first Indian power plant in 1902, and by 1930 it had opened a sales center. Today, GE Capital International Services executes various back office operations, such as call centers and IT support. After growing to become the largest shared services center in India (11,500 employees), GE then monetized its success by selling 60% of the business to a consortium of US private equity firms. Building on a strong BPO heritage, GE also conducts significant product development in India; design is performed at captive centers and GE–approved Global Development Centers run by third-party engineering service providers. Established in September 2000, the John F. Welch Technology Center in Bangalore, India is General Electric's largest Research and Development center outside the U.S., with a $120 million infrastructure and approximately 3,000 professionals. A variety of GE products are designed here, including some of its most complex jet engines.

United Technologies (UTC), like a number of other US conglomerates, made a global investment by taking an ownership stake in an Indian "pure play" engineering services business. Various UTC business units then transitioned CAD modeling and other forms of engineering support work to this and various other Indian engineering services companies.

Siemens, a $74B German company, while citing competitive pressures, shifted one-third of its 30,000 embedded software engineers to China, India and Russia. This shift affected product development operations in Siemen's fixed–line and wireless telecom, automation and drives, transportation, and energy transmission businesses.

Cummins Engine, a $13B US diesel engine and generator manufacturer, operates a Regional Technical Center in Pune, India where it has been manufacturing engines for over 40 years. Consolidating customers and tightening of EPA emission standards has prompted a corporate mandate to boost innovation without incurring a corresponding increase in engineering spend. The technical center, managed in cooperation with Satyam, employs over 200 people. It focuses on embedded software and mechanical design analysis. While product development is led from Cummins' Indiana (U.S.) headquarters, significant pieces of work are now produced in India. One of the primary benefits that Cummins has reaped from its Pune center is the ability to run analyses on literally hundreds of product variations, both quickly and inexpensively, enabling innovation to happen faster and without the time and cost of creating many physical prototypes.

Although GE, UTC, Siemens, and Cummins are all sizeable industrial companies, the phenomenon doesn't end there. Manufacturing companies of all sizes within light industrial, heavy industrial, heavy equipment, automotive, commercial aerospace, and electronics industries are moving forward with strategies for Global Product Development.

Global Product Development at PTC

PTC, a global leader in Product Lifecycle Management Solutions, has direct experience with Global Product Development, with compelling results to show for it. As a major software company, PTC has an extensive product development organization that includes more than 1600 personnel, of which approximately 1400 are directly involved in software engineering and quality assurance. Because PTC was an early adopter of Global Product Development, more than half of those 1400 personnel are based at PTC's captive offshore facility in Pune, India, which was established in 1994 and is now PTC's single largest engineering facility worldwide. Approximately 150 additional personnel are based in PTC's facility in Haifa, Israel, which provides advanced mathematics and geometry expertise at an important, albeit less dramatic, cost advantage. Collectively, these two offshore facilities represent over 60% of PTC's engineering capacity and provide a cost savings of tens of millions of dollars per year versus a hypothetical staffing profile where the same resources are uniformly deployed in high - cost regions like the United States. For PTC, the advantage gained through Global Product Development represents multiple points of bottom line profit margin on the corporate financial results.

PTC's approach to migrating work to its offshore development centers focused on two key variables: the lifecycle of the software product and the nature of the activity. PTC initially migrated relatively lower-value activities, such as quality assurance and technical publications, on its older products. The company eventually migrated higher-value activities, including development and integration, on these same products. As a larger portion of product development for its older products had been migrated to the offshore development center, PTC started moving lower-value activities on its newer products—again initially focusing on quality assurance and technical publications, then moving to select software programming activities. Today, work at the Indian offshore development center includes development for most of PTC's products. Using the Global Product Development Maturity Model, PTC's oldest products, are at Level 4– Transformational Outsourcing, and its newer products are at Level 2– Discrete Services.

For PTC, transitioning product development work offshore was a deliberate and complex decision. Perhaps the biggest challenge was ensuring access to key product and process information (e.g., source code, requirements, change requests, processes and protocols) for all the various stakeholders who needed it. PTC now relies heavily on several key software solutions to control and facilitate collaboration in its

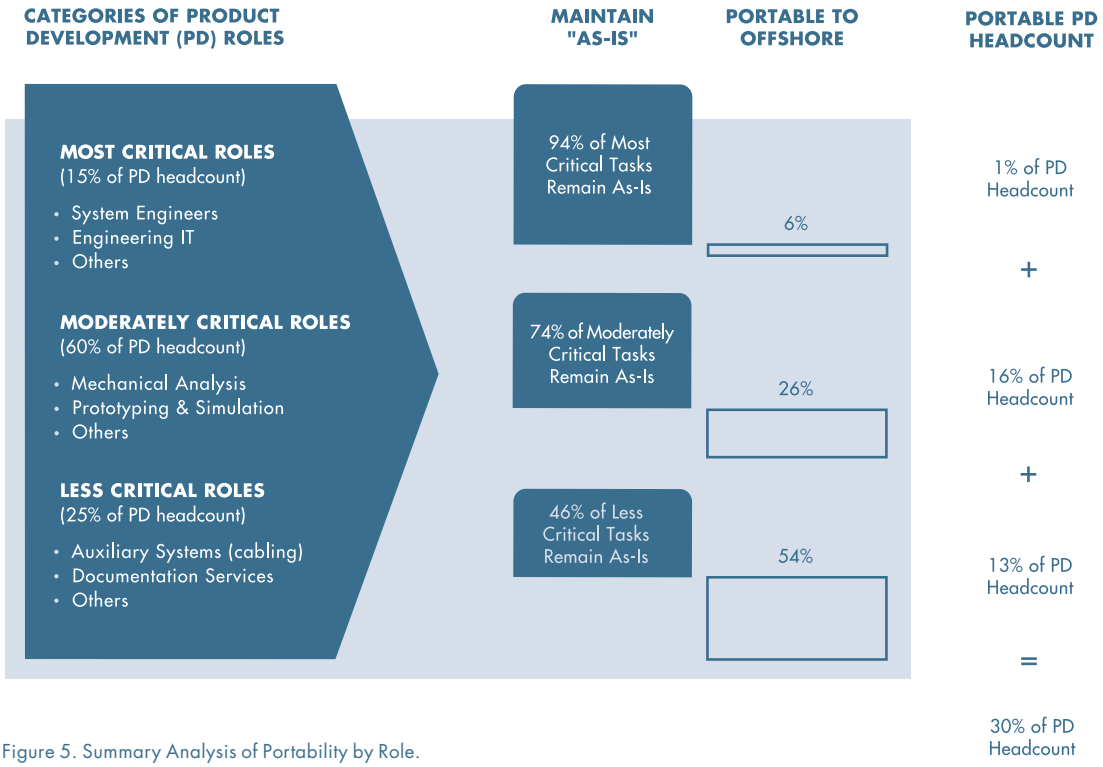


Figure 5. Summary Analysis of Portability by Role.

software engineering process. One tool, IBM's ClearCase, serves as the product control application for software development, and another tool, PTC's Windchill®, provides process and protocol information for software development.

In addition, because the company had formerly relied almost exclusively on a verbal method of maintaining and transferring its institutional knowledge (i.e., "the way things are done"), PTC proactively documented details of the development process to ensure that new participants could productively ramp-up and participate. PTC engineers created a library of accumulated knowledge that provided answers to commonly asked questions and toolkits to automate common activities. While it still takes longer for a remote software developer to become as productive as his local counterparts, these tools, and an openness to welcome cultural differences, continue to reduce the ramp-up time.

As an added benefit, many of the actions that were taken to enable Global Product Development have also paid productivity dividends to PTC's local development staff that now uses the enhanced business processes and data management tools.

Operational Considerations

The key to implementing Global Product Development is to reconfigure product development activities in a global manner to optimize the alignment of value-add and cost. However, this must be done in a considered and evolutionary fashion to avoid the real risk of a damaging disruption to the output of the product development process.

The key is balance: be too conservative and you risk leaving money on the table—money that could make an important difference in profitability or competitive advantage; proceed too fast and you risk disrupting the process, resulting in missed deliverables and product launches—a potentially catastrophic situation for the business. Go too far and you risk losing institutional knowledge that may compromise the company for years to come. A measured, methodical approach, implemented in phases over time, affords the necessary balance.

What To Offshore?

In order to proceed with the implementation of a Global Product Development strategy, it is necessary to analyze product development activities and segregate higher value-add activities from lower value-add activities. Separately, it is necessary to identify the degree to which various activities are indeed portable without disrupting the overall product development process. Some activities, though potentially characterized as lower value-add, might require higher degrees of institutional knowledge or physical co-location with the customer. These activities may be poor candidates for relocation.

The analytical approach to be followed when answering "What to offshore?" varies depending on the desired outcome as measured by the Global Product Development Maturity Model presented earlier in Figure 3. Companies that want to achieve a Level 2–Discrete Services level of maturity will retain overall management and control for all products and projects onshore, but try to identify those supporting tasks and roles that could be relocated offshore. This outcome essentially requires that companies take an approach that could be charac-

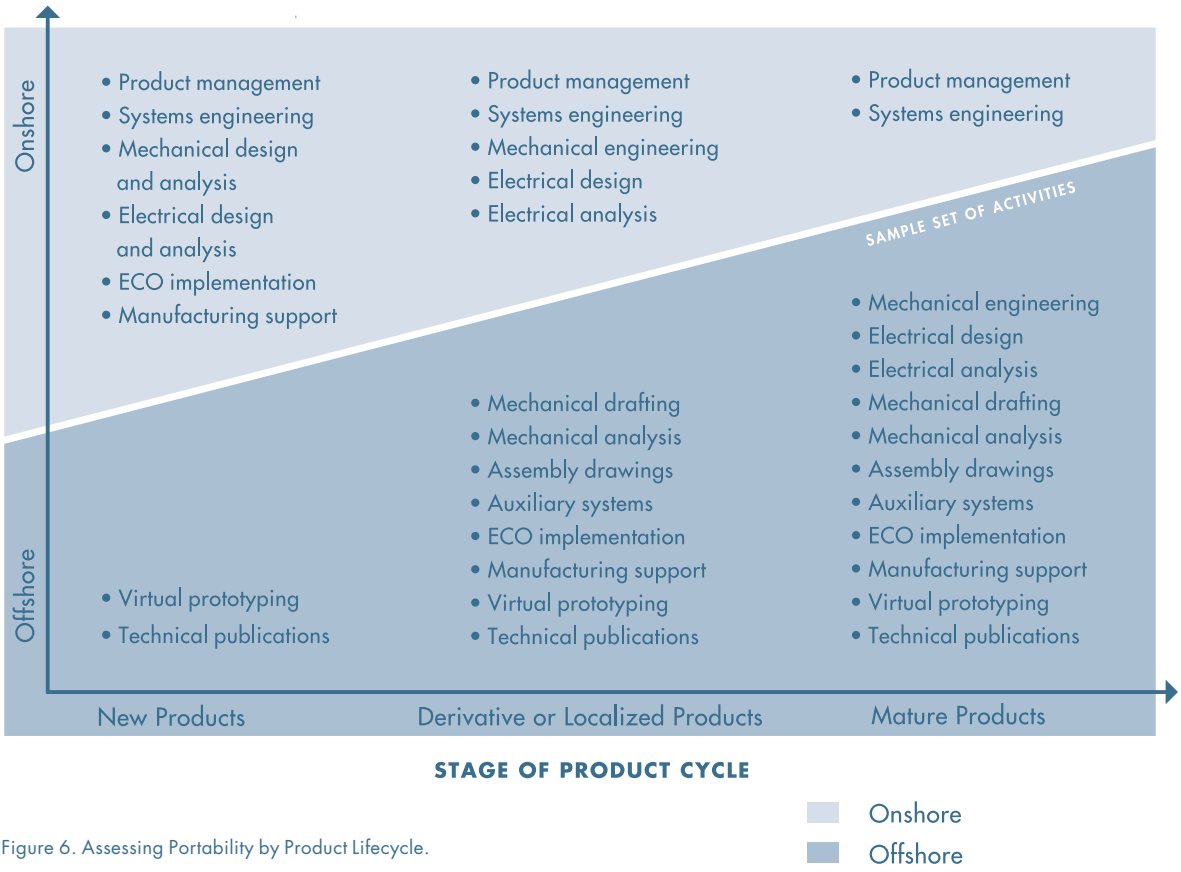


Figure 6. Assessing Portability by Product Lifecycle.

terized as "modular process design"–in other words, breaking their process into a series of discrete steps, all of which have defined inputs and outputs. Companies who want to proceed to a Level 3–Co-Development level of maturity need to take a different approach. These companies will analyze their portfolio of products and identify those products or projects that can be moved offshore in their entirety. These companies are more likely to focus on "modular product design".

To help companies proceed with this segregation, PTC developed analytical models that examine each task within a typical electro-mechanical product development process and ranked those tasks in terms of their value-add and portability. This analysis shows how companies can achieve the 30% resource portability level at Level 2–Discrete Services of the Global Product Development Maturity Model, which is the natural and more conservative starting point for most companies who are contemplating Global Product Development. Figure 5 shows the summary results from this analytical model.

There are two other key considerations when contemplating what activities to offshore: business strategy and product lifecycle. Each business must understand what its strategy is and the required core competencies in product development that support that strategy. For example, a company that focuses on a specific type of technological innovation in its products would maintain those related activities in-house.

The second consideration is the lifecycle of each product or platform. In general, more product development activities related to older product lines can be offshored versus the number of similar activities related to new products, as indicated in Figure 6. The relative value added for sustaining engineering on older products is generally less than the value of new product development associated with new, yet-to-be launched products. However, there are opportunities to utilize global product development strategies for new and old products to take advantage of cost and time-to-market benefits.

Where to Offshore?

Companies that have identified "what" activities can be relocated must next decide "where" to relocate those activities. There are a number of criteria that affect this decision, including cultural capabilities for product development, cost advantage, cultural respect for intellectual property, education levels of the population (as well as their language capabilities), the business environment, and the existing provider base.

India is a major destination—especially among English-speaking countries—for companies that want to implement Global Product Development. In addition to having a population with exceptional English-language skills, India enjoys a relatively strong educational system that produces more than 200,000 new engineers each year. In fact, it is these same engineering schools that supplied the technical recruits who were repurposed to feed the IT boom that has developed in India since the mid-1990s. Therefore, India has a large existing supply of engineers, as well as strong annual recruitment.

There are other strong players on the global outsourcing scene as well, and certain regional alignments are proving repeatable. For instance, it is common to see Western European countries transferring work to neighboring Eastern European and former Soviet countries due to a stronger alignment of culture and language. Similarly, Japanese companies are more likely to transfer product development activities to China and other Asian countries.

How to Offshore?

Once a company has decided "what" and "where" to offshore, it must then make the selected engineering design work portable. This requires both process changes and technology infrastructure.

Process Change

A degree of consideration must be given to the need for realignment of product development processes to support Global Product Development. Ad-hoc processes that may work fine when the team is familiar and physically co-located are easily thwarted when the team becomes separated by geographic, corporate and cultural divides.

For companies who desire to adopt the Level 2–Discrete Services approach to Global Product Development, consideration must be given to instituting a formalized "modular **process**" where each main step or "module" has clear inputs, outputs, and responsibilities. By formalizing these interactions, companies gain the ability to transition certain "modules" to offshore facilities or partners, with clear expectations of how the process will work when some work is done offshore and the majority remains onshore.

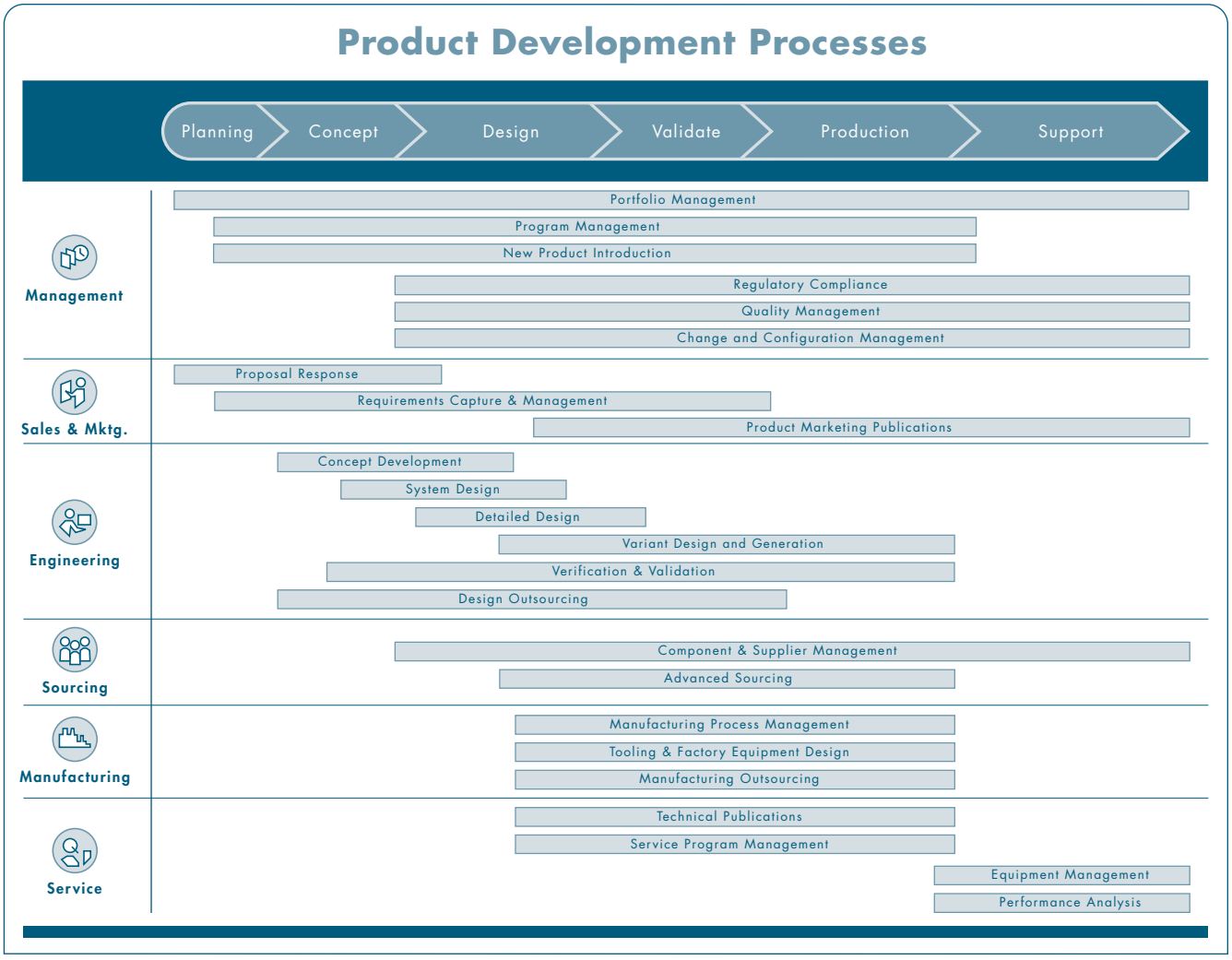
Companies who elect to pursue Level 3–Co-Development strategies need to give strong consideration to how to segregate major products or projects, so that they may be transitioned offshore in their entirety. However, when the strategy calls for transitioning sub-components of a new product design, additional thought must then be given to "modular **product** design". Unlike modular "process" design that formalizes interfaces between people, modular "product" design is a methodology for formalizing interfaces between product modules, so that design activities can proceed more independently with the assurance that the results will integrate nicely in the final product.

Required Infrastructure

It is the advancement of information technology that has made Global Product Development a practical reality. The family of CAD, CAM, CAE, PLM, and related IT technologies that companies have been deploying for internal automation purposes for the last decade now also provide the necessary enablement for Global Product Development. In order to facilitate Global Product Development, an effective IT infrastructure must enable the product development process to:

- Get Digital. By eliminating paper, and by moving to a purely digital product modeling approach, companies can make their intellectual property highly portable between locations and team members. It is this portability that allows a US engineer to work on a design during the day, have that same design advanced in India during the night, and then be ready for review again in the morning. The consistent use of CAD, in particular, is a prerequisite to any meaningful Global Product Development strategy, but the use of CAM, CAE, and Visualization technologies is required to realize its full potential.
- Get Automated. An effective information and process management environment enables companies to capture digital data content, securely control its various versions and configurations, manage concurrent changes, and automate the flow of information between members of the product development team. Like CAD, a baseline of information and process control is a critical prerequisite to avoid disabling chaos during the transition to, and ongoing operation of, Global Product Development.
- Get Global. The introduction of Internet-based collaboration technologies enables the establishment of "virtual team rooms" that allow dynamic sharing of digital product information across both geographic and company boundaries. When collaboration and data management solutions are integrated, companies can share enterprise information with offshore partners in a select and secure manner, enabling productivity without compromising the proprietary nature of intellectual property.

Modern IT infrastructure, like PTC's integrated Product Development System (PDS), provides a digital backbone that enables manufacturers to improve key product development processes and deploy Global Product Development in an orderly and productive fashion. PTC's PDS marries five core capabilities into a single IT architecture: Pro/ENGINEER® and Mathcad® to "create" high-fidelity digital product data; Windchill to enable "collaboration" across virtual teams; Windchill to facilitate "control" and "configuration" of product development data and processes; and Arbortext® and Windchill to "communicate" this content to all affected members of the global team.



PTC can help you improve your key product development processes, both end-to-end and across the global enterprise.

The Outsourcing Option

While a growing list of manufacturers want to participate in the savings advantages of Global Product Development, many lack the wherewithal or scale to start and effectively operate a captive offshore center. Such a facility requires a substantial startup investment, not to mention significant management talent to recruit, develop and retain key employees in a highly competitive world. Even some of the companies who initially launched captive offshore centers are reconsidering this strategy as they struggle to make their operation viable.

Fortunately, a number of offshore outsourcing firms are responding to the need to quickly provide employees that are trained and equipped to step in and take on an important role in the product development process. In India, outsourcing companies who provide engineering services resources and capabilities include:

- IT Services and Business Process Outsourcing (BPO) Firms. Leading IT and BPO firms like Tata Consulting Services (TCS), Infosys, Wipro, Satyam, HCL, and a host of others see product development as yet another "IT-enabled service" and have proceeded to add engineering services to their portfolio of offerings. With strong process capabilities, these firms generally excel at delivery via an offshore model, but with their limited heritage in product development or manufacturing, they may lack domain expertise and experience.

- Manufacturing Companies. A number of indigenous Indian manufacturing companies like Larsen and Toubro, Eicher, Blue Star, Tata Technologies (part of Tata Group), Harita (part of TVS), and others see an opportunity to leverage their design and manufacturing heritage to pursue this new growth opportunity, and accordingly have created business units that focus on engineering services. These suppliers typically start with strong domain expertise, but are challenged to embrace this new business model and implement world-class delivery processes necessary to make it effective. Some manufacturers are also concerned about the potential competitive issues with this model, especially since those suppliers who best understand their business also have the largest potential to compete with it.
- Engineering Services "pure play"companies. Naturally, this new phenomenon has created a number of new providers like Infotech and Onward who specialize in the delivery of offshore engineering services. Typically quite small, these companies tend to focus on various niches within the manufacturing marketplace.
- Product Development Specialists. PTC, a leader in Global Product Development solutions, offers a rich heritage in product development derived from engagements with more than 50,000 manufacturing companies worldwide over the past 20 years. PTC is best known for its market-leading CAD and PLM technologies—Pro/ENGINEER and Windchill–that are the core of its Product Development System (PDS), a critical enabler of Global Product Development. PTC has an extensive understanding of the methods and processes now enabling GPD at thousands of manufacturing companies. This collective experience shapes the services and solutions PTC delivers to hundreds of customers each day. PTC has successfully executed its own Global Product Development model, with more than 60% of its software development now located in India and Israel. In addition, because most of the major engineering service providers operating across the low-cost regions of the world use PTC solutions, these relationships have enabled PTC to understand and answer the specific needs of Global Product Development.

PTC's integral Product Development System delivers the key capabilities manufacturers need to realize more value from Global Product Development.

- PTC has a Global Services organization with offices strategically located around the world to ensure its customers can work with locally-based consultants. In conjunction with this organization, the PTC Global Services deployment model is designed to efficiently leverage its worldwide network of capabilities. Thus, the PLM industry's best consulting expertise can be delivered in an effective, high-quality and cost-effective manner.

Each of the above categories of outsourcing has the potential to deliver a viable means to get started with any Global Product Development initiative. Determining the ideal partner depends, in part, on your desired outcome versus where you want to be on the Global Product Development Maturity Model. For example, companies who want to proceed to Level 4–Transformational Outsourcing may need to pursue arrangements with indigenous manufacturing companies who have the necessary infrastructure to ultimately manufacture the product as well as design it.

Risks and Challenges

There is a long list of potential risks and challenges associated with Global Product Development, but in aggregate, they could be characterized in four primary forms that merit discussion:

- Political
- Business
- Technical
- Organizational

Political Concerns

Global Product Development ultimately results in the transition of innovation activities offshore. Many Western countries are sensitive about ceding economic power that is underpinned by innovation. The following are some common arguments that address this issue, and typical responses.

Brain Drain

- Argument: As we shift product development work to low-cost countries, we will ultimately be turning unskilled foreigners into highly skilled innovators. This will someday weaken the leadership position of the high-cost countries and put them at a disadvantage politically.
- Reply: In fact, just the opposite is likely to occur. As low-cost countries strengthen their economies, their purchasing power will rise and they will demand increasingly sophisticated goods and services from high-cost countries. Furthermore, as the low-cost countries accept the rote and mundane activities of product development, they will free up more time for higher-cost engineers to work on higher-level, innovation-oriented work. If anything, the high-cost countries will become intellectually stronger—not weaker.

Job Loss

- Argument: Moving engineering jobs to low-cost countries will compromise the economies of the higher-cost countries. Unemployed workers do not spend money, which creates a drag on the high-cost country's economy.
- Reply: Same argument as above–but with the added distinction that, as low-cost country economies begin to demand more goods and services from high-cost country economies, local firms would have to increase staff to meet demand. In short, on a localized basis, jobs may decline, but across the entire economy, increased demand will spur job growth in adjacent industries and activities. The offshoring of manufacturing did not coincide with an economic crash in high-cost countries, but actually fueled growth and prosperity.

Threat to National Security

- Argument: Many high-cost countries are prohibited from sending defense-oriented intellectual property outside the country.
- Reply: This is, indeed, true. Global Product Development will not be appropriate in all circumstances. However, there are proven ways to disaggregate defense-oriented work to isolate those components of the work that can be done offshore. Thus, one should not necessarily assume that none of the work is applicable for Global Product Development.

Business Concerns

Given that economic strength plays such a strong role in world politics today, it's not surprising that there are a series of business-oriented criticisms to Global Product Development. These criticisms operate at a level below international competition and focus more on competitiveness of the individual firm. Here's a sampling of these challenges:

Intellectual Property (IP) Theft

- Argument: Many low-cost nations have no formal IP laws and lack respect for intellectual property rights. For example, software piracy is rampant in many low-cost countries. For this reason, high-cost country firms are hesitant to distribute their own IP (e.g., product designs, CAD models, assembly instructions) outside of nations where they can't ensure its safety.
- Reply: While this is certainly true, there are measures that can be taken to mitigate IP risk. These measures include making a thoughtful and strategic up-front assessment of which IP to send and which to keep, as well as using information technology, organizational, and physical deterrents to control access to sensitive information, or portions thereof. Additionally, a number of low-cost countries recognize IP protection as a requirement to grow their services businesses, and they are working on legislation and enforcement.

Non-Standard Processes

- Argument: Some companies argue that their innovation processes are not "standard" enough to be decomposed and reconfigured for Global Product Development. In other words, they never conduct product development the same way twice.
- Reply: While aspects of this may be true, most manufacturing companies have taken steps to control their product development processes. In fact, a survey by the Product Development and Management Association (PDMA) found that 72% of companies surveyed had a formal, cross-functional product development process. In addition, for those companies that still do not have a formal process, Global Product Development can serve as a focal point around which to pilot and then instill process discipline.

Customers Will Complain

- Argument: Many companies in high-cost countries feel that they will be viewed as "unpatriotic" in the eyes of their customers for sending work outside of the home country, and they worry about losing business as a result.
- Reply: While customers might view the migration of work as unpatriotic, they will certainly not complain about lower prices or products getting to market faster. Assuming that a portion of the Global Product Development entitlement is passed back to the customer, any initial negative reactions will not be sustained. As evidence, today virtually all products have some components that are manufactured offshore, and yet customers show widespread acceptance.

Technical Concerns

Technology has played a pivotal role in the rise of Global Product Development. The ability to digitize work products, the increased bandwidth available in low-cost countries, and the proliferation of networks and computers have all contributed. While technology has great power to enable new business models, because of its naturally dynamic nature, it can cause skepticism and even fear in those who are not comfortable with it. Some common objections are:

Non-Digital Product Development Process

- Argument: Some high-cost country companies still do not use digital technology (three-dimensional CAD, Product Lifecycle Management, etc.) to orchestrate product development. So, to effectively participate in Global Product Development, they would first have to "digitize" their basic product development operations, which can create a great deal of concurrent business changes.
- Reply: Over the past decade, the world of product development has advanced rapidly, and those who have not adopted modern techniques and technologies are now in a small minority and already at serious risk of competitive disadvantage. Global Product Development can be seen as a focal point for driving an initiative to upgrade product development to be a fully digital, automated, and collaborative process. This investment will pay productivity dividends locally in the high-cost country, as well as contribute toward the Global Product Development initiative.

Viability of the Technology

- Argument: Since Global Product Development is a relatively new concept, some home country manufacturers might question the viability of the underlying technology to actually support it.
- Reply: Global Product Development is simply a more advanced application of the "Design Anywhere–Build Anywhere (DABA)" concept, which is a well–understood and proven practice. The same Product Lifecycle Management applications that have been enabling DABA now enable Global Product Development; they are well-understood and stable.

Organizational Concerns

Global Product Development implies a radical shift in the way that work gets accomplished, and this shift occurs across many different dimensions, from process, to capabilities, to organization. Many would argue that organizational issues are perhaps the most critical issues, given the importance of smooth collaboration to the success of Global Product Development.

Communication

- Argument: Management in high-cost countries may be wary of telling employees that Global Product Development will entail local staff reductions, for fear that morale and productivity will be compromised. Offshoring strategies can cause difficulty with labor unions as well. These reasons alone might be enough to prevent a Global Product Development initiative from happening.
- Reply: Like offshore manufacturing, Global Product Development is a reality whether we like it or not. Early adopters embrace the opportunity to gain competitive advantage through better productivity. Competitors must follow to regain competitive parity, or they risk suffering even worse consequences. Either way, management may have a tough message for some employees, but business failure can be far more drastic.

PTC–Your Global Product Development Partner

For companies that are intrigued by the idea of Global Product Development, but uncertain of their ability to "go it alone", PTC can be a true partner in the journey. PTC's complete solution of Global Product Development capabilities include:

- Experienced Partner. With a singular focus on improving product development, PTC has an established relationship with tens of thousands of leading manufacturing companies worldwide. As a trusted business partner with staying power, PTC uses Western business approaches, standing behind its commitments to ensure that customers get full value from PTC solutions, even if surprises are encountered in the process. With respect to Global Product Development, PTC already successfully "practices what it preaches." PTC has operated an offshore engineering practice in India dating back to 1994. With more than 60% of its 1400 engineers offshore, PTC continues to meet its customer commitments, to build great products, and to deliver profitable business results. PTC's experiences are invaluable to companies attempting to chart their path to Global Product Development.
- Enabling Infrastructure Provider. At the end of the day, Global Product Development is an IT-enabled business practice, and PTC is the sole supplier of the critical IT enablers to thousands of companies worldwide. PTC's global Product Development System is unique in the industry in terms of its ability to help companies deploy a digital, collaborative, and automated product development process. PTC also supplies IT consulting services and on-demand solutions to help customers deploy technology quickly and gain maximum advantage from their investments.
- Process Change Agent. By leveraging experiences gained internally and through engagements with leading customers worldwide, PTC has developed a series of product development process re-engineering practices that help companies decompose, distribute, and reconfigure product development processes for Global Product Development. In particular, PTC has developed and standardized techniques for implementing modular **product** approaches and modular **process** approaches—key prerequisites to implementing Level 2 and Level 3 Maturity approaches.
- Trusted Guide. PTC has already established solid relationships with many of the major engineering service providers now operating across the world's low-cost regions. In fact, these organizations are very important customers and partners of PTC. Since PTC is already an active participant in these markets, we welcome the chance to assist our customers in finding the appropriate Global Product Development engineering service provider.

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