# *Enabling Globalization with PLM*

## *GM's Homeroom Support of Global Product Development*

PLM Integration/Product Definition

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## CPDA: Collaborative Product Development Associates, LLC

CPDA's Product Lifecycle Management (PLM) research programs target the critical decisions in Product Lifecycle Management challenging Design, Engineering, Manufacturing, and Information Technology managers and executives. CPDA's PLM collaborative research programs provide in-depth analysis of strategies, products, issues, processes, technologies, trends, case studies, and surveys for assessing technology, business goals and objectives, and implementation road maps.

The cohesive suite of collaborative programs clarifies and evaluates new capabilities, standards for frameworks, and development issues; it highlights the most advanced uses of leading technologies, and it links the technical effort to the realization of business value. The four collaborative research programs include:

**Design Creation and Validation*:*** A bottom-up view of engineering requirements from the desktop across the enterprise. Advanced computer-aided design (CAD), engineering analysis, manufacturing technologies, collaboration, and visualization software serve as springboards for gaining a competitive advantage. The Design Creation and Validation service applies CPDA's structured methodology to the evaluation of new products and processes as well as to current projects in client organizations. A critical focus, the emerging technology of knowledge engineering with templates and rule-based architectures focuses on delivering the needed tools into the hands of product developers to capture knowledge, and to formalize its use. The use of direct geometry access and manipulation, data translation technology, XML alternatives, and JT options are also assessed for their ability to deliver interoperability across the diverse and disparate business and technical applications.

**Design/Simulation Council*:*** The Council promotes a standard framework employing common terminology to integrate and optimize the diverse and divergent specialist activities currently fragmenting design efforts. CAE must fully integrate with design, up front, to close the chasm between design and analysis. Analysts must actively participate continuously in design decisions and enter the mainstream. The impending breakthrough in CAE will rest on knowledge reuse, process capture, and streamlining.

**PLM Integration / Product Definition:** A top-down view provides a conceptual framework for collaboration across different product development perspectives, bridging customer needs, systems engineering and tradeoffs, design solutions, and fulfillment and manufacturing. Integration and interoperability in complex PLM environments pose substantial hurdles. The rapid transition to cross-enterprise collaboration, at all levels of design and supply, intensifies the pressure on existing, inwardly focused IT architectures to support and enable new modes of doing business.

**Product Value Management:** Common processes for design, development, and product introduction across the supply chain may be validated with reference models such as SCOR (Supply Chain Operational Reference model), or VCOR (Value Chain Operational Reference model). The first step, business process modeling (BPM), facilitates the building of consensus around a common understanding and terminology, across organizations and functional silos. Mapping BPM to a service-oriented architecture based on open standards represents a critical second step. An IT integration infrastructure in a Federated Enterprise Reference Architecture™ (FERA) supports a loose coupling between enterprises extending across the supply chain.

Collaborative Product Development Associates was formed by the PLM research team of D.H. Brown Associates, Inc. (DHBA).

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## *GM's Homeroom Support of Global Product Development*

*Michel Vrinat, PLM Research Director;*
*D.H. Brown, Chairman, CPDA*

## EXECUTIVE SUMMARY

A major opportunity and massive challenge facing nearly all industries in most countries, globalization for the automotive sector represents an especially high priority, with China alone expected by some executives to represent roughly half of the incremental worldwide growth in demand for cars over the next six years. Yet broad surveys across industry report that few companies have gained significant benefits, and over a half dozen companies reported mixed results in interviews by CPDA with executives across the automotive and trucking sectors.

A major standout, GM's grid – or decentralized – approach to globalization has scored major wins in both Korea and China over the latest decade. By 2007, China represented GM's second largest market worldwide. Even more noteworthy, a dramatic turnaround had been established in Korea with GM Daewoo shipping 1.8 million units in the latest year, up from 250,000-300,000 in 2002 when GM formed the group.

GM's decentralized grid strategy directly targets the diversity of global requirements, and represents a much higher challenge than just replicating homegrown models anywhere possible. The first objective concentrates on recruiting the best skills on a global basis, on finding talented people in every country around the world.

To gain these benefits, the "homeroom" concept distributes control for design and development across the globe, while establishing a standardized platform design and reconciling all regional variants. Specific geographic areas often present specialized skills that can be leveraged worldwide. Each center owns a particular expertise and maintains the standards governing the product, its variants, and the processes involved in designing and manufacturing the platform. For example, GMDAT in Korea became the homeroom globally for small cars, owning the expertise and design approaches.

For designers and engineers as distributed team members to effectively operate within a homeroom, they must all collaborate with the same data in real time. All

those associated with product development must be connected in real time to the standards that form the backbone of the collaborative effort.

PLM represents a key enabler for global product development and support. The management of a common definition of the product goals and strategies, with a single source of product data, represents a base requirement. Without a standard product definition supported in PLM, it would be impossible to manage and synchronize design efforts spread across multiple sites worldwide in different time zones.

In the face of multiple and complex global challenges, GM has established several critical efforts to drive their globalization effort – system standardization, modularization and product standardization, common processes, and the reconciliation of multiple views across disciplines. These four global enablers will continue to be instrumental in GM's continuing success in driving globalization.

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## GLOBALIZATION: THE NEED FOR A GLOBAL PRODUCT DEVELOPMENT STRATEGY

Over the latest decade, globalization has become a major opportunity and massive challenge facing nearly all industries in most countries. The Asian drive in particular, led by China and India, dramatizes the pressure to address global issues. A recent survey of over a thousand executives worldwide reported that nearly 70% rate global social, environmental, and business trends as increasingly important to corporate strategy. "Yet relatively few companies act on the global trend they think will affect them most; among those that do act, only 17% report significant benefits." [i] Those challenges are fully reflected in over a half-dozen interviews CPDA completed with executives across the automotive and trucking sectors.

Globalization for the automotive sector in particular, represents a very high priority, with China alone expected by some executives to represent roughly half of the incremental worldwide growth in demand for cars over the next six years. Yet the major automotive OEMs to date apply divergent strategies worldwide. Some emphasize the ability to sell standard products in multiple markets and regions. Others concentrate on the ability to coordinate and manage a standard development process for multiple design organizations, dispersed across the globe to better serve regional consumer preferences. With the increasing importance of globalization of the supply chains, the rising complexity of products, and intensifying competition, the ability to manage a truly global development program has surfaced as a critical competitive strategy for large companies.

At the same time, PLM represents a critical cornerstone of any global strategy for product development in terms of supporting a common design model to be shared across all development groups. Indeed, the companies contacted to discuss globalization were adamant in rating PLM as central to their global development and support strategy. Several stated that without PLM, there would be no way to get the job done.

## DIFFERENT APPROACHES TO SUCCESSFULLY MANAGE GLOBAL INITIATIVES

While many struggle in establishing a successful global strategy, the top two automotive OEMs have successfully driven divergent approaches that have both supported major growth initiatives.

Toyota relies on a "centralized hub and spoke" strategy with global platforms developed primarily in Japan, and local engineering for relatively minor adaptation to regional customer preferences in remote areas. For example, Toyota does not

support the design of any core platforms in Detroit, but only changes for the U.S. market. All design emanates from Toyota City. Toyota pursues an organic growth strategy that to date has successfully addressed two challenges. First, it has demonstrated the ability to scale global operations fast enough to date to preserve standards and practices that are proven and validated in Japan, and then extended to multiple regions. Quality issues over the latest two years, however, suggest that the ongoing challenge to Toyota is rising given its now-massive scale. Second, the centralization to date has maintained the flexibility to respond fast enough to regional consumer preferences even though Toyota strategy begins in Japan, and then is enforced worldwide from Japan. In its favor, Toyota's intense concentration on its employees as its primary assets contributes to a bottom-up approach that fosters change and responsiveness and extends to a careful consideration of regional demands.

GM's contrasting grid – or decentralized – approach has scored major wins in both Korea and China over the latest decade. Chairman Jack Smith initiated the effort with plans as early as 1993 for three Chinese car plants, able to make up to a million vehicles a year.[ii] Jim Queen accelerated the effort three years ago with a global engineering program based on "homerooms" that lead standardized product development efforts worldwide, while reconciling local adaptations to meet regional and local requirements.

By 2007, China represented GM's second largest market worldwide, and a dramatic turnaround had been established in Korea. With China expected to capture half of the market growth through the year 2012, GM's global momentum may "reshape the competitive landscape."[iii] In the latest year, Asia Pacific increased 15.1% in terms of production units, and accounted for 15.3% of GM's worldwide total; Latin America and Mexico rose 19.4%, contributing to 13.2% of the total. Clearly, GM's successful global drive offsets some of the continuing pressures the company faces in its domestic U.S. markets, which have historically involved high health care costs, challenging union demands, and competition subsidized by an artificially low Yen exchange rate.

The most dramatic success, however, relates to a startling turnaround for GM Daewoo Auto & Technology Company (GMDAT), formerly Daewoo Motor. Once a part of South Korea's family-run Daewoo Group, GM took a major stake in the automotive company following persistent financial woes for the parent Daewoo Heavy Industries, which put Daewoo Motor up for sale. In 2002 when GM formed the new group, Daewoo shipped 250,000-300,000 vehicles. In the latest year, GM Daewoo shipped 1.8 million units. Moreover, GMDAT is now GM's center of excellence for small car architectures.

## GLOBAL DESIGN/GLOBAL ARCHITECTURES TARGETING REGIONAL NEEDS

A car company must fulfill the consumer's expectations, habits, and tastes with the hope of "delighting" the customer. To do so, companies have to rely on people to assess and interpret local needs, in turn raising the challenge of communications across different languages. GM's decentralized grid strategy directly targets the diversity of global requirements, and represents a much higher challenge than just replicating homegrown models anywhere possible.

Maryann Combs, President Asia Pacific Engineering at GM, suggests that a global development effort offers major wins in cost and quality,

> with the ability to share so we do not have to recreate parts and assemblies involving minor-league differences. A huge benefit flows from sharing architectural products worldwide and making minor changes regionally to get more products into newer emerging markets more quickly. There are challenges, but if everyone can access the same information and reference earlier work, then you do not have to repeat the efforts to meet quality targets starting from scratch with each new design. We need to take advantage of the best skills on a global basis, with talented and skilled people in every country around the world. We need to tap into that expertise, and leverage it.

Terry Kline, Process Information Officer, Global Product Development IS&S, concurs:

> We have a shortage of engineers in the world, and some regions have unique skills in engineering. How do we find great engineers and leverage them as a company, to work collaboratively regardless of where they live on the planet? The day where they sat a couple of hundred miles away from each other are over; they may live in x, y, or z. The challenge is finding the best talent in the world to work on our products.


*FIGURE 1*
*Global Architecture Development Teams: Architecture Development Teams (ADT) & Global Design Centers (GDC) Drive to Commonality & Architecture Compliance*

*Courtesy GM IS&S*

To gain these benefits, the homeroom concept distributes control for design and development across the globe, while establishing a standardized platform design and reconciling all regional variants. The homeroom approach focuses on finding great engineers as the best talent available to work collaboratively from anywhere in the world. Specific geographic areas often present specialized skills that can be leveraged worldwide. Each center owns a particular expertise and maintains the standards governing the product, its variants, and the processes involved in designing and manufacturing the platform.

GMDAT in Korea became the homeroom globally for small cars, owning the expertise and design approaches. North America owns high performance cars, such as the Corvette. Australia holds responsibility for rear-wheel drive and the Camaro, while Germany concentrates on mid-size vehicles such as the Epsilon, Opel Vectra, Chevy Malibu, and compact Astra. Brazil develops small trucks. PATAC out of Shanghai is developing a new vehicle for GM in China that may be considered for the worldwide market.

For designers and engineers as distributed team members to effectively operate within a homeroom, they must all collaborate with the same data in real time. Everyone worldwide involved with the platform and its variants must share the product data on a real-time basis. Individual engineers may access the designs developed by the experts in any area. They may apply the same solution, or develop a version to meet regional needs when the effort is justified and the approach can be reconciled to the global standard. Clearly, all those associated with product development must be connected in real time to the standards forming the backbone of the collaborative effort.

## PLM FOR A GLOBAL PRODUCT DEFINITION

PLM represents a key enabler for global product development and support. The management of a common definition of the product goals and strategies, with a single source of product data, represents a base requirement. Without a standard product definition supported in PLM, it would be impossible to manage and synchronize design efforts spread across multiple sites worldwide in different time zones. It would be even more difficult to maintain a high level of collaboration or agreement on the common parts and standards required to support re-use given the barriers created by language differences worldwide.

"PLM is absolutely critical. It's hard enough just developing vehicles in any one region, but consider the challenge multiplied around the globe with different time zones and languages. Our engineering effort must have one master set of data." concludes Steven Clarke, Vice President of Engineering, GMDAT in Korea.

Clearly, PLM plays a major role in synchronizing the efforts worldwide that support systems that make it appear as if the developers are in the same building. The system must provide real-time collaboration extending beyond geometry to directly cover common functional decompositions and physical 3D digital representations. Parts must be managed in the context of their configuration.

Particularly daunting, the system must scale to a huge number of users while simultaneously covering an unusually broad scope of data. GM synchronizes on the order of 30,000 CAD files or 70 Gigabytes of data every day, across 26 design centers in 16 countries around the world. It cannot be done without PLM. Companies cannot afford to encounter delays updating designers in the U.S. on efforts taking place in Australia. Moreover, the sites served extend to a broad list of suppliers and partners, with many posing unique challenges for integration – particularly in the early phases in developing the worldwide network. Many companies synchronize at night, but real global design capability requires real-time communication.

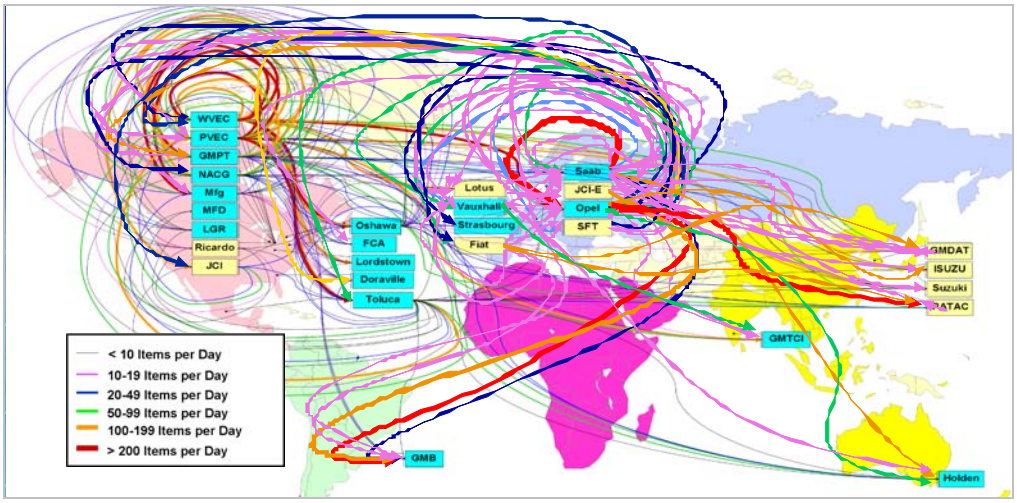


*FIGURE 2*
*Today, TcAE Manages and Synchronizes Product Math Data between GM's Global Engineering Centers and JV Locations. Shown: Data Synchronization from GM North America & GM European Sites to GM North America, Latin America, GM Europe, and GM Asia-Pacific Sites*

*Courtesy GM IS&S*

Especially important, PLM directly supports the standardization of components and sub-systems, by managing a standard parts library to avoid duplicating simple components. The approach not only cuts redesign costs and reduces purchasing overhead, but it helps to identify complex parts and sub-systems that match new platform requirements, to fully leverage the design and validation effort. The payoff not only cuts cost and cycle time, but significantly increases the quality of the products by capitalizing on established engineering expertise, and incorporating the feedback from manufacturing and support that has resolved design issues in earlier efforts. Resources may then concentrate on enhancing existing designs, or turn to new designs addressing different needs.

"A single gold source of data is definitely core to our strategy. Now, take it one step further. A particular commodity is owned by an individual team. A BOM is owned by an individual and a buyer so there is one engineer and one buyer globally that owns the BOM. If you want to change any aspect, these BOM owners have to approve it," states Terry Kline.

The benefits compound with the extension of standardization to apply to best practices and methods. The design and validation processes can be captured in templates or workflows that facilitate the engineering ramp-up in any design effort, and reduce the impact of variation from both the design and development efforts and from manufacturing.

PLM also helps promote a common language worldwide, aided by visualization. The system harmonizes the definition of the product in the terminology, and readily supports a standardized tool set. A standard functional and physical product structure can be defined and shared across sites and platforms, using a semantically consistent list of items. Everyone then talks the same language in terms of the definition of the product.

## THE CHALLENGES OF GLOBALIZATION

### CULTURAL DIVERSITY

For GM, the primary challenges of a geographically distributed organization relate to cultural diversity and regional preferences. Designers from a regional market can understand the local needs and voice the requirements. A world car does not work; it compromises rather than meets the world's diverse requirements. Coordinating the separate regions within one organization, and meeting their regional needs, while simultaneously promoting standard platforms and processes supported by a common language and shared data references, requires time and energy. The company has a long history of working worldwide, but the real challenge in globalization was addressing cultural and language issues. The choice of the best process to standardize with multiple approaches available has been a particular issue.

The head of product development in China worked with the Chinese for six years, and then lived there for another year. The first objective was to learn to understand and respect cultural differences, and only then to address the business aspects. It is important to manage not only the money side but also the day-to-day relationships. As an example, outside the U.S. it becomes particularly important to take the time to let others think and respond, at their own pace, and to avoid a quick and immediate reaction. Those in the U.S. and Germany may openly speak their mind, which presents an unusual concept to many engineers in China and Korea. There, engineers need to listen, think, and process what they have heard. Many partners outside the U.S. also accord a high priority to relationships and trust, and rate the details of any business deal and negotiations as far less important. That differs markedly from the approach in the U.S. where executives often jump to the business issues first and foremost.

Only one approach seems to resolve the challenges of cultural diversity – the time and commitment of those involved. Personal, face-to-face interaction is needed. Indeed, Terry Kline reported that he spent 80% of his time on the road internationally for GM for several years to support the global IT effort.

### MEETING AND RECONCILING MULTIPLE NEEDS

To develop a product with global market reach, variants to meet local needs must be managed and leveraged. Customer needs must be clearly recognized and addressed in the development process. PLM helps manage and reconcile all these different views, identifying what can be common and what has to be different. It supports the full definition and management of a common platform that feeds variants.

Getting everyone to share a common understanding once the terminology is established presents a major challenge because everyone has their own reference point. Time, energy, and hard work are required to support a common understanding, which entails a huge effort in global training. Then, there is a major transformation to manage the effort in the face of multiple languages and potentially conflicting cultures, across geographies and disciplines, across physical distances and different time zones.

Finally, trade-related investment measures such as local content requirements and foreign exchange balances must be addressed, as well as local regulatory requirements governing environmental, safety, and other concerns.

### BUSINESS RISKS

GM's efforts in Asia also involve business risks. For example, IP protection has traditionally represented a major issue in China. Recently, however, the Chinese themselves have begun to recognize the importance of protecting their own IP. That is a significant change from only a few years ago, and as Asia develops as a market, several of these risks may dissipate.

### LOCAL SUPPLIERS

From GM's perspective, the large global partners share a similar understanding of global requirements and organizational approaches, but smaller suppliers may typically fulfill local needs without understanding the need to adopt the standards. Ten years ago, localization sufficed, but not any more. The ability to share data and processes has become a necessity, and a challenge does arise in encouraging smaller suppliers to meet the needs.

## GLOBAL ENABLERS

In the face of multiple and complex global challenges, GM has established several critical efforts to drive their globalization effort.

### SYSTEM STANDARDIZATION

GM has clearly emphasized standardization, including a common tool set with the same version of the same software. For code updates, or block-points, GM upgrades around the globe, involving twenty-six sites in sixteen countries, in two weekends, to keep all sites on the same version of code. This includes integrations with over a hundred applications, extending to office functions, deployed worldwide. The approach is also being extended to testing and proving grounds. Any engineer traveling to any development facility worldwide will find the same tool set.

### MODULARIZATION AND PRODUCT STANDARDIZATION

Product modularization and standardization is necessary to take full advantage of the globalization by promoting common commodity components across all platforms. The standardization around common models for development can take different forms and target multiple objectives. The reuse of standard parts reduces redundant efforts for similar designs and cuts development costs. The reuse of best practices and pre-validated parts or sub-systems helps to ensure high quality.

 

Moreover, the definition of best practices in and of itself establishes a baseline to promote continuous improvement on a global basis. With standardization, design times may be slashed through parallel resource assignment with global 24/7 work schedules. Purchasing may be streamlined and volume discounts negotiated for the standardized parts or sub-systems. Collaboration improves dramatically with the development and adoption of a common terminology.

GM has standardized its system design and breakdown into sub-systems. Any of the major systems that do not affect appearance such as braking or safety are standardized. Most of the parts and systems that are not visible are standardized. The architecture team relies on the PLM system to share the architecture and product definition worldwide.

### COMMON PROCESSES

Supporting common processes, such as automated change management for rapid and predictable design iterations, represents a major requirement for globalization that has yet to be fully realized. GM values the process harmonization, following the motto, "If the process is not the same around the globe, the results will not be the same." Because the same tool can be used so differently, specific approaches on the way to create the math data need to be defined and shared. This is a continuing effort that extends well beyond the creation of CAD data, to address the need for the global standardization of approaches for both simulation and test. Everybody working in the company in a product development function anywhere in the world needs to buy in and agree to the process.

### RECONCILIATION OF MULTIPLE VIEWS ACROSS DISCIPLINES

The reconciliation of multiple views of the product structure across multiple disciplines, with different levels of abstraction and detail, also presents a key ingredient for integration. GM rates the reconciliation of multiple views and their quick assembly for a digital review as absolute requirements, as already supported by PLM solutions today. The digital mockups must be visualized without involving ambiguity by all required participants worldwide. The approach must address not only the master standardized configuration, but any and all variants that must be validated. The PLM system must also validate the information needed, in context, and in a form that is directly usable by the participants. The company has an established master data repository for design describing the geometry and performance that is shared worldwide. The manufacturing tooling design is completed based on the same data, including any simulation of the plant or stamping dies. Product simulation of vehicle performance also relies on the same base of data.

These four global enablers – system standardization, modularization and product standardization, common processes, and the reconciliation of multiple views across disciplines – will continue to be critical for GM to continue its successful drive in globalization. In turn, the PLM infrastructure provides the required tools to accomplish each of those efforts operationally, on a daily basis across the globe.

[i] *How Companies Act on Global Trends: A McKinsey Global Survey. The McKinsey Quarterly* conducted the survey in March 2008 and received 1,306 responses from a worldwide representative sample of business executives, 41% of whom are CEOs, other C-level executives, or board directors.

[ii] Close to bankruptcy with $4.5 billion in losses in 1991 and a staggering $23 billion loss in 1992, as the new chairman, Jack Smith began the process of standardizing development and design behind a centralized strategy board to manage a centralized and streamlined product plan and development process that replaced competing divisions. *The China Dream: The Quest for the Last Great Untapped Market on Earth*, Joe Studwell (Grove Press, 2002), 85.

[iii] Presentation by Michael DiGiovanni, Executive Director, Global Marketing & Industry Analysis, General Motors Corporation, SAE World Congress 2008, April 17, 2008.

 