IDEF Modeling

Abstract:
Paper one "IDEF*: a comprehensive modeling methodology for the development of manufacturing enterprise systems" [1] *discusses the IDEF* modeling methodology which is used to reduce the incompatibility between the models and help modeling maintenance. The paper also gives information on the structure and various components of the supporting software tool that is used. Paper two* "A knowledge-based approach to the generation of IDEF0 models" [2] *discusses IDEF0 modeling. It explains how IDEF0 modeling can be used for modeling manufacturing systems. Knowledge-based system approach is explained so as to automate the modeling processes in order to reduce the modeling time and maintain consistency. Paper three* "Implementing IDEF Techniques as Simulation Modelling Specifications" [3] *explains IDEF0 modeling and gives information on simulation and how IDEF can help in simulation processes. The paper also discusses a case study in brief to explain IDEF modeling and in its implementation in simulation.*

What I expected from these articles:

I expected these articles to give detailed information on IDEF modeling and explain how they could be used in any enterprise. I also expected to learn different IDEF methods and methodology. I hoped that the case study would explain to me in detail how the problem was approached and solved using the IDEF modeling techniques.

Introduction:

A model is one of the best techniques to represent an enterprise and its allied processes. Modeling helps in the analysis and design of an enterprise or its processes. Thus, in turn reduces the cost and time that would be wasted due to wrong implementation of the process. Models reduce the complexity and thus helps in better understanding. It can help in communicating the information to all types of people. IDEF is one such method of modeling. It consists of different methods such as IDEF0, IDEF1, IDEF3 and many more.

Article 1: "IDEF*: a comprehensive modeling methodology for the development of manufacturing enterprise systems" (Ang, 1999).

Computer Integrated Manufacturing Open System Architecture (CIMOSA) reference architecture suggests four complementary viewpoints namely function, information, resource and organization to view a manufacturing enterprise. When modeled from each viewpoint it causes repetitive capturing of same information, difficulty in identifying the changes and communication. IDEF*, a comprehensive modeling methodology is developed along with is supporting software tools. This

methodology is CIMOSA compliant, IDEF0-based and integrated. This helps in customizing partial functions, extending particular functions, achieving functional description of the system and maintaining model consistency. IDEF* achieves four types of modeling integration, which are integration of five modeling views, integration of three modeling levels, integration of three modeling layers and integration of enterprise engineering and enterprise operations. An IDEF0 model is built first and then extended using proper syntax so that a complete system description can be obtained sequentially. Integration of function view with process view is the first viewpoint of modeling. In this IDEF0 is extended syntactically so as to facilitate visual analysis of Business Process Re-engineering (BPR) and Total Quality Management (TQM). Figure 1 shows the seven basic elements of IDEF0*. Second view, Integration of function view with dynamic view helps in performance analysis. Dynamic information is introduced into the IDEF0 model to handle the problems involving parallel activities. Thus, the resulting model is IDEF0 based IDEF2 dynamic model. Integration of function view with data view derives an IDEF1X model from IDEF0 model to graphically represent the information content and structure of a business process. Integration of function view with resource view constructs capability set and resources. The last view, integration of function view with organization view uses CIMOSA modeling templates such as organization unit and organization cell. Four matrices supplement IDEF* to help organizational analysis, thus automatically analyzing and processing the enclosed information. Integration of modeling levels is carried out in four modeling views. In function view three models, an IDEF0 function model, an IDEF0-based process model and an IDEF0-based IDEF2 dynamic model are obtained which describes how things are done. Information view considers data and information processing using IDEF1X model while resource view is used for resource modeling using CIMOSA description templates. Organization view is formed using detailed IDEF0 function model. Integration of three modeling layers is done through knowledge-based systems to semi-automate the generation of IDEF0 models using the concepts of reference model. Integration of modeling environment of CIMOSA such as enterprise engineering and enterprise operation is done by using IDEF0-based IDEF2 dynamic model. IDEF* satisfies the eight principles of good modeling methodology, which are principle of separation, principle of functional decomposition, principle of modularity, principle of model genericity, principle of reusability, principle of process and resource decoupling, principle of separation of behavior and functionality, and principle of conformity. The software is made using some tools such as MetaDesign, Design/IDEF and VC++. The software consists of six components. They can be integrated such that the output of the first component serves as the input to the other.

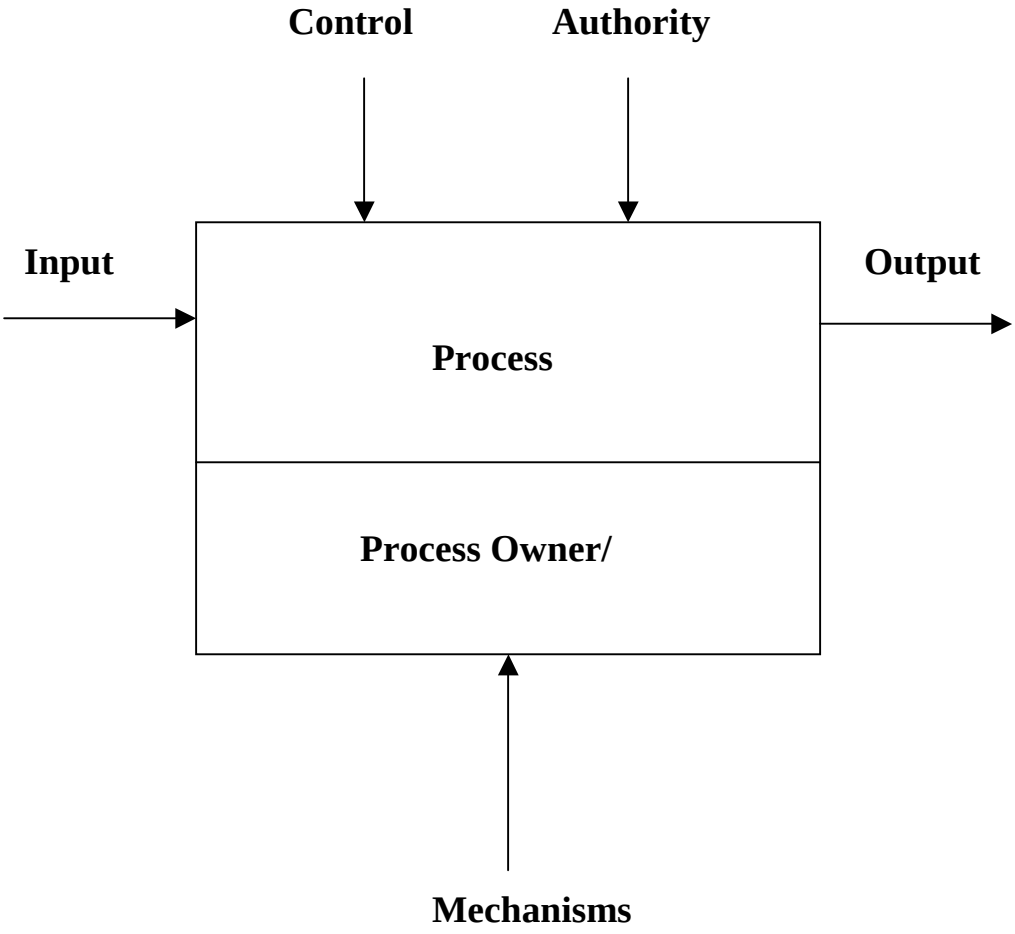

Figure 1. IDEF0* process notation

Thus the software tool enhances the effectiveness of IDEF* methodology and help support the entire enterprise system development life cycle. Advantages of IDEF* are as follows; it is easy to understand, system description is systematic and sequential and the models are compatible with no repetition of same data (Ang, 1999).

The article is good for reading, informative and easy to understand and so I strongly recommend reading it.

Article 2: "A knowledge-based approach to the generation of IDEF0 models" (Ang, 1997).

A structured analysis methodology is provided by IDEF0 to represent the complex functional relationships graphically and to identify the information and objects that interrelate functions. The major characteristics are differentiation between organizations and functions, which gives process functionality. The simple graphical characteristics of IDEF0 diagram consist of only boxes and arrows. The boxes denote activity while the arrow represents interfaces such as input, control, output and mechanism. A data abstraction characteristic of IDEF0 is a hierarchical decomposition of the system. The complex systems are decomposed to required level to get the detailed information. Preciseness is reached by the rules and conventions used. A knowledge-based system is used to automate the process of IDEF0 modeling. A four-stage methodology is developed based on the concept of reference model to automate the generation of IDEF0 models. In the characterization stage, organizational and operational details of the company are specified as an input to generate appropriate partial model of the company. In the generation stage, function wide reference models are selected on the basis of company characteristics from the knowledge base and merged with Harrington's model to get appropriate partial model. Harrington's model is a reference model for discrete manufacturing industry. In the customization stage, the partial model is customized to company specific model by decomposing the partial model and using the database. Verification and modification stage verifies and modifies the company specific model to get the company specific 'as-is' model. A library of function wide reference model is created to implement the methodology. Function wide reference model is a reference model for a particular lower level generic function (LGF) of Harrington's model. Harrington's model is built using structured analysis of IDEF0 and looks into 24 activities of manufacturing. The more the number of specialized function wide reference models and the partial models with respect to company characteristics, the more easy it is to customize. An appropriate classification scheme is developed to help specify company characteristics. Some characteristics are production batch size, manufacturing practices,

product structures and production flexibility. Partial models are decomposed in the process of customization. Partial model does not identify any specific mechanism for its functions or activities. LGFs of the partial model are classified hierarchically for systematic and standardized descriptions and a set of rules are laid down. The knowledge base stores the set of rules for translating the descriptions of the LGFs into IDEF0. The translating rules are not triggered if the description violates any of the conventions used in building of IDEF0 models. Verification and modification is carried out after customization to examine the omissions and deviations. Some of the advantages of knowledge-based system are as follows; it makes use of reference models, minimizes the chances of missing items, ensures consistency of the company-specific models produced and help produce better IDEF0 diagrams than the conventional modeling approach. The structure of the knowledge-based system consists of a database subsystem, dialogue subsystem, graphic subsystem and knowledge subsystem. The knowledge subsystem consists of three modules namely knowledge base module, interface module and acquisition module. The prototype system of knowledge base is developed using software tools such as MetaDesign, Design /OA and Design/IDEF (Ang, 1997).
The article is informative and easy to understand and so I strongly recommend reading it.

Article 3: "Implementing IDEF Techniques as Simulation Modelling Specifications" (VanRensburg, Zwemstra, 1995).

Simulation modeling when applied to real problem gives a clearer view of the problem. The benefits of simulation can be obtained if the problems basic building blocks are identified and are defined for use in the design of the simulation model specification. Simulation models such as Arena and Witness provide interfaces that reduce programming time but increase the need for the well-defined simulation model specifications. Techniques such as IDEF0, IDEF1X and IDEF3 are used in the business engineering projects to get human-to-human communication and to draw business models. The use of these technologies in simulation modeling improves the quality of simulation models and reduces the time to built them. The paper discusses the case study of Air Traffic and Navigation Service (ATNS) company which is responsible for all air traffic control activities in South Africa. The company decided to restructure drives of the organization. The aim was to develop streamlined and focused Air Traffic Control (ATC) organization, to develop a well-defined staff allocation strategy and to provide guidelines for the planning of shifts and optimization of sector times. There are three main modules of the project. The first one is business rule, which is used to understand the business operation in order to define some rules. Next is simulation

modeling, which refines the business rules such that the optimal staffing strategy is based on the control of air traffic movements. Lastly organizational structure is structured to allow development of managerial structure. Business improvement process is done using business engineering process. The business engineering process increases effectiveness (quality), efficiency (productivity) and resource balance. IDEF0 technique is used to describe business environment through activities and concepts. Hierarchical approach is used by the modeling technique with the highest possible analysis level at the start and then the problem is decomposed to an appropriate level. When an aircraft arrives at or departs from a destination, it will be under the control of four air traffic controllers. The simulation model should divide this workload during any hour of operation. An IDEF model has been developed for the different ATC positions. The ATC process model is hierarchical and each level explains in detail the ATC process. The top level gives the model context and purpose along with the viewpoint. The lower level gives the business activities that are carried out, such as ground movement control. The IDEF0 information is then used to model the actual processes, which are carried out at any particular ATC position. This is done using IDEF3 technique. This IDEF3 model gives the information about how the ATC process functions. Then this IDEF3 model is used to design the ARENA models. This reduces the analysis time, gives accurate information for simulation and improves the quality of the simulation models (VanRensburg, Zwemstra, 1995).
The article is very briefly written and I recommend reading it as a part of curiosity.

Incorporation:

Models are the best way of communication. They can be used as analysis and design tool or may be used to define the roles and relationships in an enterprise. I see my self as a future employee of a big enterprise or a consultant to it. IDEF modeling technique can be used to model an enterprise. These models will help me in analyzing and designing different processes whether they are to be newly implemented or whether they are to be reengineered. This will help me to know the effects of the processes before they are implemented. This will result in saving both, time and money. The knowledge of IDEF* methodology can be used in an industry to get the best out of all the IDEF methods.

Summary:

The three articles give information on IDEF modeling. The paper taught me in brief about IDEF0 modeling. It also helped me understand how different IDEF modeling methods are implemented and how they can be used together to get the best model. The articles also gave information on different software tools used in modeling methodology. The paper showed me how IDEF modeling can be implemented for different purposes such as air traffic control rather than the traditional enterprise. Other articles that I reviewed are "An IDEF0 model-based intelligent fault diagnosis system for manufacturing systems" (Khoo, 1999), which discuses an IDEF0 model-based intelligent fault diagnosis system for manufacturing systems. I recommend this article for reading. The other article, "Enactment of IDEF0 models" (Ang, 1999) discusses on the integrated approach for the enactment of IDEF0 models for the maintenance and development of responsive and coherent manufacturing systems. I also recommend reading this article. I wanted to review those papers, which would explain the basics of IDEF modeling. I think that the above three papers reviewed gave more information on IDEF modeling than these two papers.

References:

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VanRensburg, A. & Zwemstra, N. (1995). Implementing IDEF Techniques as Simulation Modelling Specifications. Computers & Industrial Engineering, 29, 467-471.