



## **Integrating Simulation into the Enterprise**

*A new approach called Enterprise Simulation Management (ESM) helps integrate product-related simulation activities into the enterprise and enable the capture and reuse of knowledge gained in this critical area – knowledge that is generally lost at most companies. In this way, simulation can be broadened from a domain exclusively for specialists and transformed into a visible and accessible component of the product development process, across the full product lifecycle and throughout the extended enterprise.*

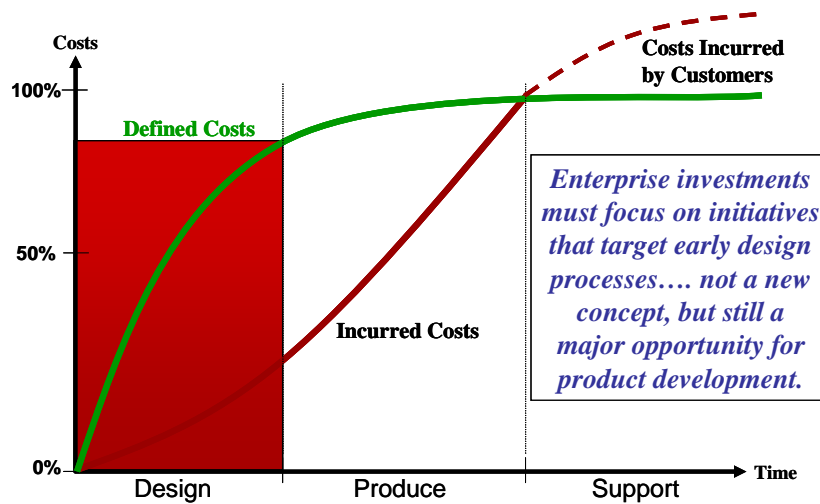
**By Ed Miller**  
**President, CIMdata, Inc.**

Manufacturers around the world are challenged to improve productivity, lower costs, compress delivery times, and enhance product quality. To be successful, companies must be innovative; both with innovative products and with innovative processes that enable more effective business operations and customer service. Thus, companies are looking at processes throughout their organizations that offer opportunities for improvement, especially many long-term processes that have been primarily focused on limited areas of the business and have not yet been effectively integrated into the full enterprise.

Over the past several years, the use of engineering simulation and analysis has become an indispensable part of product development. Technologies such as structural analysis, multi-body simulation, and computational fluid dynamics let engineers quickly and cost-effectively investigate “what-if” scenarios, explore new ideas, evaluate alternatives, and gain deeper insight into product behavior. In this way, simulation and analysis tools are powerful enablers for developing innovative products and processes.

### **Obstacles to Overcome**

Unfortunately, simulation and analysis has long been an area that is neither well understood by, nor utilized effectively by the rest of the organization. Moreover, simulation-related processes are often not as effective as they could be. At many companies, simulation and analysis is handled in a time-consuming serial manner and often not completed until designs are nearly finalized the late stages of development when the time and cost of changing the design is exponentially greater than in the early conceptual phases, as shown in Figure 1.



**Figure 1—Early Decisions Drive Product Costs**

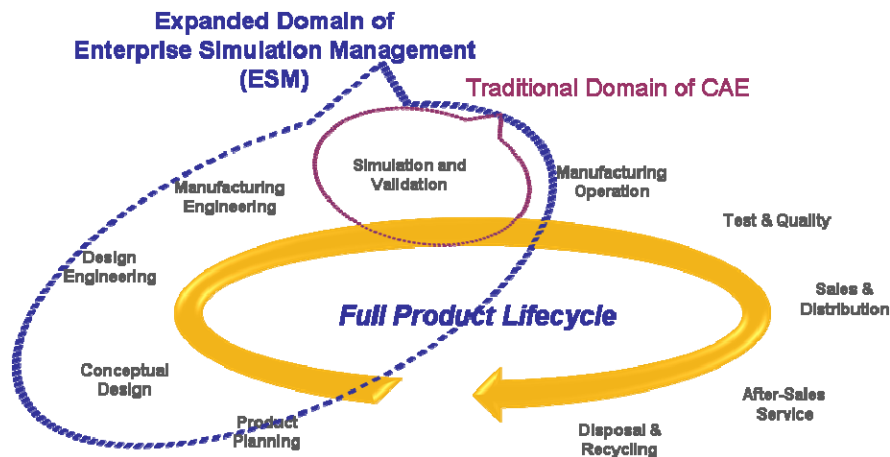
Most companies have no formal system in place for properly archiving and managing information relating to how problems were set up, which analysis software was used, which analyses were executed, what decisions were made, who made approvals, when changes were made, and so forth. As a result, this valuable intellectual capital is often discarded, lost in disorganized filing systems, or stored only in the recollections of a few individuals. Without this information, no audit trail exists documenting the way that work was performed and procedures are not recorded, forcing engineers and analysts to waste time re-inventing the same process over and over. Problems with inefficiency and inconsistency are magnified when people in different locations work on the same simulation projects with no system for exchanging analysis data or standardizing work processes.

## **Bringing Simulation to the Enterprise**

These limitations are addressed by a philosophy of Enterprise Simulation Management (ESM), an overall approach intended to enable simulation and analysis to become more broadly integrated into the product development processes and data more readily accessible across the enterprise. ESM's primary components include:

- ***Knowledge capture and replication***—enable simulation-based process knowledge to be captured, shared, reused, continuously improved, and utilized by a range of individuals across the enterprise.
- ***Integrated simulation management***—bring both information and process management science to an area previously often managed as an “art,” and integrate it with the rest of the enterprise.

The domain of ESM across the broad product lifecycle is illustrated in Figure 2, illustrating the greatly-expanded breadth of an ESM approach versus the more restrictive scope (and business impact) of traditional Computer Aided Engineering (CAE) environments.



**Figure 2—Expanding Domain of Simulation/Analysis—ESM**

Because it spans the full product lifecycle and has the potential to touch a wide range of disciplines, ESM can become a fundamental component of a company’s strategy for Product Lifecycle Management (PLM), an overall enterprise-based initiative to tackle product and product-related process improvement. PLM is a strategic business approach in which companies apply a consistent set of business solutions in support of the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise from concept to end of life—integrating people, processes, business systems, and information. PLM forms the product information backbone for a company and its extended enterprise.

### **Market Situation and Issues**

As the ESM opportunity has developed and become more visible and demanded by industrial companies, suppliers of technologies and services have worked to provide solutions to the market. Several companies are working to provide a wide variety of solutions that fit within the framework of ESM. Some suppliers are targeting broad-based offerings while others are focusing on particular aspects of ESM.

Since ESM is a fundamental component of full PLM strategies, it is not surprising that the major suppliers of broad comprehensive PLM solutions are interested in and are targeting ESM. Their current offerings typically include enterprise lifecycle process management facilities and they position their ESM offerings as utilizing and fitting within these process management environments.

Traditional suppliers of broad-based simulation and analysis offerings are also keenly interested in ESM and are striving to satisfy market demand. They are well positioned to address knowledge capture and reuse within simulation and analysis activities, as well as development of simulation-focused information management capabilities that can be integrated into broader PLM environments.

### **Initial and Long-Term Improvements with ESM**

An ESM approach provides companies with an opportunity for both substantial initial improvements in business performance and ongoing continuous improvement. Early gains derive from improved efficiencies and integrity of activities resulting from information management technologies and processes. Major longer-term gains come from the ability to capture unique company best practices and then enable continuous improvement through additional experience, enable consistent repeatability, and

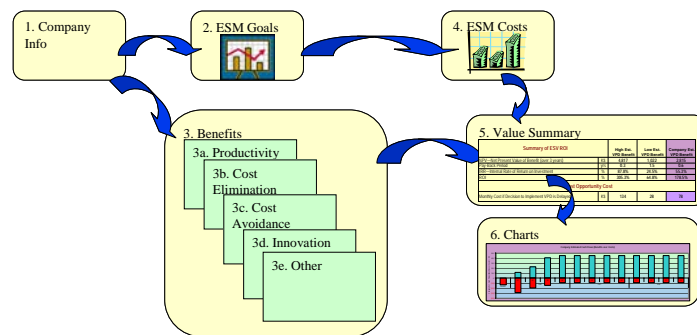
make these practices usable when appropriate by “less expert” individuals throughout the product lifecycle.

In an ESM-enabled environment, the capture of knowledge and best practices becomes pervasive and useful throughout the extended enterprise. Experts develop their practices and the environment provides a mechanism to capture both these practices and the results of the simulation analyses. Once these are captured, they are made available to be utilized by anyone in the organization capable of gaining value from them.

The ability to more broadly utilize simulation capabilities and enable non-experts to benefit from expert practices provides many positive benefits, including elimination of barriers between various groups and enabling more informed decisions and a more collaborative engineering enterprise.

### Business Impact and Value

The central role of ESM in product development opens the way to a number of positive impacts on the financial health of organizations that embrace ESM’s capabilities. Benefits can accrue from ESM in two broad categories: business value enhancements and product development cost savings. As illustrated in Figure 3, these further break down into sub-areas of benefit.



**Figure 3—An ESM Benefits Analysis Methodology**

Business value enhancements generally provide large – but often difficult to measure—benefits resulting in overall revenue increases from tenths of a percent to single-digit percentages. Opportunities for business value enhancement can be identified in several areas:

- Improve design quality by supporting the use of simulation and analysis technologies and capabilities much more broadly across the product lifecycle; early in the cycle as well as downstream in production, maintenance and service, and other areas
- Improve product designs and speed development by expanding the number and types of people who can use simulation and analysis technologies, processes, and knowledge
- Promote innovation and enable continuous improvement by capturing, continuously refining, and applying knowledge to increase revenue through increased efficiency and improvements in bidding
- Decrease time-to-market by integrating simulation and analysis earlier into the development process
- Increase new products per year by enabling faster development of products
- Improve collaboration and faster time to production because people in non-analysis areas can “see,” use, and react to simulation results

Product development cost savings are much more direct and easily measured. Experience with users in an ESM environment shows that these savings can be estimated for many areas, some of which are:

- Reduced costs, by up to ninety percent, of executing simulations through lower efforts for data acquisition, model creation, pre-processing, solving, post-processing, reporting, and simulation data and process management
- Reduced cost for managing third-party analysts through better management and coordination of their work
- Increased analysis model re-use can reduce cost by up to sixty percent
- Reduced costs, by up to forty percent, for prototyping and testing through lower numbers and costs for prototypes and tests
- Lower simulation technology budgets by up to forty percent through consolidation of simulation tools and techniques
- Lower re-work costs due to performing analyses earlier in the lifecycle and providing results earlier to designers

A clear evaluation of ESM's impact on, and value to, an enterprise can be determined quantitatively. For example, CIMdata has developed a Benefits Analysis and return on investment (ROI) methodology and supporting tool to achieve this analysis. The essential concept is that benefits in many areas described above can be quantified. When combined with information about licensing and implementing ESM, it is a straightforward process to create a multi-year ROI that can be used to help management understand the value of ESM as well as to provide a mechanism to monitor its ongoing success and impact on the organization.

## **Moving Toward Simulation-Based Design**

The transition of the area of simulation and analysis from having a few passionate advocates and a select set of highly-trained specialist users to an enterprise-focused ESM environment is just beginning, with many changes yet to be seen in many companies. The theme of product development will be "simulation-driven design," reflecting the evolution to virtual simulation environments that encompass both the physical aspects of the product as well as the end-users' experience of using the product.

Detailed analysis and multi-physics/multi-discipline capabilities will continue to be enhanced, but these capabilities will provide even more value as they are made available more broadly through "packaged" services that capture best practices so that they can be used by non-experts, especially early in the product development process. Simulation and analysis will become a fundamental part of the conceptual design process, not a validation phase that occurs after a significant level of design is completed, even though ever more detailed analyses will be performed throughout the development lifecycle.

Simulation capabilities will eventually become available much more broadly throughout a company, from purchasing, to sales, to many others as they are enabled to utilize them to make more informed and confident decisions. The business will benefit and be able to respond faster to customer requests while also improving design variation predictability, leading to more accurate quotations and higher profitability.

As ESM is more broadly adopted as an enterprise strategy, industry will gain more experience and additional advances will be made in both technologies and practices to most effectively take advantage of these continued advances. This will result in yet more value to companies that adopt ESM. Because of the overall value and benefits for the larger enterprise, investments in ESM are anticipated to be one

of the highest-priority and fastest-growing areas within the broad field of PLM over the coming years as leading companies seek to take advantage of it to improve their ability to compete successfully.

## **About PLM**

CIMdata defines PLM as a strategic business approach that applies a consistent set of business solutions in support of the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise from concept to end of life—integrating people, processes, business systems, and information. PLM forms the product information backbone for a company and its extended enterprise.

## **About CIMdata**

CIMdata, an independent worldwide firm, provides strategic consulting to maximize an enterprise's ability to design and deliver innovative products and services through the application of Product Lifecycle Management (PLM) solutions. Since its founding more than 25 years ago, CIMdata has delivered world-class knowledge, expertise, and best-practice methods on PLM solutions. These solutions incorporate both business processes and a wide-ranging set of PLM enabling technologies.

CIMdata works with both industrial organizations and suppliers of technologies and services seeking competitive advantage in the global economy. In addition to consulting, CIMdata conducts research, provides PLM-focused subscription services, and produces several commercial publications. The company also provides industry education through international conferences. CIMdata serves clients worldwide from locations in North America, Europe, and Asia Pacific.

To learn more about CIMdata's services, visit our website at [www.CIMdata.com](http://www.CIMdata.com) or contact CIMdata at: 3909 Research Park Drive, Ann Arbor, MI 48108, USA. Tel: +1 (734) 668-9922. Fax: +1 (734) 668-1957, or Siriusdreef 17-27, 2132 WT Hoofddorp, The Netherlands. Tel: +31 (0)23 568-9385. Fax: +31 (0)23 568-9111.

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*Ed Miller president of CIMdata, is an internationally recognized authority on PLM and a frequent keynote speaker at conferences and seminars around the world on trends, directions, strategies, methods, and technology issues. He welcomes reader comments and can be reached at [e.miller@CIMdata.com](mailto:e.miller@CIMdata.com).*