Available online at www.sciencedirect.com

SciVerse ScienceDirect

Systems Engineering Procedia 1 (2011) 372–376

Procedia Systems Engineering

2011 Tourism and Services Engineering Management Seminar

An IDEF0 Design For PDM-based Die Integrated Intelligent Design System Functional Model

Dong Linfeng, Guo Qiang, Wang Lin

Hainan University, Haikou570228, P.R.China

Abstract

This paper establishes a PDM–based integrated design system IDEF0 functional model. The system consist four charts: A-0 chart, A0 chart, A1chart and A2chart. A-0chart defines the range of the system; A0 chart includes 4 modules (task granting, outline design, detail design, evaluation); A1chart and A2 chart decompose and illuminate detail design module and machining processing design module. The system can be easily adapt and applied to many domains of product design and engineering design.

Selection and/or peer-review under responsibility of the Organising Committee of The International Conference of Risk and Engineering Management.

Keywords: PDM, Integrated Design, Functional Model;

1. Introduction

The whole idea of integrated design is to incorporated organization, data and process. And to meet the system's requirement, functional model, organization model, data model and process model are needed to be built up separately. Among them, the functional model describes the whole system on the view of function and defines its functional scope. It's the foundation of the whole system[1,2,3].

In the paper, the integrated intelligent design system is established with IDEF0 functional model chart, described by graph languages and nature languages which obey certain rules.

2. The Establishment of the Die Integrated Intelligent Design System Functional Model

IDEF is a popular tool to analyze and design complicated system, which consist of a series of different modeling manner. IDEF0 is one modeling manner of IDEF, which can do all kinds of works, from system planning to design. It describes the system by graph language and nature language which obey certain rules. As illustrated in Fig.1, boxes are used to represent different tasks, arrows linking the boxes represent input and output information or real objects. And the sides of boxes also represent different functions of arrows. Arrows on the left side and up side represent the needed data to fulfill the tasks, arrows on right side show output data, and arrows on the bottom represents mechanism, it can be either human or machine that perform the tasks. In this way, the tasks, the relations and data flow among objects in the system all can be described by IDEF0.

* Corresponding author. Tel.: 86-0898-66278611.

Selection and/or peer-review under responsibility of the Organising Committee of The International Conference of Risk and Engineering Management.

doi:10.1016/j.sepro.2011.08.056

E-mail address: dlfphd@163.com.

Based on the research of the integrated intelligent design system, the Die Integrated Intelligent Design System is established with IDEF0(Fig.1) functional model chart. It composes of A-0 chart, A0 chart, and A1 chart. Fig.2 shows A-0 chart. It defines the aim and range of modeling. By using product design task and practicality model as input condition ,using quality control and design criteria as control target, and with the support of staff, equipment and software, the Die Integrated Intelligent Design System can yield correct and ideal design information.

Fig.3 illustrated the A0 chart. It consist 4 modules:

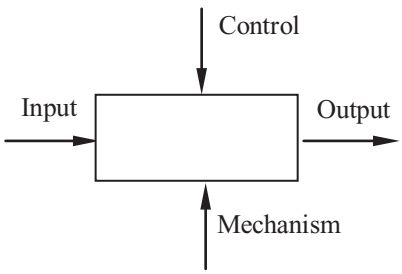

Fig. 1 Expression of IDEF0

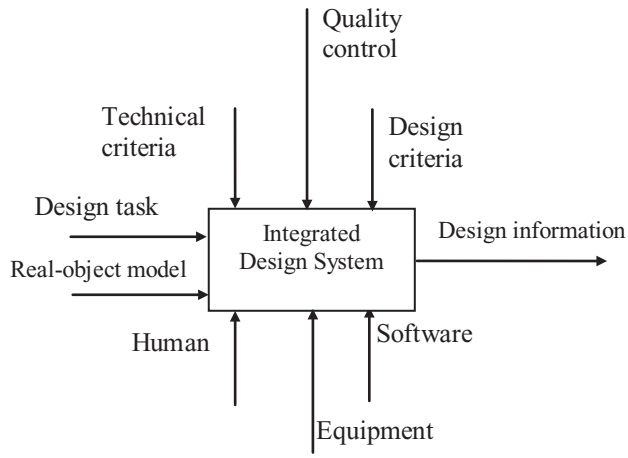

Fig. 2 A-0 Figure of the integrated design system

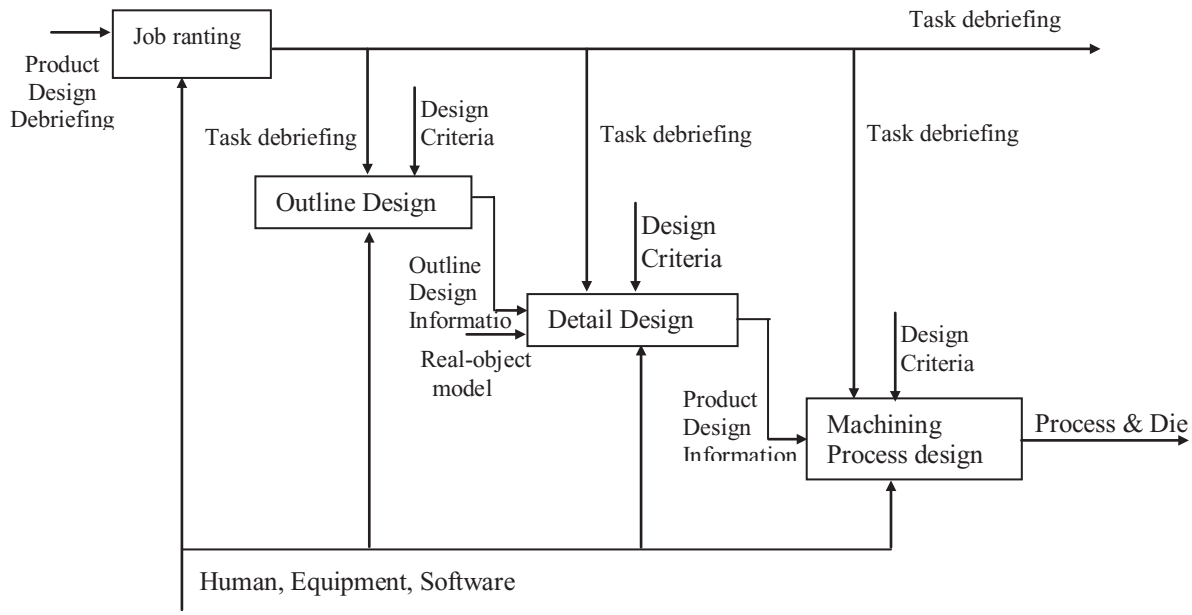

Fig.3 The A0 figure of the integrated design system

2.1. Module 1 Task Granting

It is the first step of the die integrated design. People have to document collect customer order form and market demand information into debriefing and deliver into the hand of the project management and design staff. In order to precisely describe the product concept, all sorts of reasonable requirements are needed. So, the debriefing should be

composed by all the groups that will take part in the product development.

2.2. Module 2 Outline Design

The main task of this module is to finish the product outline design according to the design debriefing. Firstly, people have to finish product assembling design and plan, then, build up product structure and set up criteria for components and parts. Models can be used to express, analyze and evaluate the basic requirement of the debriefing and other design concepts. And set a benchmark for next level design.

2.3. Module 3 Detail design

This step produce detail design according to the design information acquired from the outline design.

2.4. Module 4 Processing design

This step yields the detail design of the machining process and the Die

3. The decomposed expression of PDM-based Die Integrated Intelligent Design System Functional Model

In order to emphatically and clearly illuminate the important role of the product design and machining process, they are being decomposed and illuminated.

Fig.4 is the A1 chart, consist of 5 Modules (RE, CAD, RPM, CAE and Design evaluation) and Fig.5 is the A2 chart, consist of 3 modules (CAPP, CAMD, CAM). The details are as following:

3.1. The A1 Chart of PDM-based die integrated intelligent design system

- Module 1 RE

Through touch scanning with three-coordinate measuring apparatus , or Non-touch laser scanning apparatus and specialized software, people could acquired and convert curve-surface information into digitalized point , and output them in various format , such as ASCII, DXF, IGES, etc.

- Module 2 CAD

Use CAD software to get the 3D and 2D model of products and parts. And the curve surface reconstruct, comparing with the real ones, and create CAD model. In the die integrated design, it lay the basis for the coming design.

- Module 3 RPM

It can materialized the design, produce prototype directly based on the 3D CAD model. It integrates design and manufacture, and is a powerful tool supporting parallel design and manufacture. The prototype can be use to evaluate the design, and detect incognizable tiny problems.

- Module 4 CAE

Numerical simulation and craftwork analysis of the parts forming process are performed, using input product model and advanced CAE software and other craftwork software. Many unexpected constrain factors might cause quality problems. Theoretically speaking, we have to conduct simulation, compute the maximal stress, variables and shaping limit, choose process plan and equipments, and give improvement advices.

- Module 5 design evaluation

The main purpose of the module is to evaluate the CAD model, RPM prototype, CAE analysis result, and release the product design information.

3.2. A2 chart of PDM-based die integrated intelligent design system

- Module 1 CAPP

The module set down product processing plan with CAPP system. Many factor have to be take into account, such as technical capabilities and equipment conditions, and yield processing documents.

- Module 2 CAMD
  The module uses CAD die intelligent design system to finish the die design process.

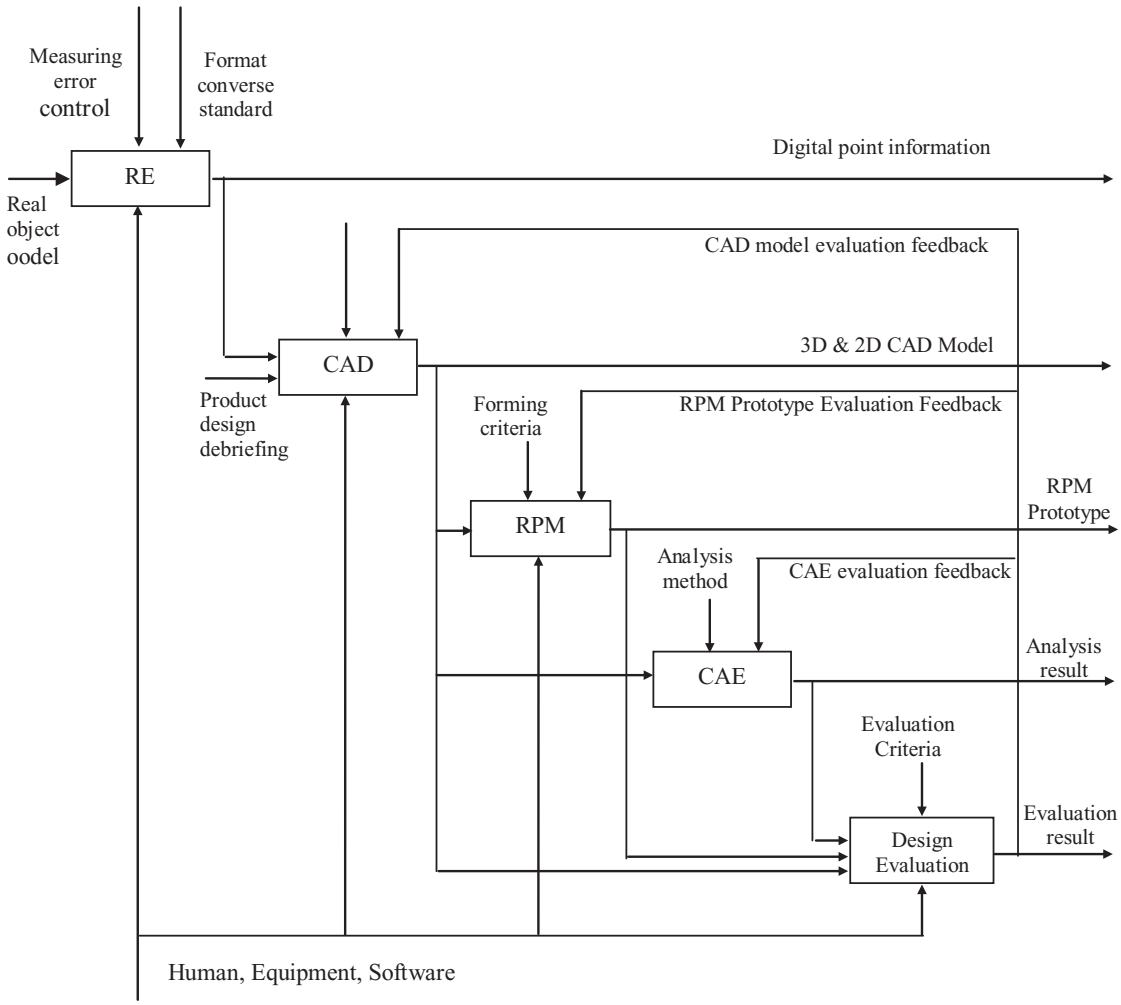

Fig.4 The A1 figure of the integrated design system

- Module 3 CAM
  The module create parts or woringing code.
- Module 4 Evaluation
  This module will evaluate processing design documents, die design documents, working code and release the design results.

4. Conclusion

This paper establishes a PDM–based integrated design system IDEF0 functional model. The model not only integrate task granting, outline design with processing, but also integrate CAD, RE, RPM , CAPP , CAE with evaluation. It is a practical intelligent design system and can be easily adapt and applied to many domains of product design and engineering design.

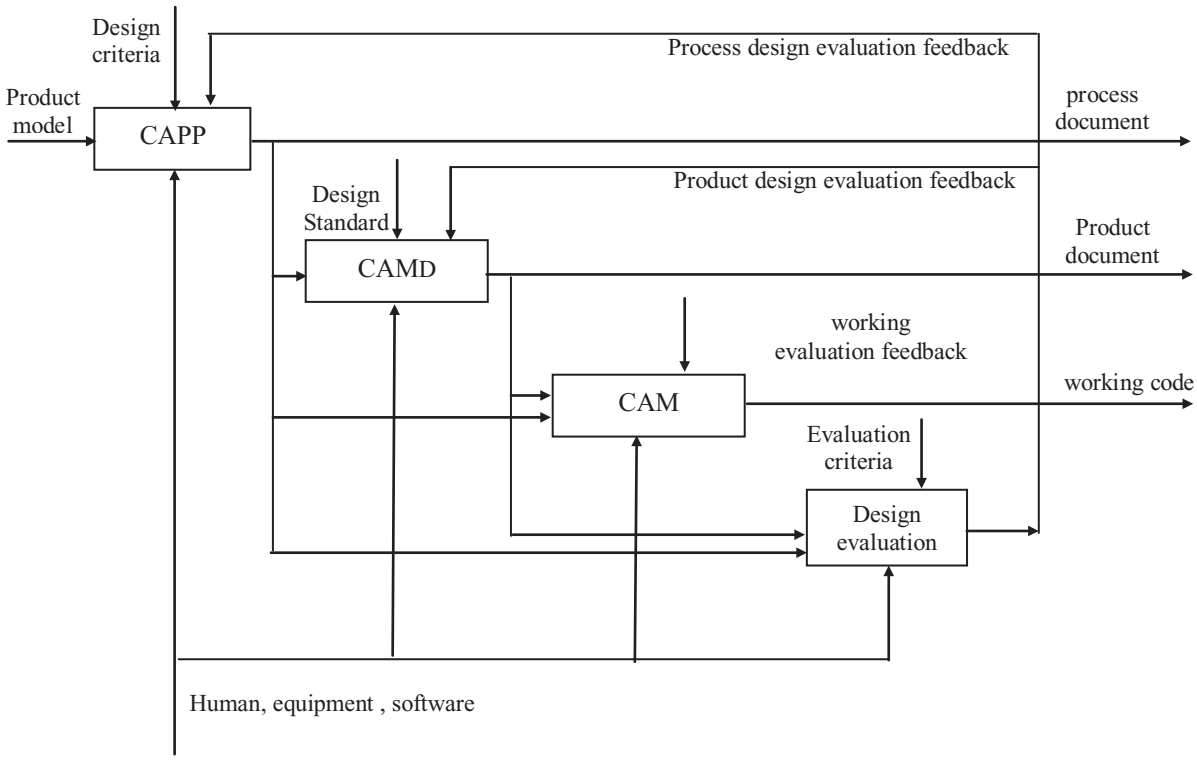

Fig. 5 The A2 figure of the integrated design system

Acknowledgment

This work was supported by Hainan University 2009 scientific research project (under No. hd09xm44), National Science Foundation of P. R. China (under No. 70761001) and Soft Science Foundation of China P. R. China (under No. 70761001).

Reference

1. Antonie van Rensburg. Implementing IDEF techniques as simulation modeling specifications. Computers Ind. Engng. Vol.29 No.1-4 467-571.

2. Charles M. Eastman, Nirra Fereshetian. Information models for use in product design: a comparison. Computer Aided Design. 7(2004) 551-572.

3. Yuh-Min Chen and Yun-Tau Hslao. A collaborative data management framework for concurrent product and process development. Computer Integrated Manufacturing. 6(2007) 446-469.