Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte
Band: 83 (1999)

Artikel: Virtual prototyping in the construction industry
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DOI: https://doi.org/10.5169/seals-62946

Virtual Prototyping in the Construction Industry

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Summary

The aim of virtual prototyping is to build a full virtual artifact in such a way that design and manufacturing problems are anticipated and discussed within a cooperative work environment This paper presents virtual prototyping as the most adequate technology for the construction industry in the next decade.

Keywords: CAD, virtual prototyping, integrated design

1. Introduction

Virtual prototypes (*i.e.* complete 3D models) have been using in the mechanical industry for many years. Perhaps the most recent and impressive example is the Boeing 777 almost entirely represented by a 3D CAD model. Nevertheless, a virtual prototype is much more than a complete 3D model of the artifact. Virtual prototyping requires 3D models that are able of integrating several sectors of a company and demands high-end technology for virtual reality environments, virtual humans and distributed environments. Moreover, a virtual prototype works as a spatial database that can be queried by anyone in the enterprise through the computer network.

2. Virtual Prototyping

The objects of the virtual artifact have several types of attributes, such as geometric attributes, design intent attributes, manufacturing attributes, cost attributes, pointers to part numbers and documentation references. It is clear from Fig. 1 that the virtual prototype is distributed over several networks with different platforms, operating systems and design teams.

Virtual prototyping should consider geometry buses and object-distributed computing. A Geometry Bus allows designers to use different CAD programs in the network. ACIS [1] and CORBA have been proposed as a geometry bus and distributed object architecture for integrated CAD systems respectively [2].

Essentially, the Product Structure shown in Fig.1 is a collection of pointers to 3D models and 2D drawings. The data exchange format STEP can be used to present components as a text description or a 3D object. STEP files can be browsed in the intranet.

Virtual prototyping requires VR technology. Virtual Reality systems provide immersive environments where the user experiences a sense of immersion. This is the case of using a head-mounted display (HMD) or a BOOM (Binocular Omni-Orientation Monitor). Fig. 1 illustrates an immersive environment where a designer incorporates an avatar (*i.e.* a virtual copy of the user) using the system Jack for virtual humans. Designers can use virtual humans in a number of ways, such as: accident simulation, workplace assessment, human strength analysis, and check of maintenance procedures in areas of difficult access.

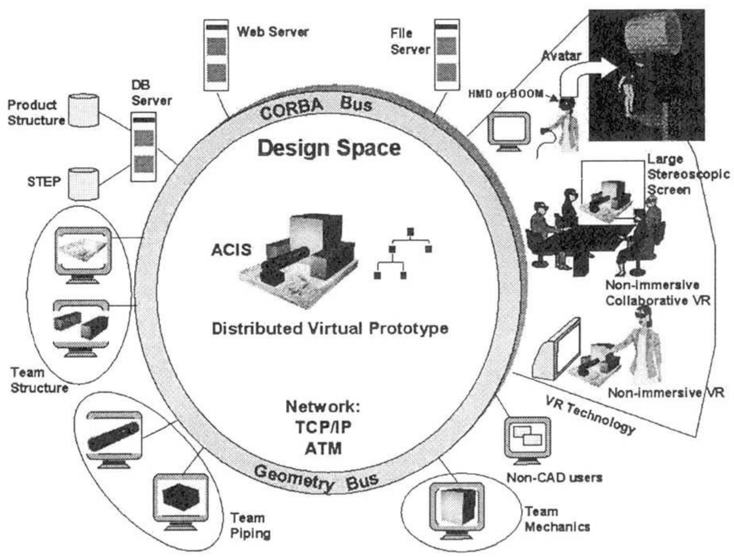

Fig. 1 Example of a distributed virtual prototype

A more rigorous definition of virtual environments and a practical guide for engineers who want to explore the possibilities of the VR technology can be found elsewhere [3].

3. Conclusions

The search for quality in structural engineering in the coming decade should consider its manifold activities, which are integrated amongst themselves, such as design, planning, construction, operation and maintenance. This integration should be considered during the design phase and the practice of virtual prototyping seems to be the most adequate approach to this question. Virtual prototypes also allow visibility to the public in real time through the internet – an important concern when environmental, social, human and aesthetic factors are critical.

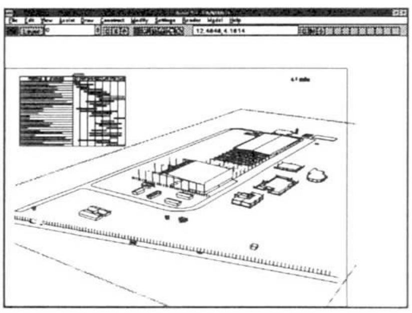

Fig. 2 Planning – 4th month

Several previous experiences by the authors support the recommendations presented in this paper. For instance, the authors had a stimulating experience with a large Brazilian construction company (CBPO), where they developed a computer system integrating 3D models with planning networks [4]. This system revealed more adequate construction methods for a factory of metallic cans and lead to a schedule two months shorter than the one obtained by the conventional planning methods, as shown in Fig. 2.

4. References

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