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THE TASK OF STEP/PDM/SADT IN VIRTUAL ENTERPRISE MANAGEMENT

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Abstract: *Virtual Enterprise (VE) is a temporary alliance of enterprises that come together to share skills and resources in order to attend a business opportunity and whose cooperation is supported by computer network. STEP is a standard used in data transfer between these enterprises. SADT is a graphical representation and in a VE is used to elaborate diagrams to improve VE management and STEP performances. PDM can be defined as: electronic handling and control of product information throughout the whole product life cycle across system and organization boundaries by means of vaulting, workflow, and product structures. The goal of this paper is to elaborate the SADT diagrams for the product information and transfer used in VE.*

Key words: *virtual enterprise, STEP, PDM, SADT, data transfer, CAD/CAM.*

1. INTRODUCTION

Virtual Reality (VR) technology uses digital computers and other special hardware and software to generate a simulation of an alternate world that is believable as real by the user. Engineers have been using computers for years to create models of physical parts, devices and systems and simulate their operations, but the present CAD/CAM (Computer Aided Design / Computer Aided Manufacturing) systems lack the realism and interactive capability provided by an immersive VR environment [4].

The implementation of a supporting infrastructure for Virtual Enterprise (VE) can be based on a number of component technologies and paradigms [5]:

- Interoperability and integration of standards – STEP, EDI, TCP/IP, etc.
- Integration of Workflow Management Systems;
- Integration of advanced Information Management Systems – PDM.
- Integration of Safety and authentication mechanisms – digital signature, etc.
- Integration of MAS development environments;
- Integration of legacy systems – PPC/MRP, CAD, CAM, CAE, etc.
- Infrastructures – Internet/Intranet/Extranet, CORBA, Java, etc.

Virtual Enterprise challenges the way manufacturing systems are planned and managed. Shared virtual environments can allow engineers from different locations to work together and in the same time. These environments give engineers and designers a better understanding of the product, improve quality, reduce time to market and ensure that designs are right from the first time, reducing the need for expensive reworking later in the process. Collaboration can be extended outside a company by sharing virtual product information with suppliers and partners, creating a closer relationship in product development.

The biggest change in recent times for the CAD/CAM industry lies with the term "integration" Integration plays a very important role in the future of CAD/CAM products.

There have been big workstation-based integrated CAD/CAM systems around for many years. They provide CAD and CAM integration by providing all pieces from the same company. But now there is a new group of products touting integration as a key issue. They pursue integration through other means than single brand products [2].

2. TERMS PRESENTATION

2.1. Standard for the Representation and Exchange of Product Data – ISO 10303 - STEP

The ISO 10303 Standard for the Representation and Exchange of Product Data (STEP) provides the means to represent and exchange data on manufactured products in a computer-understandable format.

The objective of STEP is to provide a neutral mechanism capable of describing product data throughout the life cycle of a product that is independent from any particular software application or computer platform. The nature of the description is suitable for neutral file exchange and also as a basis for implementing product databases and for data archiving [3].

It is the aim of the STEP architecture to standardize the exchange of product model data across three levels: description methods, integrated resources and application protocols (AP). The development and standardization of an AP, is really the development of a standard for the exchange of product data in a given domain. To do this, several intermediate models are set up: the "application activity model" (AAM), which is not a data model, but is similar in concept to an SADT activity model, the "application reference model" (ARM) and finally the "application interpreted model" (AIM). An example for APs is AP214 ("Core data for automotive mechanical design processes") [3].

2.2. Product Data Management - PDM

There are now computer systems on the market that help improve the flow, quality and use of engineering information throughout a company. These systems provide improved management of the engineering process through better control of engineering data, of engineering activities, of engineering changes and of product configurations. They provide support for the activities of product teams and for techniques such as Concurrent Engineering.

Product Data Management (PDM) is a category of computer software that aims to create an automatic link between product data and a database. The information being stored and managed (on one or more file servers) will include engineering data such as CAD/CAM (Computer Aided Design/Computer Aided Manufacturing) models, drawings and their associated documents. The package may also include product visualization data. The central database will also manage metadata such as owner of a file and release status of the components. The package will: control check-in and check-out of the product data to multi-user; carryout engineering change management and release control on all versions/issues of components in a product; build and manipulate the product structure BOM (Bill of Materials) for assemblies; and assist in configurations management of product variants.

This enables automatic reports on product costs, etc. Furthermore, PDM (Product Data Management) enables companies producing complex products to spread product data in to the entire PLM (Product Lifecycle Management) launch-process. This significantly enhances the effectiveness of the launch process [5].

PDM will improve engineering productivity. Engineering managers will know the exact design status. They will be able to assign resources better, and release designs faster and with more confidence. Design engineers will know which parts are available and which procedures should be followed when designing new parts. Manufacturing engineers will be able to see how similar parts have been made in the past.

In many high-tech companies, the engineering function is expensive to run, and a major customer for investment. Any increase in its internal efficiency will have a positive effect. While engineering remains an apparently artisanal and uncontrollable process, management will find it difficult to achieve the expected improvements in engineering activities. PDM systems help in attaining the goal of a manageable engineering process that makes the best possible use of engineering information.

2.3. Structural Analysis and Design Technique - SADT

In the 1970's, IDEF0 is originated in the U.S. Air Force under the Integrated Computer Aided Manufacturing (ICAM) program from a well-established graphical language, the Structured Analysis and Design Technique (SADT).

SADT consists of procedures that allow the analyst to decompose software (or system) functions; a graphical notation, the SADT actigrammes and datagram (Fig. 1), that communicate the relationships of information (data and control) and function within software, and project control guidelines for applying the methodology [6].

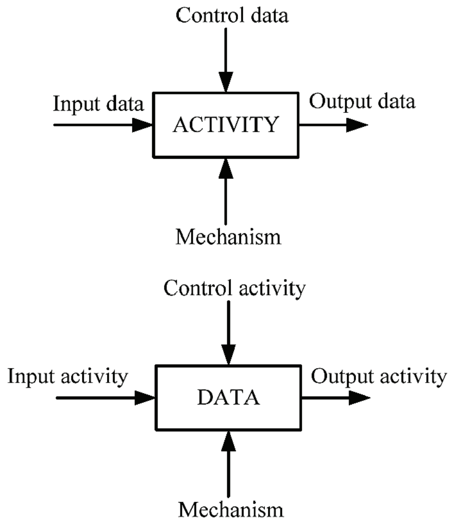

Fig. 1. The SADT basic diagrams: a – activity model, b – data model.

Inputs are data items that are transformed to outputs. Controls are items such as budget and schedule that constraint the type of degree of the process being described.

The A-0 diagram is the highest level diagram in the SADT approach to process mapping. It shows the overall context within one box. The A0 diagram is the first level diagram in the SADT process mapping methodology. It shows the first sub-processes.

Mechanisms are external aids to the process, such as tools and techniques used to perform the transformation. As with many other methods, the diagrams are arranged in a hierarchy to show more detail at lower levels.

Each diagram represents a transformation, and at most six diagrams are used to describe a function. If more than six diagrams are needed, the function should be redefined as a set of subfunctions. The diagram includes four factors: inputs, controls, mechanisms, and outputs [2].

3. CASE STUDY

Engineering data is difficult to manage because:

- there is a lot of it (with more being created each day);
- it is on many media (*e.g.* paper and magnetic disks);
- it is used by many people in different functions (often at different sites);
- it is used by many computer programs (often on different computers);
- it often has several (different) definitions;
- it exists in many different versions;
- it has multiple relationships and meanings;
- it may need to be maintained for many years (*e.g.* fifty years).

PDM systems treat engineering information as an important resource that is used by many functions in a company. They allow companies to get control of engineering information, and to manage activities in several departments. In the long term, PDM systems will allow companies to get control of all their engineering information, and manage the overall engineering process. These characteristics set them apart from systems such as CAD that aim to improve the productivity of individual tasks in one functional area. Viewed as data processing systems, EDM/PDM systems go beyond individual application programs such as CAD and NC. Viewed as organizational tools, they go beyond individual approaches such as DFA (Design For Assembly) and project management systems.

PDM systems provide a backbone for the controlled flow of engineering information throughout the product life cycle. Other systems using engineering data, such as CAD, NC, process planning, MRP and field service will be integrated to this backbone.

For CAD/CAM integration and data transfer between different Integrated Design Systems from one enterprise to another we used STEP Standard in our study.

It is the aim of the STEP architecture to standardize the exchange of product model data across three levels: description methods, integrated resources and application protocols (AP). The development and standardization of an AP, is really the development of a standard for the exchange of product data in a given domain. To do this, several intermediate models are set up: the "application activity model" (AAM), the "application reference model" (ARM) and finally the "application interpreted model" (AIM).

SADT is a graphical representation which can transpose in programming language used in AAM (Application Activity Model) defined in norm ISO 10303 (STEP). This standard is utilized in data transfer between different Integrated Design Systems.

The SADT methods has been exploited in order to structure the research oriented towards the realization of the directory scheme, for a better definition of the existing situation and for detaching the functional specifications of the projected system, which has to meet an analysis of the needs.

We choose the actigrammes as tools of shaping in our analysis. We understand to call "actigram" those diagrams of the model, which are graphically represented as boxes designated by verbs, sometimes accompanied by complementation data are represented by arrows and designated by names. This representation allows a description of the series or parallel activities, as well as of feedbacks.

The model is hierarchically constructed. At its most general interpretation, the system is perceived as a simple box. I can therefore expand and decompose this box, thus creating a first diagram, which can provide wider information in the field. The boxes of this diagram can be deconstructed in their turn, and can create new diagrams, and so on and so forth, until we reach the proper level of detail.

The first diagram is presented in Fig. 2. The purpose of this SADT diagram is to optimize data transfer between different IDS software. At this case study we work from last year and we don't finish yet but we made some progress from last published paper.

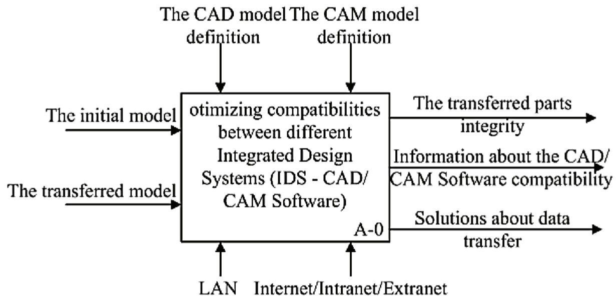

Fig. 2. Diagram A-0: The data transfer modeling by using STEP format.

We develop this SADT until the "Generating the 2D or 3D parts/assemblies in CAD Module" activity (Fig. 3). There are two ways to elaborate the parts/assemblies in IDS: The first one is to design the parts/assemblies directly in actual IDS and the second one is to import the parts/assemblies model realized in previous IDS.

When the parts/assemblies 2D and 3D are generate from another IDS we must take account about transferring standards (STEP, IGES, and DWG/DXF) and make the adaptation of the part/assembly in the actual CAD.

Whichever are the ways to elaborate the 2D and 3D assembly the final drawings and 3D parts are validating in the present IDS by project director? At the end of this stage the virtual prototype is realized and validated. Technical and functional data, part/assembly geometry are inputs.

4. CONCLUSIONS

The SADT/STEP/PDM plays a major role in VE.

PDM systems are designed to:

- reduce engineering costs by at least 10%;
- reduce the product development cycle by at least 20%;
- reduce engineering change handling time by at least 30%;
- reduce the number of engineering changes by at least 40%;
- store, control, managed documents and other information about products;
- enable engineering teams to share information on products and processes quickly and with consistent accuracy
- permit the integration of techniques such as CAD/CAM (Computer Aided Design/Computer Aided Manufacturing) into coherent business systems across an entire enterprise.

PDM addresses issues such as control, quality, reuse, security and availability of engineering data.

PDM offers important new functions for the engineering environment.

It will help solve many of the problems that beset today's engineering environment, and for those who master it, will offer new strategic opportunities.

The advantages of PDM used in Virtual Enterprises are:

- reduce the time to introduce new products;
- reduce the cost of developing new products;

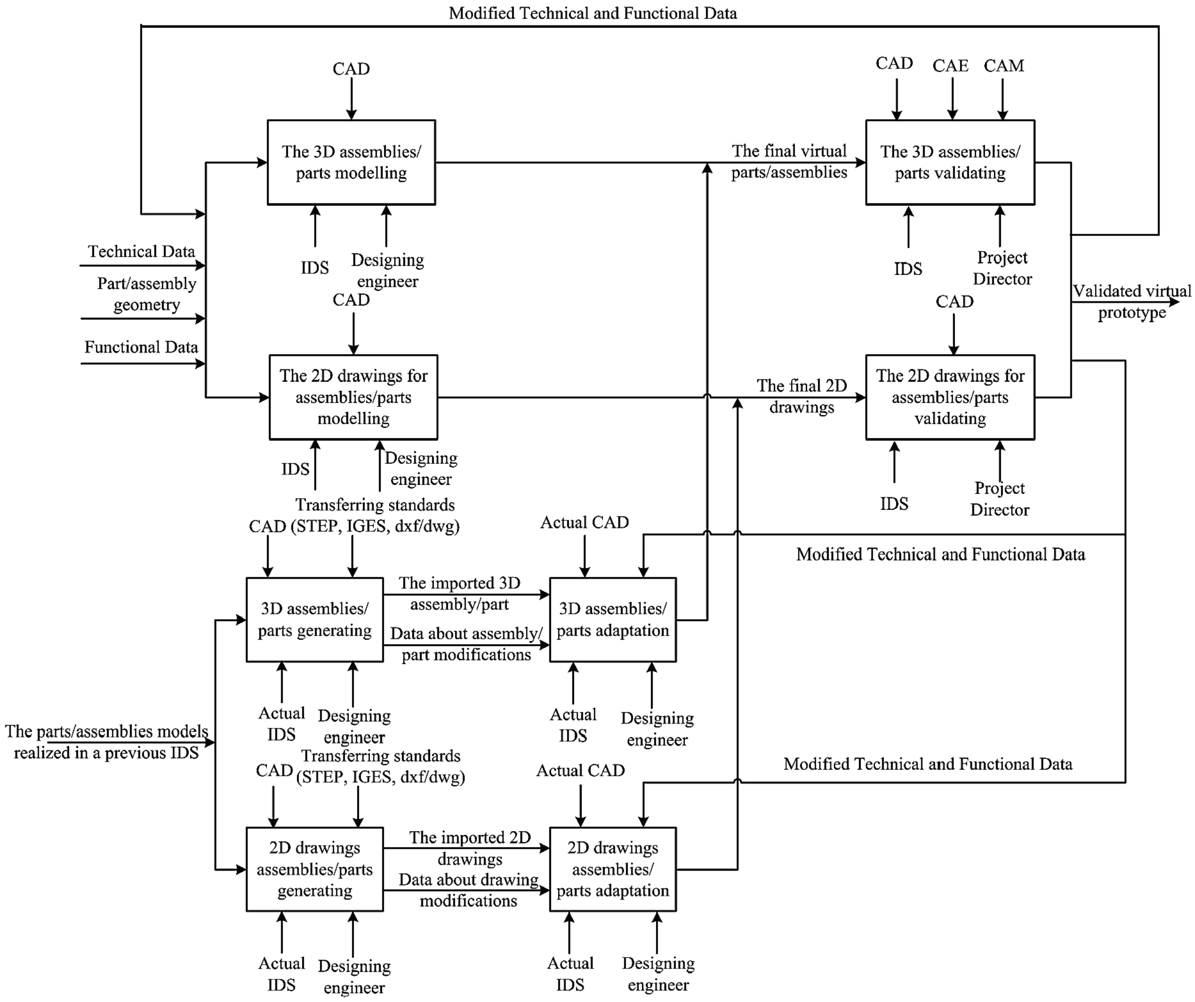

Fig. 3. Diagram 2-1: generating the 2D or 3D parts/assemblies in CAD Module.

- reduce the cost of new products;
- improve the quality of products and services;
- improving design and manufacturing accuracy;
- have a strong effect on competitively, market share and revenues.

All these benefits are achievable only if in the PDM systems are used the STEP Standard for data transfer between enterprise and implicitly is very important to improve this data exchange by using SADT technique.

The main focus of this paper is to sketch the SADT diagrams of an IDS data transfer model in order to improve CAD/CAM communication.

The case study presented in the previous chapter is not finished. The finally results will be published when ready.

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