ARCHITECTURE FOR VALIDATION OF A CMM INSPECTION INFORMATION MODEL IN CONCURRENT ENGINEERING

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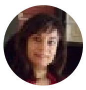
5 AUTHORS, INCLUDING:

J. Barreiro
Universidad de León

Eduardo Cuesta
University of Oviedo

J.E. Labarga
Universidad de León



A. I. Fernández-Abia
Universidad de León

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Author(s):

BARREIRO, J.; CUESTA, E.; LABARGA, J. E.; MATEOS, S. & FERNANDEZ, A. I.

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ARCHITECTURE FOR VALIDATION OF A CMM INSPECTION INFORMATION MODEL IN CONCURRENT ENGINEERING

BARREIRO, J.; CUESTA, E.; LABARGA, J.E.; MATEOS, S. & FERNANDEZ, A. I.

Abstract: *an architecture is defined for the testing and validation of a previously developed information model. The aim is to integrate the inspection activity using coordinate measuring machines (CMM) with the previous activities in the cycle. The integration is at the level of definition, exchange and sharing of information. The resources used include a CATIA CAD, modified for using as a product and process modeller, an EXPRESS database, and a motorized CMM.*
Key words: *Information modelling, integration, CMM, concurrent engineering.*

1. INTRODUCTION

The following current research lines can be identified in relation to automated inspection:

a) Formulation of theories and development of computer assisted systems to carry out analysis of tolerances.
b) Theoretical formulations for the optimization of specific aspects of the inspection planning.
c) Developments of computer assisted environments for the automatic planning of the inspection.
d) Work whose aim is the elaboration of standards as for dimensions, tolerances, and control commands for the equipments of dimensional measure (DME).
e) Work whose objective is to integrate the inspection systems with the rest of the systems that compose the production cycle.

It is in this last line where this work is centred. In that context, it is observed that a high integration exists among automated equipments of production in what concerns to the physical connections and communication protocols. However, it is no possible to say it about the structure and the semantics of the information that is exchanged and shared. At the present time a real integration doesn't exist among the different activities (applications) of the production cycle, and this fact means an important barrier for the effective installation of environments of concurrent engineering.The information considered by the existing standards for exchange of information is incomplete, since it is considered from the point of view of each particular activity without keeping in mind the necessities of the rest of activities of the cycle; also, it is not possible to share this information in an appropriate way when working with different representation schemas.

In the last years, to improve this communication, environments have been developed to integrate the different activities of the production cycle in what concerns to the information that they share and exchange, but almost all are limited to the design activities and production, without considering other activities and, in particular, the dimensional inspection (Ríos, 1996; Al-Ashaab, 1992; Liu, 1992).

2. A PROPOSED SOLUTION

Taking these facts into consideration, the structure of information must be defined coherently from the design

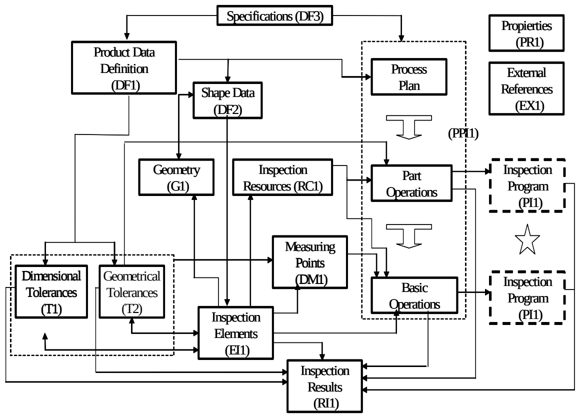

Fig. 1: Summary of information groups

activity to inspection, and not only in what concerns to the format of the data, but also to the semantics of the information (ISO10303, 1993).

The solution that has been intended is based on the definition and development of structures of information or an information model with capacity to represent all data, (geometry and technological) associated with the inspection process, and in particular with automated CMM.

Two basic requirements have been settled down:

1) The representation of the information should be independent of any system or particular application
2) It should be avoided the redundancy and duplicity of data along the production cycle.

3. METHODOLOGY

During the development and validation of this model of information a series of tasks have been carried out. They can be grouped in two big stages:

1) Definition stage: it has been carried out an analysis of the information required in the inspection process with CMM and the definition of the structures of information.
2) Implementation/testing stage: the schema of information has been validated in a real environment of work.

Detailed information of the defined structures of information can be consulted in references (Barreiro, 2001; Barreiro, 2003). In total they have been defined 244 application objects of information, grouped in thirteen groups of information (figure 1). For the formal representation of all these elements the EXPRESS modelling language has been used. The implementation/testing stage is explained in detail on the next point.

4. IMPLENTATION AND TESTING

A real work environment was developed, which is composed by a computer assisted system for the modelling of product (CATIA), an object oriented product central DB (EDM) and a CMM (DEA MISTRAL with Tutor), so that the

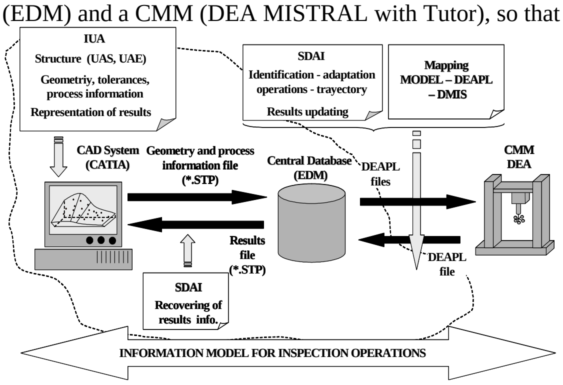

Fig. 2: Environment for model validation

transfer of information among these systems is made exclusively in agreement with the developed schema of information, and always going by the product central database (figure 2).

Revolution and prismatic parts were considered for the analysis. So, it was possible to pick up the different casuistic when assignment of tolerances and inspection parameters. It was necessary to adapt the CAD system for the introduction of the geometrical and technological information (process parameters, operation criteria) and their storing in accordance to the structures of the information model. The “product modeller architecture” is composed of two subsystems: a) a functional subsystem and b) an operative subsystem. The functional subsystem prepares the CATIA application to support equivalent structures of information to those of the proposed schema. It is based on two elements of the programming interface of CATIA: UAE and UAS. In accordance with this, each group of the information reference schema was associated to one UAS. Also, each entity defined inside these groups of the reference model was associated to one UAE, assigning to it an equivalent group of attributes to the ones defined in the schema of information for the corresponding entity (figure 3).

Starting from here, the operative subsystem populates the product modeller database in agreement with the structures defined by the functional architecture and based on the data introduced by the user. This operative architecture is composed by three types of elements: procedures, panels and modules, using functions defined in the programming interface IUA/CATGEO of the application CATIA. The process of data introduction is fully guided and automatic, that is to say, it is an attended input of data. It was necessary to transfer the information from the DB of the product modeller to the product central DB, so that all the agents implicated in the production cycle have access to it. Files and

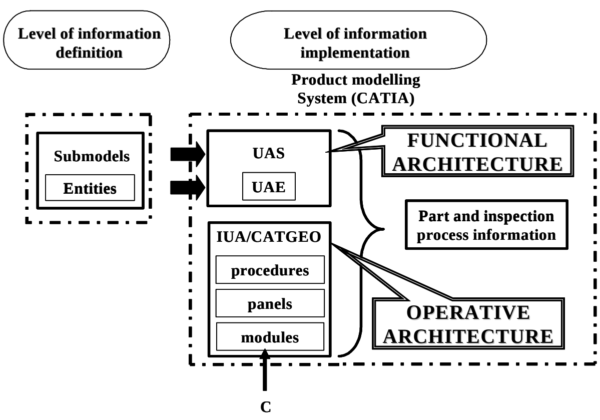

Fig. 3: Product and process modeller architecture

standard data access functions with format defined in the norm ISO 10303 were used. This central DB stores data in agreement to the structure indicated in a EXPRESS schema.

The connection among the DB with the CMM was one of the main barriers. The control applications associated with this kind of devices are very closed. This supposed a barrier when demonstrating the viability of the information schema. The solution was the creation of mapping tables between the entities of the developed schema and the DMIS and DEAPL data formats. This solution is not in agreement with the objectives of this work, but it allows demonstrate that the schema of information contains the required information along the cycle. The cycle closes in inverse sense for feedback of information to the product modeller.

5. CONCLUSIONS

An information model is proposed for the integration of the inspection activity in the production cycle. This leads to two important improvements in the development cycle of a product: 1) on one hand the information is consistent and unique, and this is a guarantee that it is fully interchangeable and accessible for all the agents and applications along the production cycle; 2) the diversity of formats and standards for the exchange of information that exist at the present time is eliminated, as well as the annoying post-processing step.

6 . FUTURE WORKS

It should be considered the implication of the proposed structures of data on the Quality Control techniques, considering the feedback to the different processes of the production environment for their dynamic adjustment. Moreover, this new integration must be carried out updating the latest CATIA and CMM software releases (i.e. from Tutor-DEAPL to PC-DMIS format)

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