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UTILIZATION DATABASE SYSTEM USING THE PROTOCOL STEP

Summary: Information systems in today's manufacturing enterprises are distributed. Data exchange and share can be performed by computer network systems. The present manufacturing scenario demands the efficient database systems for manufacturing to perform the operations globally. Database systems are the key to implementing information modeling. Engineering informations modeling requires database support. This paper proposes a manufacturing database system for STEP-NC data from EXPRESS entities.
Keywords: STEP, STEP-NC, CNC, EXPRESS, XML file.

INTRODUCTION

Engineering activities are generally performed across departmental and organization boundaries. Product development based on virtual enterprises, for example, is generally performed by several independent member companies that are physically located at different places. Information exchange and share among them is necessary. It is also true in different departments or even in different groups within a member company.

Information systems have become the nerve center of current computer-based engineering applications, which hereby put the requirements on engineering information modeling. Databases are designed to support data storage, processing, and retrieval activities related to data management, and database systems are the key to implementing engineering information modeling. Design and manufacturing companies eager to integrate their engineering processes around product databases, but engineering databases are expensive and difficult to create [2, 3].

Integration around product databases can enable concurrent engineering, a process where multiple engineers work on different facets of a product concurrently. However, integrated product databases are yet to be common in industry in the STEP-NC and EXPRESS entities perspective. Engineering design objects and their components are not independent. Spatio-temporal data modeling is essential in engineering design. The software systems are developed to share and exchange the product and production information in order to effectively organize production activities of enterprise. However, the systems are generally developed

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independently. In such an environment of distributed and heterogeneous computer-based systems, exchanging and sharing data across manufacturing units are very difficult. An effective means must be provided so that the data can be exchanged and shared among deferent applications and organizations [1].

STEP/STEP-NC

The contemporary product design and manufacturing environment requires a bidirectional and seamless data flow throughout all stages of data transactions. Standard for the Exchange of Product (STEP) Model Data is a large and powerful set of ISO (International Organization for Standardizations) standards, all under ISO 10303.

The main objective of STEP is to provide a mechanism that describes a complete and unambiguous product definition throughout the life cycle of a product. STEP provides both broadly useful data modeling methods and data models focused on specific industrial uses. STEP is suitable for not only neutral file exchange, but also as a basis for implementing and sharing product data bases [1].

As an extension to STEP, STEP-NC provides the potential to finally close the gap between design and manufacturing in the drive for a complete, integrated product development environment. The STEP-NC data model is a long overdue improvement in the domain of computer numerical controls (CNC) where G-codes have been in use for more than half a century. STEP-NC brings richer information to CNCs presenting an opportunity for the development of more intelligent, interoperable and informative machining. Two different ISO subcommittees are working towards such a STEP-NC standard with two different foci; ISO TC 184/SC1 is working on ISO 14649, termed the Application Reference Model (ARM) whereas ISO TC 184/SC4 is developing STEP AP-238, termed the Application Interpreted Model (AIM). Both models represent the data model information to program intelligent CNC controllers, but the AIM is fully STEP compliant, whereas the ARM contains the information required to program a CNC machine. The ARM is to be used in an environment in which CAM systems have exact information from the shop-floor, whereas AIM is more suitable for a complete design and manufacturing integration. The ISO 14649 STEP-NC standards were developed and published by the above two sub committees under the different ISO standards such as ISO 14649-1, 14649-10, 14649-11, 14649-12, 14649-111 and 14649-121 bases [1, 3].

STEP-NC CONFORMANCE

In the overall process, from art to part, STEP-NC provides the data interface between CAM systems and CNC machine tools (see Figure 1). CAM systems output STEP-NC data while CNC systems read in STEP-NC data. At present,

"data transfer" is accomplished using a physical file in ISO 10303-21 format; data sharing scenarios (i.e., a common database) may be used in the future.

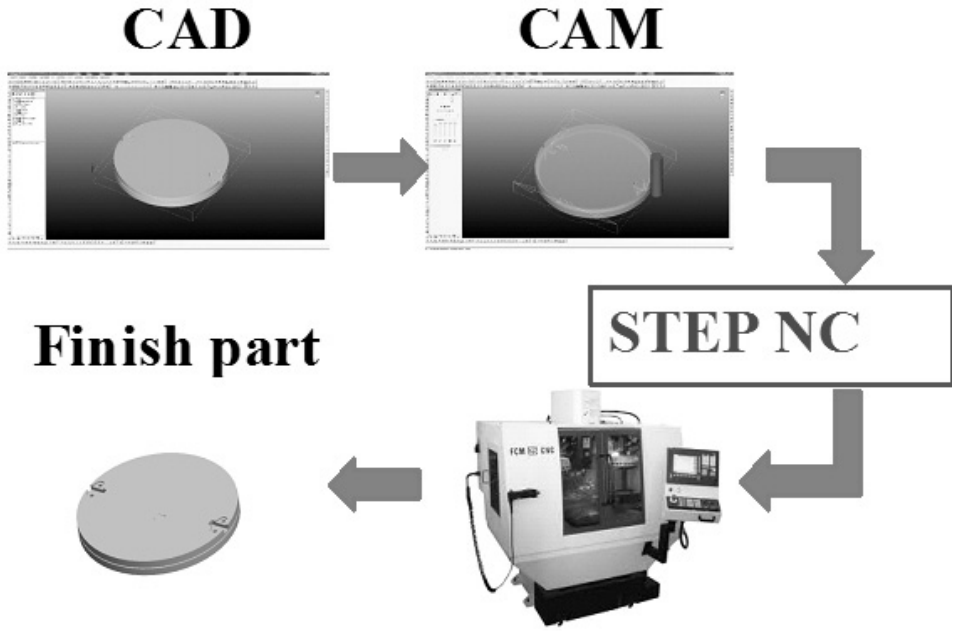

Fig. 1. Overall Process

STEP NC protects machining data as a key manufacturing asset. As long as the company has its database of STEP NC files, the parts can be manufactured regardless of what happens to the external or internal supplier [6] .

DATABASES

A database is a system intended to organize, store, and retrieve large amounts of data easily. It consists of an organized collection of data for one or more uses, typically in digital form. One way of classifying databases involves the type of their contents, for example: bibliographic, document-text, statistical. Digital databases are managed using database management systems, which store database contents, allowing data creation and maintenance, and search and other access.

Our task is to create interfaces that bring together the information defined by STEP and STEP NC. Product geometry can be defined by one STEP application protocol. Product features can be defined by another STEP protocol. Machining operations can be defined by STEP NC. However, all three types of data and others must be integrated in a complete product model database. Starting with product geometry in the STEP format is the easy part because STEP translators are built into most CAD systems these days (and they handle 3D geometry, doing so more effectively than IGES ever did, apparently).

STEP NC establishes a hierarchy of workingstep supertypes /subtypes. In other words, it breaks down every machining operation into the steps required to perform the operation. These steps include actions to be taken as well as data (such coordinates of point-to-point motion) to be applied. These steps are then linked to the appropriate part model geometry to fill in the values. STEP Tools is setting up tables to match workingsteps, workingstep-methods, workingstep actions, and machined features.

A key part of STEP Tools approach to the super model database is the use of XML in its interfaces. XML, the eXtensible Markup Language, is a vendor-neutral data exchange language for passing information, not just data, across the Internet. XML allows data to be "tagged" so that software applications reading the database can identify what type of information is stored in the database and extract the data that is needed. HTML, the Hyper Text Markup Language, is a similar "metadata" language that the Web uses so that text can be displayed no matter what Internet browser happens to read it. XML offers a comparable level of interoperability. An XML standard for STEP is nearing completion. This standard will ensure that all data in a product model is "tagged" in the same way

XML provides a convenient means to link manufacturing strategy, tool path, and tool selection information to geometry, features and machining steps in the database. By sorting out data with the appropriate tags, for example, geometry identified as a hole to be drilled can be linked to operations such as rough drilling, boring and counter boring steps. Each of these steps will require that other data be extracted, such as workpiece material, surface finish requirements, and so on, to link with speed and feed tables. XML provides the tags so that the data is sorted correctly [4, 5].

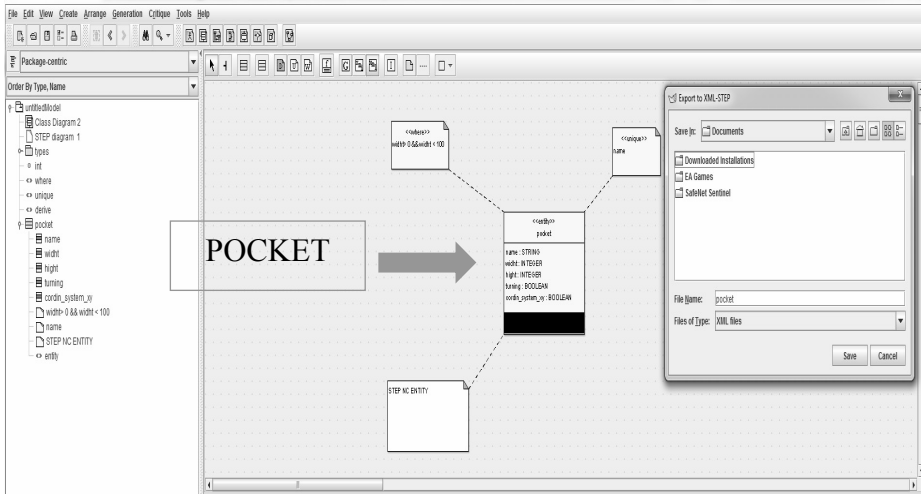

Fig. 2. Creating of EXPRESS entity

On the figure 2 we can see created EXPRESS entity with name „POCKET“ and attributes: NAME, WIDTH, HIGHT, MILING, COORDINATING SYSTEM. This EXPRESS entity is designed as STEP schema, which then we save in XML format.

In the STEP schema editor we can open a particular schema in this case have name „POCKET“. Through the use of text boxes, we can write list of specific data values or a given attribute. On the figure 3 are definite three pockets of different values. Thus definite STEP scheme we can save in the database, or used directly as format 10303 part 21 (STEP physical file).

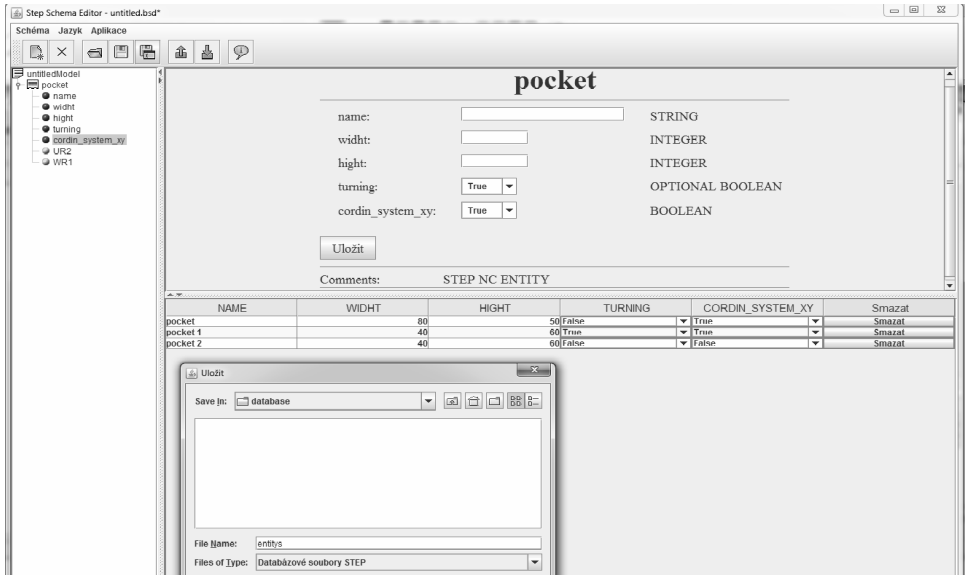

Fig. 3. STEP editor schema

Current Database Models

Engineering information modeling in databases can be carried out at two different levels: conceptual data modeling and logical database modeling. Therefore, we have conceptual data models and logical database models for engineering information modeling, respectively. Database models for engineering information modeling refer to conceptual data models and logical database models simultaneously [3].

Conceptual data models

Much attention has been directed at conceptual data modeling of engineering information. Product data models, for example, can be viewed as a class of semantic data models (i.e., conceptual data models) that take into account the

needs of engineering data. Recently, conceptual information modeling of enterprises such as virtual enterprises has received increasing attention. Generally speaking, traditional ER (entity relationship) and EER (extended entity-relationship) can be used for engineering information modeling at conceptual level [3].

Logical Database model

A logical data model (LDM) in systems engineering is a representation of an organization's data, organized in terms of entities and relationships and is independent of any particular data management technology.

Logical data models represent the abstract structure of some domain of information. They are often diagrammatic in nature and are most typically used in business processes that seek to capture things of importance to an organization and how they relate to one another. Once validated and approved, the logical data model can become the basis of a physical data model and inform the design of a database. Logical data models should be based on the structures identified in a preceding conceptual data model, since this describes the semantics of the information context, which the logical model should also reflect. Even so, since the logical data model anticipates implementation on a specific computing system, the content of the logical data model is adjusted to achieve certain efficiencies.

The term 'Logical Data Model' is sometimes used as a synonym of 'Domain Model' or as an alternative to the domain model. While the two concepts are closely related, and have overlapping goals, a domain model is more focused on capturing the concepts in the problem domain rather than the structure of the data associated with that domain [4].

CONCLUSION

Database system using the protocol STEP are solved by doctoral thesis: utilization of STEP protocol for programming CNC machines (využitie protokolu STEP NC pri programovaní CNC strojov). This paper concentrates on the extraction, storage and management of manufacturing data from STEP-NC file using EXPRESS schema entities are in the backend. This implementation provides flexible environment to the people, who are using STEP-NC data and manage the EXPRESS entity data.

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UŻYTKOWANIE SYSTEMU BAZ DANYCH WYKORZYSTUJĄCYCH PROTOKÓŁ STEP

Streszczenie
We współczesnych przedsiębiorstwach przemysłowych systemy informatyczne występują powszechnie i są niezbędne. Udostępnienie i wymiana danych odbywa się przy wykorzystaniu sieci komputerowych. Realizacja procesu wytwórczego wymaga wydajnych systemów produkcyjnych baz danych do wykonywania operacji w ujęciu globalnym. Systemy baz danych są kluczem do zarządzania przepływem informacji. Inżynieria zarządzania informacją wymaga odpowiednich metod obsługi bazy danych. Niniejszy artykuł proponuje produkcyjną bazę danych opartą na modelu STEP-NC korzystającą ze języka programowania EXPRESS.
Słowa kluczowe: STEP, STEP-NC, CNC, EXPRESS, plik XML.

Note: The solved problem supports a partial solution of EU Operational Programme – Education: "A Flexible and Attractive Study on University of Žilina for Both Employment Market and Knowledge Society Requirements"; Code ITMS 26110230005.