Seven Tips for Improving Global Design Collaboration

How to Establish More Effective Partnerships that Speed Time-To-Market and Boost ROI

In a recent survey of executives at worldwide manufacturing companies, over 44% of respondents stated that globalizing key business functions was one of their top three corporate initiatives–up from just 28% the year before. And the one function that's being targeted most? Global Design Collaboration.

Today, industrial manufacturers are looking to improve collaboration with external partners in order to gain benefits in market share, profitability, and time-to-market. But many industrial manufacturers are unable to gain the ROI from design outsourcing that they anticipate.

Yes, it is possible to improve the collaborative processes in design outsourcing–by following the seven best practice guidelines described in this paper. These industry-proven methods–reinforced in this paper through a real-world case study–can improve your global collaborative design processes, and help deliver the benefits you're expecting in faster time to market, increased productivity and lower costs.

The Growing Footprint of Global Collaboration

For most industrial manufacturers, relying on globally dispersed teams has become more than just a means of competitive advantage; it is now essential to survival. Indeed, during the past decade, the globalization of product development has been a proven source of significant cost savings and productivity increases. To stay competitive against these companies who are increasing profit margins while lowering their prices, others in the industry must follow suit.

Without doubt, the momentum toward global outsourcing is growing fast. A 2008 PTC survey of executives at worldwide manufacturing companies shows that more companies are reconfiguring their products and processes, balancing the costs of high- and low-skilled development activities, and spreading them around the world.

Design collaboration, in particular, has been an effective approach for industrial manufacturers seeking to gain market share, profitability, and time-to-market benefits. According to another recent study–the Aberdeen Group's Global Product Design Benchmark Report–adoption of global product design is increasing steadily, with many companies now designing products in more than four or five countries. The reason? Design collaboration enables organizations to increase product research and development capacity, while lowering total costs and freeing up valuable resources to focus on innovation.

However, despite the promise of collaborative design partnerships, many industrial manufacturers still struggle to alter processes and to structure products so they're best suited to these new relationships. As a result, many manufacturers fail to realize their anticipated ROI. In fact, Gartner Group studies show that about 50% of business deals involving outsourcing ultimately end in failure. Those companies who practice global collaboration today are usually doing it on a tactical, ad-hoc basis.

Without a 'holistic' strategy, companies struggle with fundamental questions such as: how do I engage and collaborate with partners; what products or product module designs should I outsource; what tools and methodologies should I use; and how can I achieve a balance of cost, risk, and value-add for work performed in-house vs. work outsourced. In addition, data management and sharing also pose complex challenges, including intellectual property protection, access/version control, change management, and obtaining visibility to project status.

While this paper focuses on global design collaboration from the manufacturer's perspective, the lessons and tips for success are relevant across all types of global partnerships. Global teams, working collaboratively, can take on many different forms–from "distributed" teams where internal departments are spread across regional or international geographical boundaries, to "outsourced" teams where a third-party partner is engaged for a specific product development activity.

While some issues, such as the sharing of intellectual property, may be alleviated when teams are internal, effective collaboration is still crucial to the success of the product development process as a whole. Often, an internal department or division may share the same corporate branding, but its processes, tools, and priorities may be as different as those of third-party suppliers. Supporting effective collaboration is crucial in allowing teams of all types to align along shared goals.

Manufacturer Challenges	Supplier Challenges
How do I establish an effective supply chain strategy that aligns with my corporate objectives and business opportunities?	How do I deploy a collaborative environment that aligns with the differing processes of each of my customers?
How can I deploy a collaborative environment that enables product development activities across distance and teams?	How do I find and reuse product and project information more effectively?
How can I effectively exchange product information with suppliers?	How can I effectively exchange product information with customers and suppliers?
How can I effectively collaborate across my supply chain, while efficiently managing changes?	How do I work effectively with multiple CAD data formats and design tools demanded by my customers?
How can I track and protect the intellectual property I'm providing to suppliers?	How do I protect the intellectual property in the product designs I'm sharing with suppliers?
How can I architect products to support outsourced design activities?	

Figure 1. Challenges of Global Collaboration: Manufacturer and Supplier Perspectives.

Despite the many challenges in design collaboration, it is possible for companies not only to attain the value they expect from global partnerships, but also to simultaneously improve the efficiency of day-to-day product development practitioners. The success of the outsourcing practice can be dramatically improved by following these seven guidelines, described in greater detail below:

1. Understand the 'Why' Before You Tackle the 'How'
2. Think 'Process'–Not Just 'Product'
3. Engage Your Partners and Align Expectations Early
4. Align Maturity Levels and Climb the Maturity Ladder Incrementally
5. Use a Consistent Approach to Defining Working Practices
6. Consider Your Product Architecture
7. Plan for Change and Configuration Management

Case study example: a major crane manufacturer

As an example to reinforce the process in each of these tips, we will walk you through a case study of a PTC client–a major manufacturer of cranes and other industrial products. This PTC customer manages a number of product development and manufacturing locations around the world. They recently entered into a design collaboration partnership with a third-party engineering partner in Central Europe to realize cost savings. However, this relationship was not as effective as they had initially hoped. The PTC customer needed to quickly improve their collaborative processes and close the gap between the expected value and delivered value of the relationship. Specifically, the customer faced challenges in these areas:

- **Technology:** Both the company's internal design resources as well as the partner's resources lacked common 3D design tools and standards, making design collaboration difficult.
- **Engineering Productivity:** The skills of the engineering partner were being underutilized due to collaboration difficulties. In addition, project teams didn't fully understand the partner's capabilities, and thus didn't involve the partner in new projects, which would have saved time and money.
- **Management Control:** Executive stakeholders within the crane company lacked consensus on everything from product development processes to the right supporting tools. This lack of consensus, in turn, created a lack of standardization among distributed design groups.

The challenges that the crane manufacturer faced in trying to collaborate with its European partner also highlighted the customer's own internal collaboration challenges. Multiple acquisitions throughout the years had led to the crane manufacturer now coordinating multiple regional research and development centers worldwide, each with local processes and tools. To improve its collaborative processes, the PTC customer had to take into account each center's interactions with the partner. In the following pages, we'll review how this PTC client applied each of PTC's seven guidelines to improve their global design collaboration.

Tip 1: Understand the "Why" Before You Tackle the "How"

As with all product development technology projects, it is important to understand exactly why global collaboration improvements should be made before determining how they will be made. While the following value drivers in making these improvements will vary among product development scenarios, they will always stem from the company's fundamental need for improved growth and profitability. Here's what an organization may gain from optimizing design collaboration:

- Reduce time-to-market and process cycle time
  - Improve global enterprise organization and process
  - Manage design activities occurring in multiple time zones and work shifts
  - Improve development agility
- Improve innovation and flexibility
  - Improve product differentiation in local markets
  - Establish operations closer to the market
  - React to demand spikes on a global scale
- Improve readiness and reduce execution risk
  - Balance IP protection with collaboration needs
  - Improve access to skilled labor pools and knowledge
  - Navigate global regulatory and labor protection laws
- Reduce product development costs
  - Improve product profit margins
  - Keep pricing competitive
  - Manage pressure on labor and benefits costs

Keep in mind that, because the stakeholders involved in such a project will have varied roles within the organization, they will also tend to have different perspectives, priorities, and considerations. While a VP of Engineering may see the main driver of improving collaboration as the need to increase innovation, a CFO may deem that reducing costs is more important. Once all the drivers are understood, the optimization team needs to reach consensus on the relative priorities, so that a definition of project success can be established and expectations can be set.

PTC suggests using what's called a Value Identification and Planning (VI&P) approach to plan and organize the project. Here are the key steps to the VI&P process:

First: Align on Priorities

- Prioritize value opportunities
- Prioritize improvement initiatives
- Identify and prioritize processes and technology capabilities required to drive maximum value from investments
- Identify capability gaps

Second: Define Clear Measures

- Develop a balanced scorecard
- Establish time-phased improvement targets

Third: Select Focus Area

- Identify process areas
- Identify product development projects

Fourth: Identify Improvements

- Identify practitioner-level improvements
- Define high-level architecture and Service Level Agreements (SLAs)

Fifth: Establish a Value-Based Roadmap

- Create a 2–5 year value roadmap that communicates phased improvement–coordinated across processes technology and organizational groups–as well as the value impact of this activity
- Include ROI per activity
- Establish incremental goals, with progress checkpoints (measured against success metrics) along the way

For the crane manufacturer, PTC polled the company's executive stakeholders, and identified the following improvement opportunities for their current global collaboration processes:

- Detailed Design
- Design Outsourcing
- Change and Configuration Management
- Concept Development
- Program Management

The stakeholders then defined specific metrics to document progress–from reducing the number of common CAD platforms used by design teams, to reducing time spent accessing and transferring data between internal engineers and the partner, to increasing the measurable cost-savings gained through the outsourcing relationships. For each of these metrics, PTC's customer then documented activities that would generate the needed results–from defining and communicating new partner data transfer and collaboration processes, to replacing CAD platforms at various internal design centers with a standard system. By setting short-term goals with associated checkpoints, and by establishing a long-term plan, the stakeholders were able to agree on a course of action and started making progress toward their goals.

Tip 2: Think 'Process'–Not Just 'Product'

In the third step of the Value Identification & Planning approach mentioned above in Tip 1 (Select Focus Area), stakeholders must identify the process areas they need to focus on. You can only make the improvements needed to meet your metric goals if you clearly understand your current product development processes. In addition, you have to understand the capabilities of your current or planned technology infrastructure. This underlying technology infrastructure is what makes your product development processes–and all improvements–possible. When implementing changes to support better collaboration, both the processes and the supporting technology must be considered in tandem.

Understand and Improve Product Development Processes

Evaluating and optimizing your overall product development processes is the first step to improving collaborative relationships. Changes must be made incrementally to avoid disrupting current workflows. To fully understand all associated product development processes–not just those internal to the engineering department–PTC segments product development into a set of critical processes that span the product development lifecycle. These processes are captured in a set of documented artifacts, referred to as the Process Landscape (see Figure 2). The Process Landscape includes both concurrent and sequential processes that are executed by various departments within and outside the company.

By considering all processes encompassed in the Process Landscape, you can achieve the best results, as it allows you to understand the relationships between processes, departments, and tasks. Only with these relationships in mind are you able to:

- Formalize repeatable processes around best practices at all levels
- Improve people's capabilities to execute the processes in day-to-day work
- Deploy software and service capabilities designed to support process
- Plan the changes to coincide with product development programs

In addition, mapping out existing processes enables you to identify integration points between your processes and your partners' processes. This knowledge allows you to:

- Establish a common understanding of terminology, scope, and relationships between processes selected for improvement
- Provide the basis for validation of process flow, including tasks, roles and PDS (product development system) software alignment at multiple maturity levels
- Provide documentation of multi-level, best-practice procedures for training

Establish Supporting Technology

Technology is the underlying backbone of the collaboration process; it is the advancement of information technology that has made global collaboration a practical reality. To improve collaboration, current technologies must be evaluated for their ability to support collaborative product development processes and improve them wherever possible. An effective IT infrastructure must enable the product development process to:

- **Get Digital.** By eliminating the use of paper in product design, and by moving to a purely digital product modeling approach, companies can make their intellectual property highly portable between locations, third-party partners, and internal team members, regardless of anyone's global location. It is this portability that enables engineers across multiple time zones to collaborate on product design around the clock. The consistent use of advanced 3D CAD tools, in particular, is a prerequisite to any meaningful outsourced design strategy, and the added use of CAM, CAE, and visualization technologies is also recommended to realize the full potential of design outsourcing.
- **Get Control.** An environment that promotes effective information and process management enables companies to capture digital data content, to control its various versions and configurations securely, to manage concurrent changes, and to automate the flow of information between members of the product development team. A baseline of information and process control is a critical prerequisite to avoid disabling chaos during the transition to, and ongoing operation of, collaborative product development.

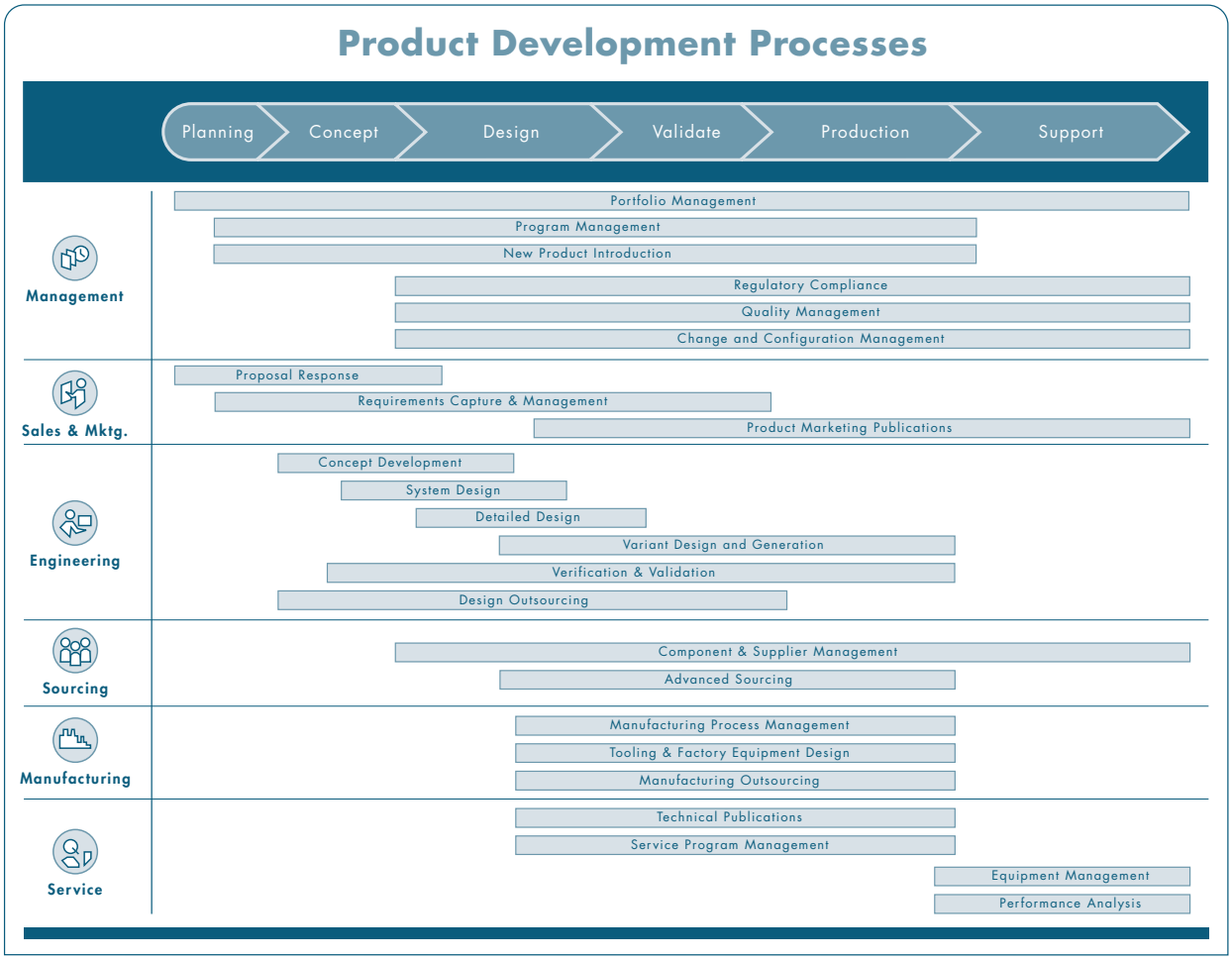


Figure 2: The Process Landscape: the critical processes that span the entire product development lifecycle.

- **Get Global.** The introduction of Internet-based collaboration technologies will enable your organization to establish "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, promoting productivity without compromising the proprietary nature of intellectual property.

With a modern IT infrastructure, like PTC's integrated Product Development System (PDS), you have a digital backbone that enables manufacturers to support product development processes. In the PDS, the three core capabilities (also referred to as create, control, and collaborate), described above, are married into a single IT architecture comprised of the following solutions:

- Pro/ENGINEER® 3D CAD software to create high-fidelity digital product data;
- Windchill® PDMLink® to facilitate control of product development data and processes;
- and Windchill® ProjectLink™ to enable collaboration across global, virtual teams.

For PTC's crane manufacturer, the areas in most need of process and technology improvement were clear: Multiple historical acquisitions had resulted in design centers having different processes for product development, as well as multiple design technologies. Consequently, interfacing with the various design centers was difficult and inefficient for the partner, as they had to learn a different set of processes for working with each center.

In addition, product designs were being created and edited with a wide variety of CAD tools, making it difficult to share designs between the company and the partner. This customer desperately needed standardization both for its design tools and its product development processes among its internal design centers. Following the guidelines set forth in the Value-Based Roadmap that the customer had created, they established a phased plan for replacing their multiple existing CAD tools with a common 3D design solution at many of the design centers. With common design tools in place, the customer could specify standard product development processes both for the design centers and the partner.

Tip 3: Engage Your Partners and Align Expectations Early

While it's clear how you can affect your own internal product development processes, optimizing your partners' processes isn't quite so easy. While you can't necessarily tell your partners how to change their processes, you can improve the contact points where your processes and your partners' processes intersect. Convincing your partner to adopt process changes is far easier when everyone's goals are aligned, and the criteria for project success are agreed upon.

When proposing process changes, remember that the collaboration and control challenges faced by internal teams will differ from the challenges between manufacturers and their partners—though they may seem similar. Differences tend to cut across people, process, technology, and planning elements, as follows:

- **People:** Cultural and language issues are introduced by project team members from different regions of the world and from different organizational cultures. These differences require increased emphasis on multi-level alignment and adoption.
- **Process:** The processes of your outsourced partners typically differ (both on paper and in execution practices) from those of the buyer. These differences require increased emphasis on process and working-practice standardization, documentation, and communication across the extended team.
- **Technology:** Global design teams consist of external team members. Accordingly, it is imperative to evaluate each project's information-sharing requirements, and to determine how to enable access to that information without compromising sensitive internal data. Properly restricting access to information can be in conflict with the need to share and reuse information. Appropriate configuration of technology capabilities to support process execution is essential.
- **Plan:** Outsourced suppliers often work with multiple buyers, both when the relationship is at arm's length and when it is of a more strategic nature. The overall business situation of the supplier can introduce priorities that are unsupportive or in conflict with the priorities of the buyer improvement program. Further, global design teams work across time zones that often have minimal overlap during the course of a business day. These dynamics require increased emphasis on ensuring that deliverable requirements are well understood and are tied to delivery timelines across the extended enterprise.

Engage your partners early to align expectations; involve partners in process and working practice development discussions. Define supplier relationship categories, and align improvement activities with each supplier in each category, including:

- Identifying priority improvement targets for the manufacturer and partner independently
- Focusing on overlapping improvement areas first
- Developing a continuous improvement roadmap, by supplier

By better understanding its partner's practices, and involving partner representatives in process improvement discussions, PTC's customer could better understand the needs and challenges of the partner. The crane company, in turn, was able to communicate their strategic goals to its partner, and help them see the "big picture" behind proposed changes. When new product development processes were proposed, the partner was able to provide input on how each change would affect them. This communication enabled the customer to weigh both the priority of the strategic goal and the impact to the internal and external design teams before moving forward.

Tip 4: Align Maturity Levels and Climb the Maturity Ladder Incrementally

While collaborative design relationships between manufacturers and partners can vary, they usually involve all the complexity of co-located, in-house design teams, yet with the added challenge of having to communicate across distributed locations. Implementing drastic changes can be seemingly impossible, as it becomes a struggle to manage all of the required people, process, and technology changes at a rate that product development practitioners and budgets can absorb.

To better understand the collaboration gap between the current relationship—and the ideal relationship–with the partner, it helps to think in terms of "maturity levels". The maturity level of a process refers to how optimized that process is–ranging from an undefined, ad-hoc process to an advanced and formally defined process supported by integrated technology. The model below depicts four maturity levels for outsourcing design capabilities. Each higher step depicts how advancement in maturity levels leads to more collaborative and strategic relationships, ultimately driving value.

- Level 1: Ad Hoc
  - Independent and ad-hoc design processes at both the manufacturer and partner
  - Ad-hoc process for engaging and collaborating with design partners
  - Little or no virtual design collaboration or collaborative project management
  - Product data is exchanged using email and FTP, or by sending hard-copy documents
  - No transaction traceability or content management
- Level 2: Structured
  - Formal design outsourcing process at a departmental or functional level (e.g., ECAD group, mold design, etc.)
  - Manufacturer and partners have a controlled process for interaction and data exchange (manual or automated)
  - Manufacturer maintains different processes for each partner
  - Limited or no insight across different outsourcing projects

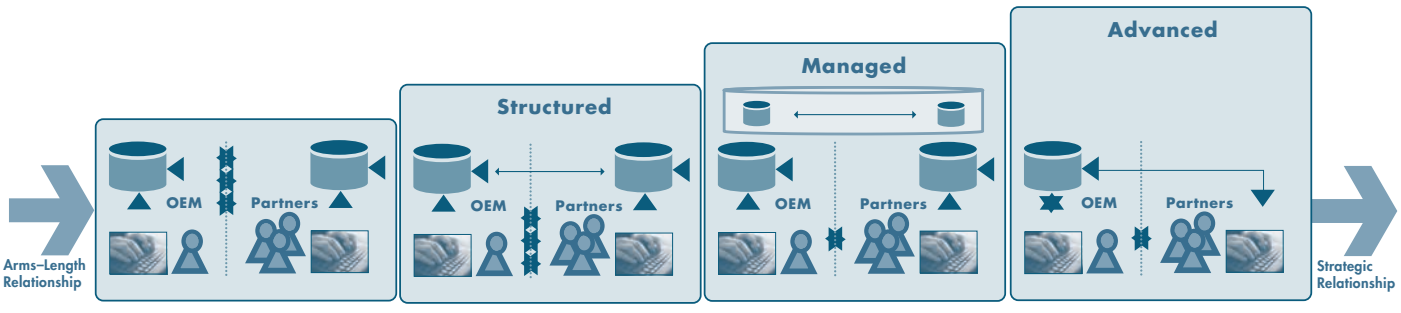


Figure 3. Four Maturity Levels of Design Outsourcing Capabilities

- Level 3: Managed
  - Formal design outsourcing process consistently applied across the company
  - Manufacturer and partners have common, controlled, and verifiable procedures – often automated – for collaboration and data exchange
  - Overall project management with shared design milestones and deliverables
  - Process enables early design-partner involvement and fosters strategic relationships with partners
  - Close collaboration and ongoing design feedback during the lifecycle of the project
- Level 4: Advanced
  - Formal design outsourcing process used consistently across company and partners
  - Process accommodates multiple types of partner relationships, from arms-length to strategic
  - Manufacturer and partner each have identical design tools and methodologies

Based on the design outsourcing process improvements that you would like to achieve, you should first determine which maturity level you would like to reach with your suppliers. Keep in mind that the ideal level can vary based on your goals and the constraints of the partner relationship; Level 4 maturity may not be appropriate for all suppliers. Once you have established the target maturity level, define the steps necessary toward achieving incremental improvements. Climb the maturity ladder at a manageable rate that enables end-users to easily absorb the changes in their day-to-day activities.

PTC's crane manufacturing customer was using its outsourced partner primarily for CAD data conversion and detailed drafting work. While much of the company's original design work was still being done by their internal design centers, their partner was performing some semi-complex work, such as developing modules on the existing platform with new design features, or design-for-manufacture redesign. Product design data between the customer's internal centers and the partner was exchanged manually via email, meaning that changes could not be performed concurrently. This meant that development cycles could be very long, as designers waited for an updated version of the design to be worked on and then emailed back to them. Referring to the maturity levels defined above, this method put the customer's design outsourcing process maturity at Level 1. However, it became clear that the complete separation of design processes was hindering the partner's effectiveness.

The PTC customer decided to move the current relationship to maturity Level 2 by inviting the partner to use the design centers' virtual workspace (provided by PTC's Windchill® ProjectLink™). This workspace allowed the partner to access product data on its own, thus eliminating the need to send data via email. The control features in the Windchill technology platform also allowed the partner to access segments of the design individually, allowing concurrent design on other segments of the project. These changes shortened the time needed for design with the partner, making partner involvement on projects more appealing and the partner themselves easier to work with. This solution increased the company's utilization of its partner's services dramatically, and improved product development costs. Moving the relationship from Maturity Level 1 to Level 4 would have been unmanageable, but moving the relationship to Level 2 helped the company meet its improvement goals and realize a greater ROI.

Tip 5: Use a Consistent Approach to Defining Working Practices

In addition to improving and standardizing working practices with partners, it is also essential to define and document these practices, so they can be communicated and repeated. Use a consistent approach to define working practices across process areas and organizational boundaries. PTC refers to these formal definitions as the "Collaboration Framework". This framework supports a consistent way of:

- Relating process and product scope to the outsourced partner's strategy
- Coordinating collaboration working practices at multiple process levels
- Prescriptively relating process tasks, roles, access policies, and deliverables to the technology vehicles used to support the collaboration

The steps for creating a Collaboration Framework:

Step 1: Define and Document Standard Working Practices

Establish a clear set of standard methods and policies for collaborating and exchanging information with distributed engineering teams.

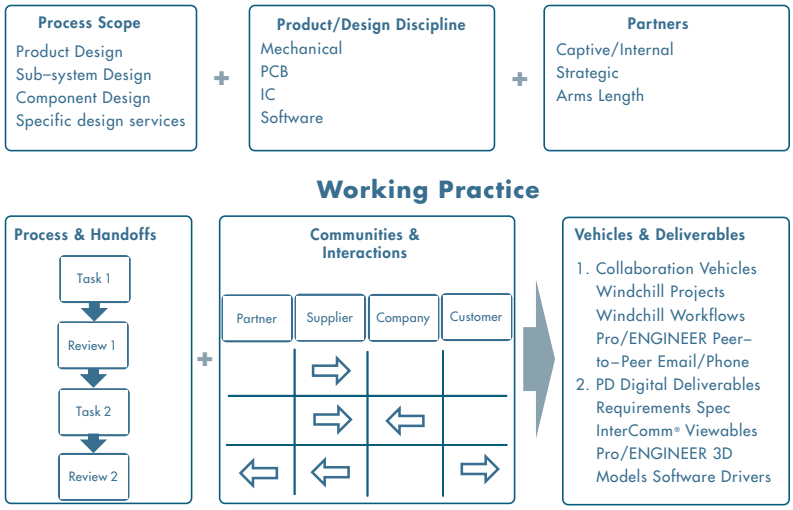
- Define Information and Intellectual Property Policies
- Define Collaboration Protocols

Step 2: Identify Project Collaboration Vehicles

Explicitly identify the tools and technology available for collaborating and exchanging information with design partners and distributed engineering teams.

- Identify Collaboration Vehicles Linked to Product Data
- Identify General Project Collaboration Vehicles

Figure 4. Collaboration Framework



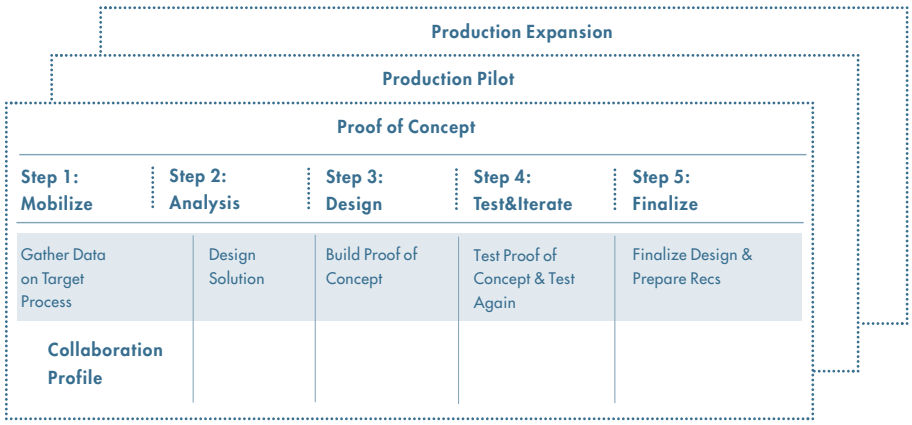


Figure 5 High-Level Work Plan

Step 3: Map Collaboration Vehicles to Events and Deliverables

Identify the events that occur during a global design project that trigger collaboration and information exchange among team members. Identify the appropriate collaboration vehicle to support each event. Ideally, most, if not all, of this definition would have been completed when you were reviewing your process and technology framework, as described earlier.

- Identify Global Design Collaboration Events
- Map Collaboration Vehicles to Events

Step 4: Establish Supporting Infrastructure

Project collaboration and information exchange with global partners and remote teams relies heavily on your organization's supporting technical infrastructure. An unreliable or poor-performing infrastructure can halt collaboration and affect the success of your global design project. Ensure that your existing technology framework is set up to support not only your processes, but the collaboration points with your partners.

- Optimize Technical Infrastructure
- Configure Applications for Distributed WAN Environments
- Embed Working Process into Technology

In our example of the crane manufacturer, PTC's Collaboration Framework helped the customer define and communicate standard practices for collaborating with its global design partners across each of their distributed design centers. Now, with clearly defined, consistent practices, the interactions between the various design centers and the partner became more consistent. More consistent practices, in turn, made it easier for the partner to learn them, resulting in fewer mistakes and missed steps.

Tip 6: Consider Your Product Architecture

Product architecture is an important consideration when deciding to outsource design components to a third-party supplier; when improving collaborative processes, architecture should be reevaluated and optimized if necessary. If you are not already utilizing a modular product architecture (MPA)—as opposed to a traditional integrated architecture—then determine whether this shift to an MPA is more effective in enabling your concurrent design and product development processes.

Whether you elect to "co-design" an entire product with a partner, or merely to outsource sub-segments of the design to the partner, you must be able to segregate and transition design components to and from the partner. These transitions will only be effective if they can be done without consuming re modeling or re structuring of the product data. To manage the transfer and re-integration of design data, additional thought must be given to "modular product design". Unlike modular 'process' design that formalizes interfaces between people, modular 'product' design is a methodology to formalize interfaces between product modules, so that design activities can proceed more independently, with the assurance that the results will integrate nicely into the final product.

A well-thought-out system architecture results in better product performance, enables increased design commonality, improves design reuse, and improves field serviceability. Additionally, a modular product architecture supports managing the integration of electrical hardware and software into mechanical systems, helps automate and streamline the detailed design process, supports distributed and outsourced development, provides well-aligned control points for managing the significance of product changes, and protects core competencies by exposing only common interfaces.

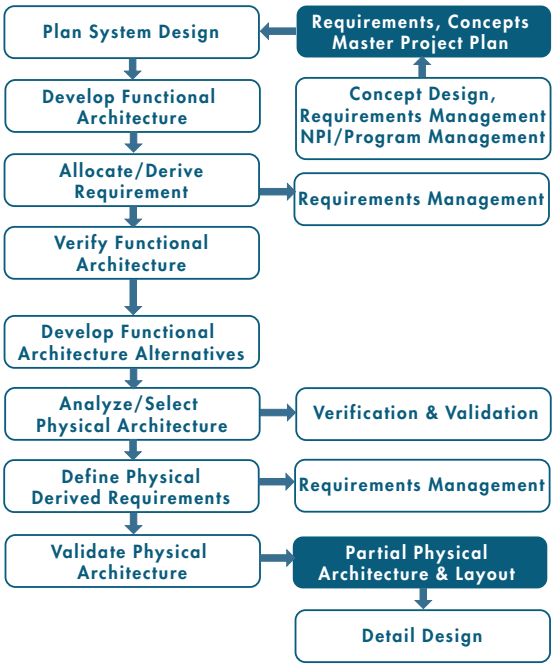


Figure 6. System Design Process

The System Design Process (see Figure 6) defines management of the physical architecture and the interfaces necessary for successful system-design planning, and top-down management of detailed design activities.

Architecture implementation involves the following three-step approach to ensuring that the System Design Process results in the right level of product modularity.

Step 1. Architecture Definition
The Architecture Definition phase results in the documented description of a new product structure:

- Architecture aligned with business objectives
- Modules identified
- Interfaces identified

Step 2. Architecture Realization
Architecture realization results in the embodiment of the new product structure:

- Upper-level product structure in PDM (product data management) system
- Module specifications and CAD framework
- Interface specifications and CAD framework

Step 3. Architecture Deployment
Architecture deployment results in a fully defined product design that meets its identified architecture requirements:

- Completed product structure in PDM system
- Completed CAD content and documentation for the product

It's important to consider your product architecture when defining best practices across the process landscape. If you do determine that a modular product architecture is crucial to your outsourcing success, rely on a partner with experience to help you with implementation, as this can be a daunting task. With over 20 years in the product development business, supporting some of the world's leading manufacturers, PTC is well versed in both the challenges and best-practice methodologies of implementing modular product architectures.

In our customer example, the crane manufacturer had a number of other objectives, outside of improving collaboration, that motivated a move to a modular product architecture. As the crane company moved towards serving a "global" marketplace, they realized that "one-size-fits-all" products no longer met its buyers' needs. Instead,

its buyers had varied and highly specific regional requirements, including different international transportation regulations, levels of operational simplicity, and standards of efficient performance. For the crane manufacturer, meeting customer needs with highly customized products was becoming very costly. By implementing a modular product architecture, the crane company was able to provide highly configured products faster, with lower development costs. This modular architecture also simplified the process of design outsourcing with their partner.

Tip 7: Plan for Change and Configuration Management

A key element to improving collaborative relationships with design partners is planning for change. Ongoing change is essential to product improvement; product design change is inevitable. But when product development is happening collaboratively or concurrently between multiple internal and external teams, change can cause product development to become slow and costly. The key to success is a simple, repeatable change and configuration management process, so you can control how informal and formal changes are proposed, analyzed, planned, implemented and released.

Product design change can happen for many reasons–from a newly uncovered customer requirement to a newly passed regulation. Small changes that occur at the earliest stage in the design cycle can often be managed through informal processes. But when changes are necessary later in the design process–especially when products are being developed collaboratively by internal and external partners–changes can become more complex, difficult, and costly to implement. A well-defined and orderly process for controlling both informal and formal changes becomes vital.

An overly complex change process, coupled with a lack of user knowledge, can result in low process adoption among both internal teams and third-party suppliers. Changes are either avoided, or the process is bypassed, and as a result, downstream documentation is either incomplete or incorrect, and valuable design and configuration history is lost. This causes problems in downstream product development stages. This process is further complicated when design partners are using multiple systems or tools to manage product information, and different applications to aid in the change process execution.

For a fully effective, global change and configuration process, your collaboration technology must support your product change management. In general terms, the change management process has four major steps, defined below:

1. **Identify the Need for the Change.** The goal here is to enable your product development contributors and external parties to report problems with, and enhancements to, your products.
2. **Investigate the Need.** When the change has been identified, the change team can then proceed with an in-depth change investigation. The change investigation is captured in an Engineering Change Request (ECR). Next, the goal is for product experts to accurately assess the scope of the change: its feasibility, its impact on downstream products, solution proposals, plus the cost and business justification. Upon completing this evaluation and investigation, the change process may follow either a formal process involving review and approval by a cross-functional team (Change Review Board), or a less-formal process without any approvals. Whether a change follows a formal process path or not generally depends on change complexity or product maturity state.
3. **Plan the Change.** Here, you want to plan the detailed implementation of the change, including schedule, work tasks, and resources. The change planning is captured in an Engineering Change Notice (ECN). As part of the planning, the implementation team will decide how to incorporate changes to impacted product configurations, as well as to new or revised parts, and how to manage obsolete parts. If the change follows the formal process, the implementation plan has to be reviewed and approved by a cross-functional team (Change Implementation Board).
4. **Implement the Change.** The goal of this final step is to implement, review, audit and release the change. Upon approval of the implementation plan, all work tasks, as required by the implementation plan, need to be delivered to the designated users. During change implementation, automatic notifications (via the collaborative technology) are essential for a smooth process flow. When all work tasks are approved, a designated reviewer–typically the engineering manager–will perform a final review and analysis of the entire ECN (based on planned changes), as well as effective date of the change, the disposition of obsolete parts, and the new and updated product configurations. Upon approval, the change will be released.

For our case study customer, managing the ongoing change process was extremely important. To identify the crane manufacturer's needs for both product and process changes, PTC worked with the customer to establish quarterly global engineering workshops geared toward sharing information. Three instances of this workshop were held: one for engineers, one for IT administrators, and one for management. Both internal employees and representatives from the design partner attended. Participants shared best practices, and communicated potential improvements. In addition, the three groups worked to achieve consensus and global alignment on key process and practice topics, including top-down design approach, enforcement of working document standards, and CAD & PLM attributes. Process changes that were identified during these workshops were defined and managed through the Collaborative Framework described previously. Product changes were managed through the integrated best-practice workflows, following the four steps defined above, and managed by the customer's Product Development System from PTC.

Conclusion

Global design collaboration involves a complex set of product development process improvement opportunities. Companies are most successful in attaining the value they expect from global collaboration improvement initiatives when they follow best practices and supporting methodologies. This paper introduced some of the most important best practices surrounding global design collaboration, as summarized below:

- Understand the value drivers behind your global collaboration improvements. Align key stakeholders, and use a Value Identification and Planning (VI&P) approach to identify improvements, set clear measures for success, and determine a timeline for moving forward.
- Identify which processes need to be improved, by looking at your organization's end-to-end product development lifecycle. Include those processes that happen outside of your organization, i.e., through partners, as well as internal processes. By looking at processes across departments, not just within your engineering department, you can anticipate which concurrent, dependant, or intersecting processes will be affected by changes. Make sure you have the technology foundation to support the improvements you want to make.
- Understand your partners' processes, cultures, technology infrastructure, and strategic plan. Consider how your process improvements will affect them, and how this will impact your ability to make changes. Involve your partners in process improvement discussions early on; give them the opportunity to provide feedback, and clearly communicate your strategic goals.
- Understand into which category of maturity your current partner relationships fall. Set a goal for where you want to be in the future, and put together a plan to move incrementally towards that goal. Climb the maturity ladder at a manageable rate so that end-users can absorb changes in their day-to-day activities.
- Formally document collaboration processes with a "collaborative framework." Identify and define standard working practices; describe tools and technologies available to support collaboration and identify when these tools should be used.
- When evaluating potential improvements in your collaborative relationships, consider your product architecture. A modular product architecture can have a beneficial effect on outsourcing practices, while also improving concurrent design capability and supporting design reuse. In addition, a modular product architecture can provide additional benefits throughout the product development lifecycle, including managing product complexity, reducing testing times, improving product quoting and planning, and increasing the ability to offer customized products.
- Changes both to processes and products are inevitable, and affect both internal teams as well as partners. The key to maintaining effective collaborative relationships is having a simple, repeatable change and configuration management process for both informal and formal changes. This change and configuration process must take into account the processes of, and communication with, both internal teams and external partners. A technology architecture that supports change and configuration management through automated workflows is essential when changes originate from both internal and external sources.

In the case of the PTC customer that we've been following throughout this paper, this crane manufacturer was able to follow these same guidelines to rationalize, organize, and synchronize its many disparate product development processes, to streamline design collaboration, and ultimately to gain the benefits of working with a lower-cost European partner.

These improvements were supported both by existing technology and by new, strategic software implementations. By evaluating all seven tips and then making necessary incremental changes, any organization can see dramatic improvements in the effectiveness of their global design collaboration.

3311-IGC-WP-0308