Product Data Interfaces in CAD/CAM Applications

Design, Implementation and Experiences

Edited by

J. Encarnação R. Schuster E. Vöge

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Preface

Interest in product data exchange and interfaces in the CAD/CAM area is steadily growing. The rapidly increasing graphics applications in engineering and science has led to a great variety of heterogeneous hardware and software products. This has become a major obstacle in the progress of systems integration. To improve this situation CAD/CAM users have called for specification and implementation of standardized product data interfaces.

These needs resulted in the definition of preliminary standards in this area. Since 1975 activities have been concentrated on developing standards for three major areas:

- computer graphics,
- sculptured surfaces, and
- data exchange for engineering drawings.

The Graphical Kernel System (GKS) has been accepted as an international standard for graphics programming in 1984, Y14.26M (IGES) was adopted as an American Standard in 1981 and the VDA Surface Interface (VDAFS) has been accepted by the German National Standardization Institute (DIN NAM 96.4).

Although considerable progress has been achieved, the complexity of the subject and the dynamics of the CAD/CAM-development still calls for more generality and compatibility of the interfaces. This has resulted in an international discussion on further improvements of the standards.

The major goal of this book is to bring together the different views and experiences in industry and university in the area of Product Data Interfaces, thereby contributing to the ongoing work in improving the state of the art.

The book contains papers presented in a seminar of the ZGDV (Zentrum für Graphische Datenverarbeitung) in cooperation with industry held at the Technical University Darmstadt from December 1984 to February 1985.

Chapter 1 focuses on the necessity of product data interfaces within the applications framework and on the basic methods of computer graphics. The entire scope of applications, especially in the automotive industry, is shown.

Design, implementation and experience of specific interfaces for graphic systems (GKS), product definition data, drawings and sculptured surfaces (IGES, VDAFS) are presented in Chaps. 2, 3 and 4. Special consideration has been given to VDAFS since a lot of work has been done in industry in this area.

The growing importance of specification and validation of software products supporting the interfacing process has to be acknowledged. Three contributions in Chap. 5 concentrate on this matter.

Chapter 6 contains an outlook on further developments in the area of product data interfaces.

The editors thank the authors for their valuable contributions which stem from their expertise and experience. Thanks also to the Technical University Darmstadt and to the Zentrum für Graphische Datenverarbeitung for their support, and especially to the manager of the ZGDV for the organization of the seminar from which this book resulted.

Darmstadt/München, May 1986

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Chapter 1

Introduction

Reference Models, Interfaces, Integration Issues

1.1 Goals in the Application of CAD Interfaces

E. Vöge

1.1.1 Global Objectives

1.1.1.1 Introduction

Within a few years of the Massachusetts Institute of Technology (MIT) introducing the concept CAD – Computer Aided Design – in the 1950s, a considerable range of diverse applications were being developed. These include not only applications in the representation and analysis of geometrical contexts (CAD), but also systems for calculation processes (CAE, mainly using the finite element method – FEM), systems for test automation (data acquisition of test systems in real time operation), and systems for computer aided manufacturing (CAM, e.g., automatically programmed tool – APT).

The main goals were the elaboration of basic concepts in the form of solutions to principles as well as the demonstration of technical feasibility. The application of computer assisted processes for the entire range of engineering problems was not the primary goal, although the significance of the integration of various systems for a complete computer assisted application was recognized very early.

If a resume of the work during the first ten years (1960–1970) is made, it may be said that the technical concepts developed at that time have proved operable for immediate application, and have laid the foundations for subsequent research work. At the same time, however, the tasks of

- systems integration,
- economy, and
- integration in management organisation

have still proven to be key problem areas to be rethought and solved. In this context, CAD interfaces assume a major significance in systems integration.

1.1.1.2 Ranges of Application for the CAD Interfaces

Figure 1.1.1 summarizes the tasks in engineering from the initial idea of a product to the commencement of its manufacture. Figure 1.1.2 shows a rough sketch of the more traditional course of development.

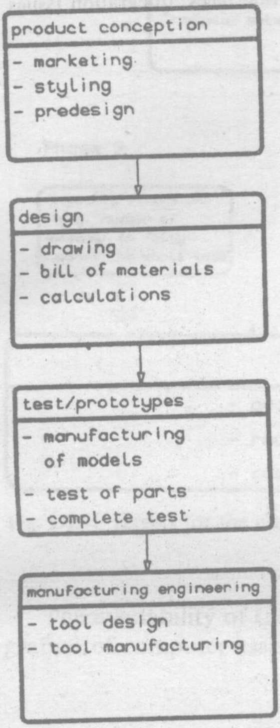

Fig. 1.1.1. Engineering tasks (without manufacturing and quality control)

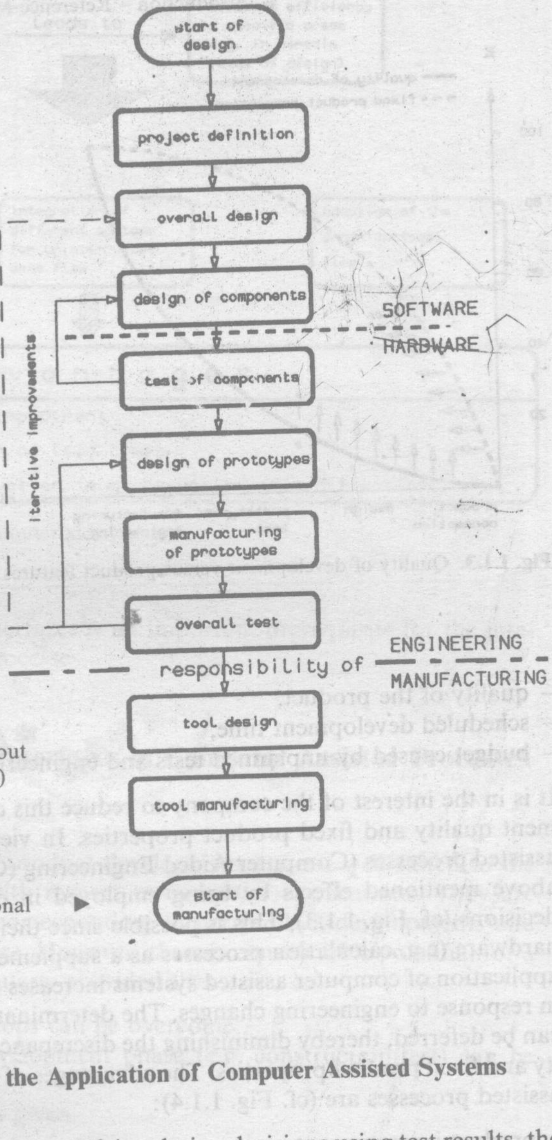

Fig. 1.1.2. Schema of the conventional design process

1.1.1.3 Global Objectives for the Application of Computer Assisted Systems and of CAD Interfaces

Figure 1.1.2 illustrates that, when verifying design decisions using test results, the development quality of the product can only be improved at the end of the scheduled development time in order to meet the original design goals. This correlation is shown qualitatively in Fig. 1.1.3 (lower line). If on the other hand, the fixed product properties resulting from design decisions are shown as a function of time (upper line), there is rather the opposite tendency.

First, many decisions are based on assumptions and experience which in the course of product development can turn out to be wrong, thereby negatively affecting the:

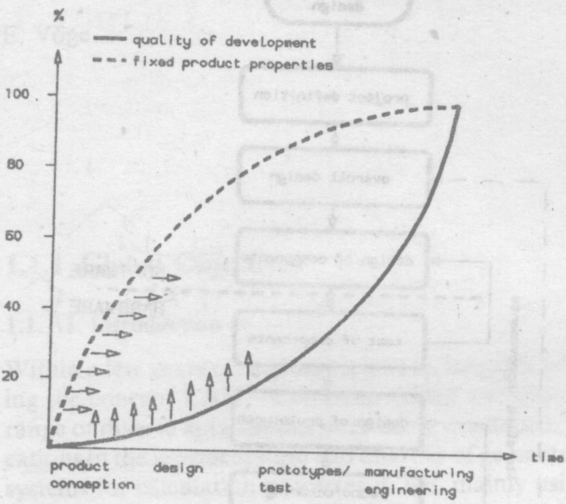

Fig. 1.1.3. Quality of development versus product features fixed

- quality of the product,
- scheduled development time,
- budget caused by unplanned tests and engineering changes.

It is in the interest of the company to reduce this discrepancy between development quality and fixed product properties. In view of this situation computer assisted processes (Computer Aided Engineering (CAE) systems) can reduce the above mentioned effects by being employed in early phases to verify design decisions (cf. Fig. 1.1.3). This is possible since their application requires no test hardware (e.g. calculation processes as a supplement to test processes, [1]). The application of computer assisted systems increases the flexibility of development in response to engineering changes. The determination of a product's properties can be deferred, thereby diminishing the discrepancy between development quality and fixed product properties. The advantages of the employment of computer assisted processes are (cf. Fig. 1.1.4):

- product improvement,
- reduced development time, and
- cost reduction caused by engineering changes.

These factors justify the high costs of computer assisted systems.

A quantification of these advantages is in most cases only partially possible, and only after having gained experience with the application of these systems.

The primary objective is therefore to clarify the above-mentioned decisive advantages and to establish an implementation strategy while simultaneously considering the integration problem within a complete chain of tasks (cf. Fig. 1.1.4).