

# Simultaneous Product Development: The Move from Serial Collaboration to Parallel Co-Development

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**Abstract:** This paper discusses foundation of the next generation of CAD systems, focusing on technology for simultaneous product development.

**Key words:** Simultaneous product development, Design collaboration, Functional modelling.

## 1. EVOLUTION OF DESIGN COLLABORATION

Companies that design and manufacture world-class products have always sought out better ways to improve communication during product development. Current trends in manufacturing toward global supply chains, extended enterprises, and virtual teams have only intensified the need for a strategic approach to information sharing.

Interest in collaborative product development began to gather momentum in the 1980s with industry initiatives in concurrent engineering and simultaneous engineering. Over the next several years, as workstation and networking technology became more sophisticated and powerful, software tools evolved to help companies implement electronic collaboration among local and remote team members. Even with rapid increases in CPU speed and capacity, however, the sheer size and complexity of most digital product models greatly limited the extent to which engineers could collaborate directly with the rest of the development team.

This picture changed in the mid- to late 1990s as modeling software vendors began to incorporate Internet technology into their product offerings. Web browsers could now deliver lightweight “views” of a digital model. The term *web collaboration* was coined as a catch-all to describe

many different kinds of activities that a product development team might engage in when sharing ideas, such as online viewing and markup, automated workflow and email notifications, interactive design reviews, and the like.

Web collaboration tools represent movement forward, but they fall short for companies that wish to implement a strategy for developing products in Internet time.

Manufacturers are increasingly decentralized. Strategic partnerships and virtual corporations are commonplace. In supply chains, OEMs delegate more design responsibility to subcontractors. Product development teams are no longer made up exclusively of designers and engineers but include representatives from manufacturing, industrial design, and other disciplines. Distributed teams collaborate throughout the product life cycle, defining configurations and making engineering changes from the conceptual stages of design until the time when the product is no longer in service.

ImpactXoft responds to the demand in the design and manufacturing community for tools that enable dispersed multidisciplinary product development teams to work more quickly and more efficiently. Design collaboration is now a business driver.

## 2. THE NEXT STEP: SIMULTANEOUS PRODUCT DEVELOPMENT

Simultaneous Product Development, or SPD, is a method of design collaboration in which members of the entire global development chain work in parallel, synchronously or asynchronously, to create and finalize product definitions. *Simultaneous* means *at the same time*. Companies that practice Simultaneous Product Development achieve the closest possible collaboration between designers and the rest of the development chain.

Simultaneous Product Development shifts the paradigm for collaborative product design. Up to now, collaborative practices have been serial and alternating, not parallel and simultaneous. In serial collaboration, copies of digital product files are passed back and forth like a baton among development team members who must wait to get the baton back before they can make or even suggest design refinements. View-and-markup sessions bog down while MODELING specialists incorporate changes and regenerate a separate master model. Days and weeks pass as a design progresses serially along these steps in the development life cycle.

ImpactXoft has created the IX SPeeD Suite™ of software expressly to support the practice of *Simultaneous* Product Development. The software opens the full functionality of digital modeling to any participant in the development process. All the specialists in product development, regardless

of location or role, can work together simultaneously in order to define and correct design intent.

### **3. KEY TECHNOLOGY SERVES AS THE FOUNDATION FOR SIMULTANEOUS PRODUCT DEVELOPMENT**

Three interdependent ImpactXoft technologies underlie the IX SPeeD Suite. These technologies make Simultaneous Product Development possible:

*IX Functional Modeling™*. Described in further detail later, it is a unique approach to modeling that lets designers focus on the required functionality of the product instead of the details of geometry creation. As a result, technical and non-technical members of the development team can easily refine product definitions.

*IX Functional Object Representation™ (FOR)*. Described in further detail later, it is an ingenious solution to the problem of sharing over the Internet the large digital files typical of digital models. Rather than simplify product models to reduce their size, and thus eliminate important details, FOR technology captures the inherent properties of each design element and their place and purpose within a model. The FOR for each digital model is expressed as a small bundle of intelligent data. It is used as the vehicle for communicating design information and instructions over connections even lower than 28.8 kbps.

*IX Design Intent Merge™ (DIM)*. Using this DIM technology, the FOR bundle provided by functional modeling is communicated among project members and merged on their respective desktops to instantly integrate the changes on the fully functional model.

ImpactXoft's Functional Object Representation and Design Intent Merge lighten the process of electronic collaboration. These two technologies depend on the simplified approach to building geometry that is inherent to Functional Modeling.

#### **4. FUNCTIONAL MODELING TECHNOLOGY ANSWERS THE NEED FOR A NEW APPROACH TO DESIGN AUTHORING**

ImpactXoft's invention of Functional Modeling began with a long look at current modeling tools in the context of intensified calls for supply chain collaboration. The conclusion was undeniable: many modeling systems represent the principal bottleneck to collaboration between engineering and the rest of the product development team. In order for companies to implement productive strategies for collaborative product development, design authoring itself had to change.

ImpactXoft's Functional Modeling is the technology that allows engineers to design more in accordance with the way they think – that is, to add features to parts and to build models intuitively, without having to satisfy the constraints of geometric or history-based modeling systems.

Design authoring tools have always catered to mathematicians. Many engineers design for mathematical precision rather than the functionality of the end product. Due to the complicated mathematics of existing systems, a product's design can have flawless geometry but still be difficult or impossible to manufacture. The fundamental technology behind Functional Modeling solves this problem. ImpactXoft's modeling software incorporates advanced generative geometry which allows industry specialists to design with the functionality of the model in mind, thus liberating them from the oppression of geometric modeling.

Functional Modeling technology makes it possible for the system to automatically infer and maintain associative relationships between all design elements. There is no need to make or break parent-child relationships in order to move elements around within a design. If one element changes, any elements associated with it are automatically updated to maintain a fully functional model.

Since current modeling systems impose a modeling process based on an encumbering history tree, engineers and designers have a fundamental problem. The drawback of history-based modeling is that it limits creativity and productivity by placing strict rules on the order in which model elements can be implemented and changed. In order to change one model component, an engineer may have to backtrack through the model's entire history. Too often they find themselves navigating and rearranging model history trees instead of concentrating on design intent.

Functional modeling is a breakthrough when it comes to history independence and makes it easy to edit, manipulate and change a design, no matter what stage it is in. Engineers can use the tool intuitively and apply modeling operations where and when they desire. Because Functional Modeling is history independent, designers can implement and change

design elements at any stage in the model life cycle, regardless of the order of operation. Rather than spending time devising system workarounds, engineers can focus on fulfilling their vision for the end product.

A key component of ImpactXoft's Functional Modeling approach is its introduction of behavioral features. Each of these features embodies a specific behavior with various options. To apply a feature is to apply an element with a unique behavior while leaving the system to create the resulting geometry. With this approach, engineers can use the feature they need without worrying about how it was constructed. The modeling process is streamlined, and the end product is a design based on the specific behaviors of the parts.

Without the unique aspects of Functional Modeling, Simultaneous Product Development could never exist. It is the fundamental way that models are created that enables a new method of collaboration.

## **5. SIMULTANEOUS PRODUCT DEVELOPMENT BENEFITS COMPANIES THAT DESIGN AND MANUFACTURE PRODUCTS**

Because SPD simplifies the design process and promotes early collaboration, it boosts products through the development cycle and saves companies time and money.

SPD also simplifies the modeling process by building a collaboration bridge to the engineering "island." Design activities today are often complicated by the fact that engineers work in software systems that are isolated from the rest of the development team. Engineering organizations have long understood that early and ongoing feedback about requirements, manufacturing, testing, service, and so on results in better and more cost effective product models. However, hard-to-use modeling software has traditionally prevented manufacturers, suppliers, marketers, and other development team members from providing feedback at vital decision-making moments during the product modeling phase. Costly engineering change orders and late-stage design changes stall product releases and are a constant problem in the development chain.

Simultaneous Product Development minimizes expensive late-stage design revisions because the entire development team is continually engaged in a product's definition. Manufacturers, suppliers, and even customers are equipped with easy-to-use modeling tools and can evaluate and make changes to the product design. Complete input in the early stages of design can greatly reduce the amount of time and cost it takes to bring products to market. Shedding one or two weeks from the development cycle saves manufacturing companies millions of dollars.

ImpactXoft's tools for SPD open the door to the engineering realm by providing a means for fast, efficient, and complete collaboration. Because ImpactXoft's authoring tool simplifies the design process and reduces the emphasis on geometry creation, even novices can easily revise the original model.

## 6. NEW OPTIONS FOR COMPANIES THAT WISH TO PRACTICE SIMULTANEOUS PRODUCT DEVELOPMENT

ImpactXoft is redefining the whole meaning of collaboration. As stated earlier, simultaneous means *at the same time*. Unless designers and other members of the development chain can work on the same digital model at the same time, their productivity is a fraction of what it could be. The IX SPeeD Suite fills that final gap in productivity by allowing project members around the globe to *simultaneously* revise the same model. Most importantly, team members are engaged in revising the actual geometry of the model, not performing mere redlining or markup.

The IX SPeeD Suite provides tools for two new modes of collaboration in Simultaneous Product Development:

In synchronous mode, project members work together on their own manifestations of the same model in real time, performing, sharing, and instantly merging their modeling operations.

In asynchronous mode, project members work on their own tasks offline and can share, receive, and merge modeling operations whenever they choose to go online.

These new options for design collaboration are made possible by the Internet-centric architecture of ImpactXoft's tools and the interplay of Functional Modeling, Functional Object Representation, and Design Intent Merge seminal technologies.

Each product specialist, regardless of location or role, is equipped with hands-on modeling software and can quickly define or correct the design intent represented in a digital model. Participants experience the design session as if they are all on the same computer, but with the advantage of being able to work on their own tasks. There is no need to wait for one person to finish a modeling operation before others can begin. There is no need to record multiple redline suggestions and then apply them to a master model. One project member can be adding ribs to a model at the same time someone else 3,000 miles away is working on the external shape of that very same model. They can both be online, working on the same file and receiving each other's updates, or they can both be offline and merge their updates when they choose.

Members of the development chain whose tasks directly affect design accuracy but who are not experts with design tools, now can have timely input into decisions. After learning some simple methods for manipulation and a few editing techniques, any development team member can make and communicate a valid contribution to a model.

## **7. THE FUTURE OF SIMULTANEOUS PRODUCT DEVELOPMENT**

Most current software for collaborative product development, including many varieties of modeling software, is geared toward serial collaboration. No matter how ingeniously these tools are retrofitted for the Internet, they will never surpass their original intent to support a slower, stepwise tradition in product development. The advantage of true parallel co-development will be realized as companies begin to utilize the next generation of technology. Conceived and developed expressly for the Internet, the IX SPeeD Suite breaks through the limitations of current design collaboration practices. The practice of Simultaneous Product Development, and new technologies for digital product modeling that enable this approach, will influence corporate strategies in the design and manufacturing companies of the future.