PRODUCT LIFECYCLE MANAGEMENT ENABLES GLOBAL NETWORK INNOVATION

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ABSTRACT

In today's environment of increasing global competition, manufacturers have realized that they have to synchronize and optimize their global operations in order to better position themselves for profitable growth. The manufactures need a set of applications that directly support the collaborative creation, management, and dissemination of product definition and production processes throughout the manufacturing enterprise and across the product lifecycle.

Traditional product authoring and testing applications like CAD/CAM/CAE and singular IT initiatives, such as Enterprise Resource Planning (ERP), Supply Change Management (SCM) and Customer Relationship Management (CRM) are not sufficiently because they are adopted to wring surplus cost out of the operational side of the business. These initiatives often have a limited focus and could not been able to increase a company's revenues, to foster innovation at every stage or control expenses associated with managing the products across their active lifespan.

From the manufactures perspective the challenge is to find a holistic solution to support the broad scope of the product lifecycle with all steps from creating, planning, production and maintain process. These needs have given rise to the expansion of the role of **P**roduct **L**ifecycle **M**anagement. PLM is an integrated, information-driven strategy which speeds the innovation and launch of successful products. It's built on common access to a single repository of all product-related knowledge, data and processes and offers unprecedented capabilities to global teams by bridging siloed departments and systems and providing global network innovation for collaboration.

This paper takes a look how manufactures can used effectively PLM technology to create their own Global Network Innovation along the way of the global product development process.

Keywords: Product Lifecycle Management, global network innovation

1   INTRODUCTION

Today's the manufactures have to operate in a dynamic, global environment which increased dramatically across every industry. Business conditions shift in an instant. Customers are more demanding and diverse. Industry and government regulations change constantly. Competition appear overnight through mergers, new business models or new innovations.

In these highly competitive global markets, the manufacturers must generate growth through continuous innovation around their products. That requires the manufacturers has to improve dramatically their ability to manage their resources and processes to develop, manufacture and support them.

Over the past years the manufactures have made substantial investments in their IT infrastructure including packaged enterprise applications such as ERP, CRM, SCM, etc. and legacy systems. These IT systems often have formed islands of information due their evolution and implementation. That means the knowledge is isolated/encapsulated by the geographical, technological and organizational boundaries that divide the major domains in the companies product lifecycle process. In consequences

of this the intellectual assets are often trapped within these boundaries like ERP, SCM and CRM systems [1]. The result is that the information is scattered across these singular domain focused IT systems.

Meanwhile the manufactures understand, that their most valuable asset is not their inventory of components, parts, and products, but rather the collective knowledge of their extended enterprise - the intellectual capital and experiences conglomerated from their own organizations, as well as from suppliers, partners and customers [2]. Furthermore the collective knowledge present all information from the entire value chain and the ability to efficiently manage the product lifecycle process – from initial requirements planning to product definition, production, distribution, maintenance and repair, retirement and recycling and furthermore the involvement of strategic partners, key suppliers and customers. The companies understand that they have to collate and leverage information, they have to provide an environment for the creation and management of information for the product and production processes, integrating the product design elements with business systems, manufacturing, and factory floor production systems.

This has given rise to the expansion of the role of PLM applications (beyond the traditional product authoring and testing applications e.g. CAD/CAM/CAE) to transform the process of innovation.

2 PRODUCT LIFECYCLE MANAGEMENT PROVIDES A PLATTFORM FOR A GLOBAL INNOVATION NETWORK

### 2.1 Overview PLM Strategy / Technology

PLM is an enterprise strategy built on common access to a single repository of all knowledge, data and processes related to the products.

As a business strategy, it lets distributed organizations innovate, develop, support and retire products as a single company. PLM is focuses on driving top-line revenue from a repeatable innovation process [3]. It captures best practices in products, processes and intellectual capital for re-use.

As an information technology strategy, PLM builds a coherent data structure that enables real-time virtual collaboration and data sharing among geographically distributed teams. It lets companies consolidate systems while leveraging existing investments during their live. Through open APIs and adherence to industry standards, it minimizes data translation issues while providing information access to those who need it at every stage of the product's life. PLM provides visibility into workflows and dependencies critical to management decision-making at all stages of the product lifecycle.

- PLM is an integrated, information-driven approach to all aspects of a product's life - from its design inception through its manufacture, deployment and maintenance, culminating in its removal from service and final disposal that addresses this end-to-end process from a holistic perspective [4].
- PLM provides an environment for the creation and management of digital information for the product and production processes, integrating the product design elements with business systems, manufacturing, and factory floor production systems.
- PLM is built on common access to a single repository of all product-related knowledge, data and processes. It is enables a company to capture all of the product knowledge and leverage it in seamlessly integrated lifecycle processes to improve the efficiency of the product lifecycle.
- PLM represents a set of applications/solutions that directly support the collaborative creation, management, and dissemination of product definition and production processes throughout the manufacturing enterprise and across the product lifecycle [5].
- PLM enables a company to capture all of the product knowledge and leverage it in seamlessly integrated lifecycle processes that improve the efficiency of the product lifecycle from start to finish.

PLM based on information, integration and collaboration and is fundamental to build a solid foundation for future. The PLM strategy unites multiple constituencies including engineering, manufacturing, marketing, packaging, training and support through an open yet secure digital environment, see figures 1.
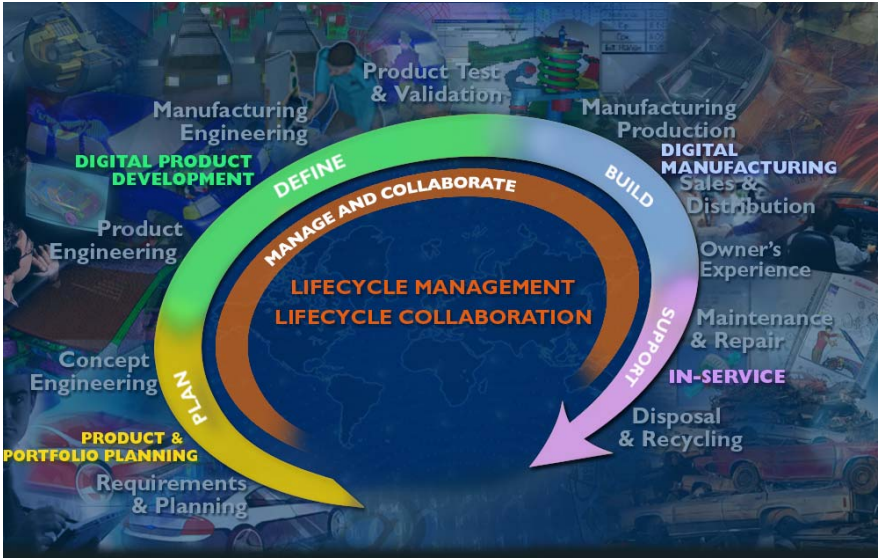

Figures 1, Product Lifecycle Management/Collaboration

In particular, companies can tailor their PLM environment to address:

- Digital product development enables a holistic approach to new product development and introduction that stresses knowledge capture and re-use in a managed development environment. Visibility into information, programs and processes leads to greater flexibility, responsiveness and efficiency along with improved product performance and quality.
- Digital manufacturing combines knowledge management with process improvement in a virtual environment that lets companies optimize the quality, process, plant, resource and simulation aspects of their manufacturing operations. Improved collaboration and control of manufacturing operations ensures the economic success of innovative product designs.
- Digital lifecycle management enables the world's biggest organizations to engage all parts of their business in the introduction of successful new products. Integrated idea capture and management, real-time conferencing and project and portfolio management tools are combined with industry-leading product design and development solutions in a single, shared source of product and process knowledge.

2.2 PLM Business Aims

PLM involves data from many siloed databases and people from different business functions, often in different organizations around the world. It provides a vehicle to establish coherent, repeatable functions and processes as well as consistent and accurate information over the life of the product – from ideation to retirement. By establishing a single system of record, PLM makes it possible to compare, balance and optimize disparate product requirements, directly linking performance and manufacturing considerations with design intent. It digitally connects customer, marketing and regulatory requirements to designs, documents, specifications, models, test results and other types of product information that are required at different stages of the lifecycle. PLM should address the company needs, see figures 2.
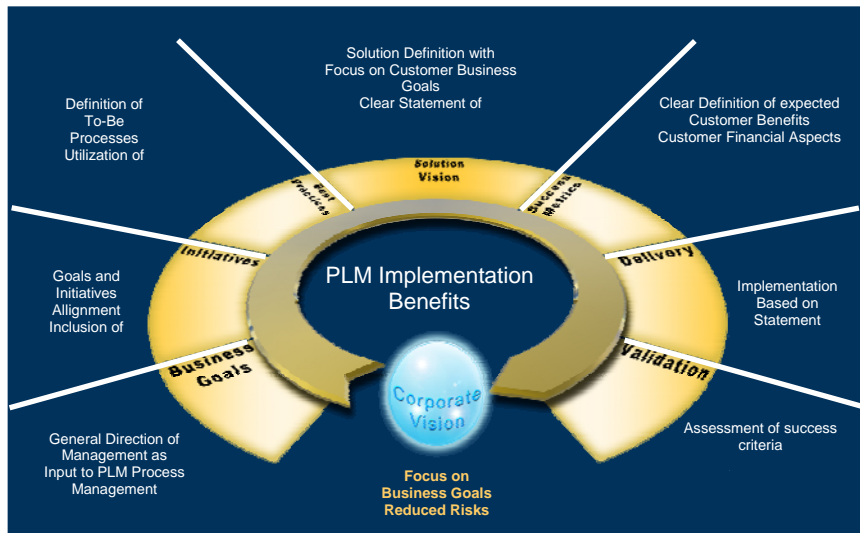
Figures 2, PLM Implementation Benefits

PLM business aims are:

- Optimize information reuse through interconnection of all product information - including parts information, bills of information, requirements, specifications, and even schematics, software, and maintenance manuals - and connect the enterprise systems which drives the business

- Optimizing resources to increase efficiency, facilitate collaborative efforts and exploit extended product team creativity with improved information access and enhanced coordination/communication processes

- Increasing the yield on product and process innovations through enhanced information processes. The users of the system can view and analyze the same basic data from multiple perspectives based on their business needs

- Compressing time-to-market with automated and accelerated product lifecycle processes to ready products for market such as review cycles, configuration management, and change processes

- Addressing dynamic business constraints and regulatory requirements with considering of industry standards like ISO, FDA or others in ways that reduce costs

3   GLOBAL NETWORK INNOVATION

3.1   Network Innovation aims

Global Network Innovation represents a transformative business model built on collaboration that fosters innovation at every stage of the product lifecycle and every level of the value chain. It should unite global partners, suppliers and customers through a shared base of product/process knowledge. By allowing distributed value chains to innovate as a single enterprise, these global network drive today's crucial business imperatives while the company could integrate their value chains - customers, strategic partners, and suppliers - to leverage their expertise, market knowledge and available resources, see figures 3.
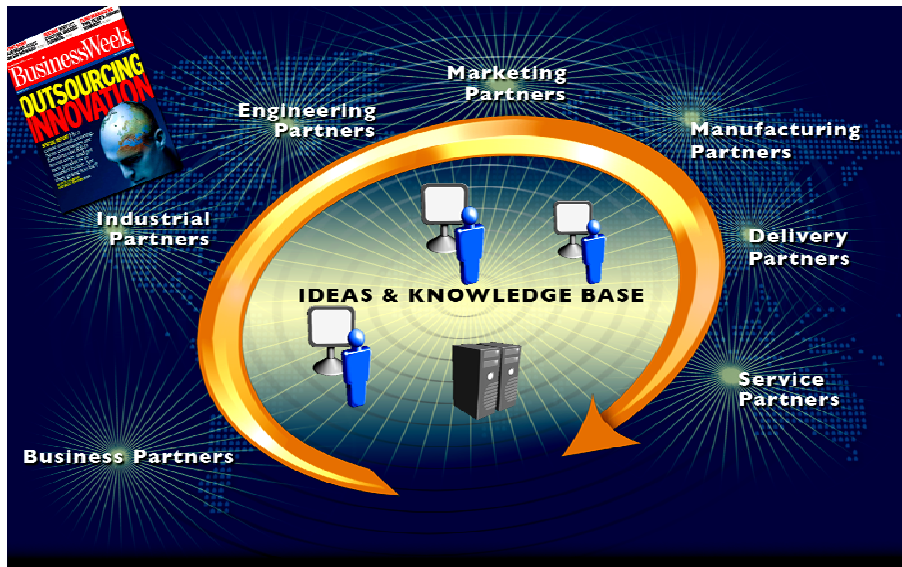
Figure 3, Global Network Innovation

Today's most forward-thinking companies are building Global Network Innovation that let them continuously improve their products and processes - and organize their value chain so that innovation can flourish. Global Network Innovation fields:

- *Increasing the yield of innovation*
  By enabling the companiy value chain to view new product ideas and validate them against customer, engineering, and manufacturability requirements, Global Network Innovation accelerate the entire process of innovation and expand the innovation capacity.
- *Compressing time to market*
  Global Network Innovation provide project and portfolio management tools that the company can use to manage program performance against measurable goals and determine whether their processes, designs and/or suppliers are working effectively.
- *Optimizing resources*
  By maximizing the company ability to re-use the ideas, processes, resources, skills, designs, parts, documents and sourcing relationships that differentiate the company, Global Network Innovation enable companies to cost effectively respond to rising customer demands.
- *Meeting business and regulatory requirements*
  By incorporating compliance as an integral process in the company product lifecycle, Global Network Innovation provide a cost effective solution that the company can use to mitigate the risk associated with non-compliant products.
- *Maximizing globalization advantages*
  By uniting the participants in the company distributed value chain at every level, Global Network Innovation allow the company to "design anywhere, build anywhere, and support anywhere."

As an integrated, information-driven approach to managing all aspects of the product lifecycle, product lifecycle management is at the core of a "design – build – support anywhere" strategy that leverages a collaborative network to accelerate invention-to-innovation cycles. A comprehensive digital product platform offers unprecedented capabilities to global teams by bridging siloed departments and systems and providing a virtual environment for collaboration. Recent research shows that the source of innovation increasingly lies outside traditional boundaries. According to a Forrester survey of manufacturers worldwide, "20 percent of them now source half of their inventions externally, while another 20 percent license their innovations to other firms" [6].

Innovation is not simply one item on a checklist of requirements. Ideally, it is a process that becomes standard practice, and it must be supported by implementing the right technologies. Fortunately there are incremental steps that provide substantial rewards along the way.

Through a series of critical initiatives, key business requirements – innovate more, move faster, be compliant, get optimized, go global – can be systematically enabled. Each initiative gives manufacturers the opportunity to establish the PLM framework, best practices and product related data that will form the core of their Global Network Innovation. Key investment initiatives enable product-centric innovation in any industry.

3.2   Building-up of global network innovation abilities

The following eight topics explain the business challenges and rewards that can accrue from each company. Manufacturers should start their journey toward establishing a Global Network Innovation by addressing the area that is most critical to their business in the near term [7]. Ultimately, they will achieve the full benefit of PLM through the combined power of implementing all these initiatives:

1. New product development and introduction

The future of a company is dependent on the successful launch of new innovative products and services. While a majority of executives rank new product development among their top priorities, less than 20 percent view their own IT organizations as innovative. To reduce development time for demand-driven innovation, a number of companies are re-examining product development's traditional linear flow from design through manufacturing and sales. The current process is far too slow, even in industries with a reputation for quick response.

The new product development initiative creates a real-time, global, collaborative environment for product development that integrates people, processes and systems. It links the functional execution and management of product programs through simulation, design, validation and manufacture [8]. As a result, critical paths, key dependencies and leverage points are outlined early and acted upon quickly. The best ideas are tested and validated against market opportunities.

> ➢ *Design, simulate, validate and manufacture innovative products by establishing real-time, global collaboration among people and processes in R&D, product planning, sourcing, development and launch.*

2. Knowledge & IP Management

Knowledge Management investment initiatives represent some of the best paths to quickly and efficiently accelerate the companie´s business growth and evolve their innovation abilities.
To truly embrace new and innovative ideas from multiple sources, companies must gather and make available relevant product and process knowledge from and to key constituents. Knowledge and IP management empowers decision-makers by enabling the exchange of accurate and timely information with the right people – from ideation, engineering and design through specification and requirements, sourcing, manufacturing, production, sales and service. The result is improved product development productivity and collaboration, plus accelerated throughput. Product quality is improved by re-using knowledge contained within the enterprise and among strategic partners.

Corporate knowledge and intellectual capital are competitive weapons and strategic assets for innovation. Through Knowledge and IP Management initiatives, companies expand their innovation capability by capturing, sharing, managing, protecting and reusing their proprietary knowledge about products, processes, customers, and competitors [9]. Using the unique corporate knowledge to automate lifecycle processes dramatically accelerates time to market, ensures the consistent application and re-use of company best practices, and improves product quality [10]. Through

effective capture and re-use, manufacturers can optimize returns on their knowledge assets, and protect intellectual property in global network of partners and suppliers.

> *Continually improve product and process development by capturing and automating the knowledge of your expert employees.*

3. Enterprise data management

Organizations generate an abundance of product data throughout the product lifecycle critical for decision making, business system data exchange, and various product efforts. This data often resides in formats and locations that inhibit collaboration and the ability to keep this data current, meaningful and accessible. Effective enterprise data management breaks down barriers between siloed systems and departments, ensuring that the right people receive timely and accurate answers every time [11]. Physical and intellectual assets can be leveraged more effectively to increase product competitiveness.

This initiative opens up silos of information and provides a secure, single point of reference for product and process knowledge. All authorized personnel get fast access to the information they need and are able to share product knowledge with team members no matter where they are located. To facilitate and improve decision-making, critical data is matched with other relevant information throughout the product lifecycle.
Enterprise Data Management is the core of an affective PLM solution that ensures organizations can establish, optimize, and execute from a single source of product data and processes that will support innovation and collaboration across all elements of the value chain.

> *Leverage physical and intellectual assets for greater competitiveness by managing and providing secure access to critical product and process data over the life of the product.*

4. Communization & re-use

Increase the innovation capacity of a company for new product introductions by getting maximum value out of existing components and processes. Be able to re-use information on an ad hoc basis and as part of a proactive strategy focused on communizing platforms, standardizing parts and designing modular systems.

Today's leading manufacturing companies are focused on achieving proactive communization of product portfolios, efficient capture and preparation of reusable content for down stream re-use, productive access to globally distributed information, and synchronized re-use across the extended enterprise. Many manufacturers are finding that communization and re-use gives them the ability to reduce costs, improve quality and bring products to market at a faster pace with few recalls. It allows parts libraries to be quickly searched by engineers, enabling them to make minor changes as needed to fit new product designs and then automatically test them for manufacturability, quality and other key requirements. [12]. By making key data readily available for communization and re-use, companies maximize their ability to apply best practices to the development of new parts. Bad product ideas are quickly eliminated. Efficiencies are created in design, manufacturing, testing and compliance. Existing strengths in parts, assemblies, equipment and processes are all leveraged to the highest degree. Manufacturing processes are automatically modified and revalidated.

> *Create efficiencies and foster best practices in engineering, manufacturing, purchasing, sourcing, marketing and support by re-using proven parts, assemblies, equipment and processes.*

5. Value Chain Synchronization

Companies must commercialize more innovative products, in less time, to appeal to new and growing markets all over the world. Successful companies are turning to their supply chains, aligning the procurement activities more closely with design, early enough to have an impact. By automating sourcing processes, they have more time to focus on strategic Supplier Relationship Management (SRM) that helps to produce more innovative products [13].

Innovators do not perceive their supply chains as being passively connected, but rather as strategic tools whose power can be harnessed to reduce costs while improving product quality and innovation. Those on the leading edge of innovation talk about implementing a demand driven supply chain with seamless PLM processes tightly integrated.

Value chain synchronization establishes the basis for a design anywhere, build anywhere global strategy. It helps companies gain the needed visibility to collaborate across the value chain. Engineering and procurement are integrated with suppliers. Design data is synchronized with workflow-driven processes. And manufacturing processes are aligned and simulation results are shared with OEMs. The exchange of knowledge and information is enhanced at every link in the value chain so that the best ideas, assemblies, parts and process data are readily shared. Efficiency is maximized so companies can improve processes, slash costs and respond quickly to demand.

> ➢ *Respond effectively to global demand by optimizing the exchange of ideas as well as product and process information among all players at every stage of the value chain.*

6. Regulatory compliance

By establishing an enterprise-wide digital PLM environment for collaboration and innovation, companies can manage their product-related information more cost-effectively across the value chain and throughout the product lifecycle. Effectively managing the business processes impacted by compliance legislation is imperative to avoiding negative impact to revenue. The implementation of a compliance strategy in an organization maximizes the visibility of compliance information to all stages of the product lifecycle and thus minimizes the risk and cost associated with non-compliance.

Many compliance initiatives focus on auditing and traceability but fall short of including product lifecycle management (PLM) as an essential part of their compliance strategy. Compliance starts early in the innovation process as teams define both product and process capabilities. PLM ensures that repeatable processes with phased-gated sign-offs are in place to enable traceability that can be checked throughout the innovation through manufacturing process. PLM also plays a significant role in the identification of product capabilities which are predetermined by regulatory governance. With PLM solution, companies can create a single product-centric system of record supporting environmental, safety, financial or governmental compliance. Identified product capabilities can be traced and managed throughout the innovation process, thereby ensuring that when a product comes to market it meets the regulatory requirements.

> ➢ *Mitigate risk and achieve compliance by ensuring adherence to environmental, safety, financial and governmental regulations early in the design cycle and by automating data collection and reporting.*

7. Production efficiency

Innovation success does not stop at product design but encompasses every stage of the product lifecycle. Innovation efforts that end at product design risk failure when it comes to commercialization. Without a comprehensive innovation program that includes manufacturing, companies risk delayed market delivery, unanticipated costs, and loss of revenue opportunities. Production efficiency drives innovation success and accelerates product delivery to market by

eliminating wasteful processes and non-value iterations during the manufacturing stage. Production efficiency promotes more efficient collaboration and informed decision-making. It results in the creation of manufacturing best practices that deliver production flexibility, high performance and superior quality. Through a complete digital manufacturing environment manufacturers quickly identify the best strategies for boosting productivity and lowering cost [14]. It also includes capturing and managing all plant, process, product and manufacturing resources. Interconnecting design with manufacturing engineering creates robust work instructions and share-as-built data. Seamless interconnection with multiple manufacturing and support subsystems is a key success factor.

> ➢ *Increase production flexibility, performance and quality by integrating product design with process design and production information in manufacturing best practices.*

8. Systems engineering and mechatronics

Systems engineering and mechatronics establish an integrated approach to the design of products that includes complex components, subsystems or computer controlled electromechanical systems. Advanced PLM systems with mechatronics capabilities can model and analyze interactions among the requirements, subsystems, constraints and components of complex products that can include mechanical, electrical and software elements. Mechatronics products combines mechanical, electronic, electrical and software technologies by creating, capturing and delivering a systems perspective in an open product lifecycle management solution. The innovation affects the entire product lifecycle, beginning with systems engineering capabilities to design the product's integrated software and electro-mechanical subsystems. The mechatronics product requirements are communicated through all lifecycle processes, including development, manufacturing and support, to guide decision-making and resolve integration issues consistent with the product's strategic intent.

These systems allow engineers to rapidly model and evaluate design alternatives to ensure that products are right the first time. Real-time decision-making takes place in the context of customer needs and traceability is supported throughout the life of the product.

> ➢ *Improve the customer's value experience and accelerate time-to-market by optimizing product performance, integration, quality and reliability through the visual analysis of interdependent mechanical, electrical and software subsystems, constraints and components*

4   SUMMARY

PLM technology drive the effectiveness of global partner, supplier and customer relationships, the productivity and agility of customer innovation cycles and the efficiency of product launch and market uptake. As result PLM technology acts as a multiplier that delivers huge dividends and supports the company effectively to move forward strategically while achieving near- and long term results.

This paper displayed the PLM Environment and key PLM initiatives for building up global innovation networking abilities with a significant impact. It is no question that growth will come from more innovative, successful products and processes. Manufacturers, who are open to non-traditional sources of new ideas and which have create a culture and an environment for continual innovation will transform their business and achieve these goals.

The key to have success in the PLM environment are the employees with their know-ledge in a company. Global Network Innovation are all about shared knowledge. So no one is left out of the innovation process. Because to compete in an outsourced world, no company can afford to take the chance that the best idea isn't heard and shared. Ensuring this level of collaboration is at the core of a true Global Network Innovation with PLM Technology.

ABOUT SIEMENS UGS PLM SOFTWARE

UGS PLM Software, a division of Siemens Automation and Drives (A&D), is recognized as a leading global provider of effective product lifecycle management (PLM) software and services with 4.4 million licensed seats and 47,000 customers worldwide. Headquartered in Plano,Texas.

UGS PLM Software's vision is to enable a world where organizations and their partners collaborate through global network innovation to deliver world-class products and services while leveraging UGS PLM Software's open enterprise solutions, fulfilling the mission of enabling them to transform their process of innovation.

For more information on UGS PLM Software products and services, visit www.siemens.com/ugs.

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