CHAPTER 3

An Abstract Modelling for Information Systems: A first step to automate the analysis phase

By

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ABSTRACT

Software is becoming more and more complex to be developed. New technological advancement and increasing user requirements demand large numbers of designers and programmers, good cooperation, and experienced project management for effective and efficient software development.

Despite the resources employed in the software development especially in the design phase (object orientation. highly specialized design tools: Newera with Informix, Power Builder with Sybase, and Designer 2000 with Oracle), the malfunctioning of automated systems and projects running out of budget re regular news. The software crisis is a frequent subject of the new media all over the world.

In order to overcome this case in the future, improved methods and techniques for software development will solve the crisis by increasing the quality of the analysis phase and hence of the developed software systems.

This paper is aiming to launch, formulate, and give precise definitions of micro steps and micro entities during the analysis phase to reach a frame of a model for an information system. The paper shows the conceptualization and the mapping prosesses, define the "modelling" from IS point of view. This research includes the abstraction of the human rules in information systems development. Also, a refinement view of methods, techniques and tools are shown. Finally a model of an IS is given.

1. INTRODUCTION

More than 80% of computerized applications are MISs in their various forms.[1] Methodical information system development is mostly performed in stage such as: scope definition, analysis, design, construction, and use[2]. During development,

there are general problem solving techniques: conceptulization which is the creation of a complete and formal system specification starting from the informal rough specification, and mapping which is the transformation of the specifications on a conceptual level (i.e. without presentation and implementation details) to the machine executable specification.

Figure 1 shows that development can then be depicted in a pathway in the 2 dimensional areas. The ideal path is to go sharply from the informal point to the complete formal point and then sharply vertical to the machine level point. Any other path especially the opposite of the above will cause a problem. This set of problems was defined as the software crsis i.e. when large part of the conceptualization process is performed on the mapping level.

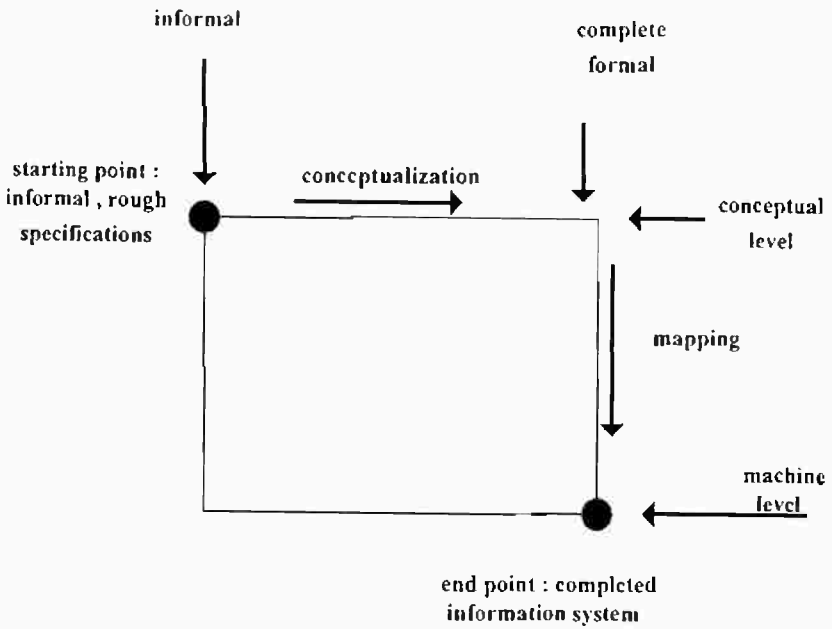

Figure 1: conceptualization and mapping

In this paper, we give a defintion of a model from the point of view of information systems in Section 2, while the problem we try to tackle is defined in Section 3, and proposed approach in Section 4. In order to automate the analysis phase the manual procedures and their performer's roles should be precisely defined. The task of Section 6 views and definitions of terms like: method, technique, and tool are shown. Section 7 describes the relations between different types of models and systems and where a model for an IS will be presented.

Diagrammatic formula modelling is shown in Section 8, while Section 9 proposes future research.

2. MODELLING

Developers make use of models more extensive in the mapping phase than in the conceptualization phase. Variants of most model types are defined in relations to the various development stages.

Definition (1) :

"A system A is used as a model to obtain knowledge about system B, where the system A is neither directly nor indirectly interacting with the system B".[3]

Models, through the history of information system development, are used widely for processes, data, databases, and interfaces. Tools such as diagrams, schemes, tables, and programs are used to create a communication language among developers across the life cycles of systems.[6]

3. THE PROBLEM DEFINITION

The current modelling processes in information systems are suffering too many problems:

- Different models are constructed for the same system at hand at the diferent development stages.
- The modelling process takes too long.
- The models are not consistent with the systems they are supposed to model.
- The gathering of information's specifications is hard.
- The modelling techniques are vague and unformalized.
- Experienced modellers are scarce and expensive.
- Automatic modelling tools are not exist especially in the early conceptualization phase.

4. THE SOLUTION APPROACH

Abstract modelling and standardization is an approach to solve the problem of informality during conceptualization i.e. make the modelling process of the techniques applied during information systems development more explicit. If we can answer the following questions:

- What is the best way to construct a model, when a specific technique is applied?
- What is the formal basis of the modelling technique?
- How is one particular model related to other models of an information system?

then we would realize a set of goals to get rid of the problems mentioned in Section 3. The starting point for making the modelling techniques more explicit is the claim that the modelling techniques more explicit is the claim that the modelling process can be more formatized than it is now.[6].

5. THE HUMAN ROLES IN DEVELOPING A MODEL FOR INFORMATION SYSTEM DEVELOPMENT

Figure 2 shows a view to the roles of people take parts in modelling information systems. The lower part of the figure overviews the roles of developers while the upper parts describes the activities of the environment. The following definitions are given to each participant [4, 5]:

a) *Commissioning Agent:* A person who has the responsibility of giving the task to devlop a system and the assignment of other roles in the environment.

b) *Informant :* A person who is specifying information about the organizational and the hardware requirements and about the data to be stored in the information system.

c) *Acceptor :* A person who is responsible of the approval of the complete intermediate requirement specifications and the final operational system.

d) *User :* A person who plans and manages all development activities and the related resources.

e) *Analyst :* A person who performs the analysis stage of the project in which the system scope is defined and the current system in described (the modeller).

f) *Designer :* A person who develops the specifications of the new system (the modeller).

g) *constructor :* A person who constructs and documents the information system on the basis of the requirements' specification.

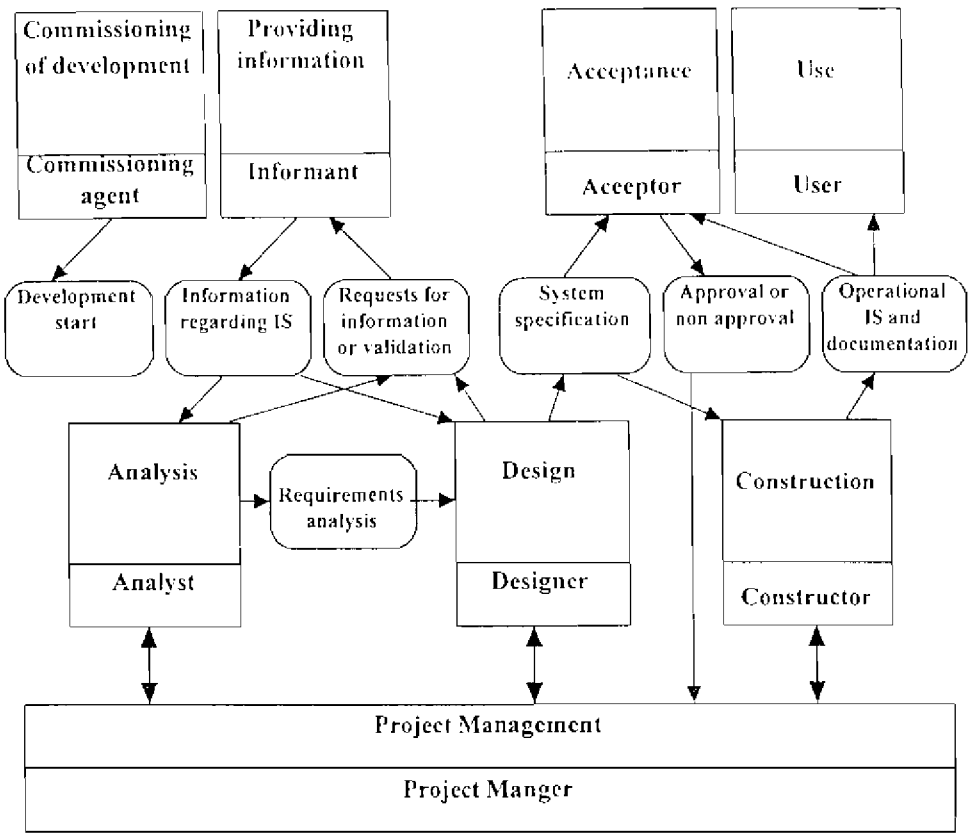

Figure 2: Process structure and cast of a development project

6. A VIEW TO METHODS, TECHNIQUES, AND TOOLS

Definition (2) :

"The methodology of information systems development is the systematic description, explanation and evaluation of all aspects of methodical information systems development" [8].

Even so, methodological schools differ: SWE, DBMS, MIS, and infological approach, It is a differentiation which can be considered as one of the causes of software crisis.

Definition (3) :

"A method is an approach, based on a certain way of thinking, to carry out an information system development process, consisting of directions and rules structured according to a systematic ordering of development activities and corresponding development process" [8].

Examples are: ISAC, IEM, and SDM [9].

Definition [4] :

"A technique provides the description of the manner in which, and the notation with which a part of the development must take place. This incorporates the practical steps to follow when carrying out a development" [8].

Examples are : process decomposition, affinity analysis, change analysis, and group interviewing [9].

Definition (5) :

"A notation is a system of symbols with a corresponding set rules, which determine the correct application of the symbols. A notation is used to denote the results of a technique" [8].

Examples are : decomposition diagram, association matrix, and NIAM [9].

Definition (6) :

"A tool is a possibly automated mean to carry out a part of the development process. A tools may support a notation, a technique, or even a method" [8].

Examples are : Designer 2000, Developer 2000 of Oracle, Power Builder of Sybase, and Newera of Informix [9].

7. MODELS OF INFORMATION SYSTEMS

It is known [3] that there are 3 classes of systems:

- *Conceptual systems* : Systems of which entities are concepts or things in the minds of people (e.g. Set theory).
- *Concrete systems* : Systems of which entities are concrete objects (e. g. hardware systems).
- Symbolic systems : Systems of which entities are uninterpreted syntactical symbols (e. g. C - language).

From definition (1), models are systems stand in a particular relation with another system, so we may have nine possible cases, only four of them will be considered as shown in figure 3. It shows the nine possible transformations among the 3 types of systems. Each is a model type. We will consider: conceptualization, mapping, representations, and translation.

- *Conceptualization model* : Such a model may result after the observation of a concrete system. It is the heart of the analysis phase.
- *Mapping model* : It is the conceptual model of a conceptual system (e. g. transfer from DFD [10] to TSAC technique [11].
- *Representation model* : It is the symbolic model of a symbolic system (e. g. the activity model of the DFD).
- *Translation model* : It is the symbolic model of a symbolic system (e. g. the transfer of data flow activity to the ISAC activity technique [11]).

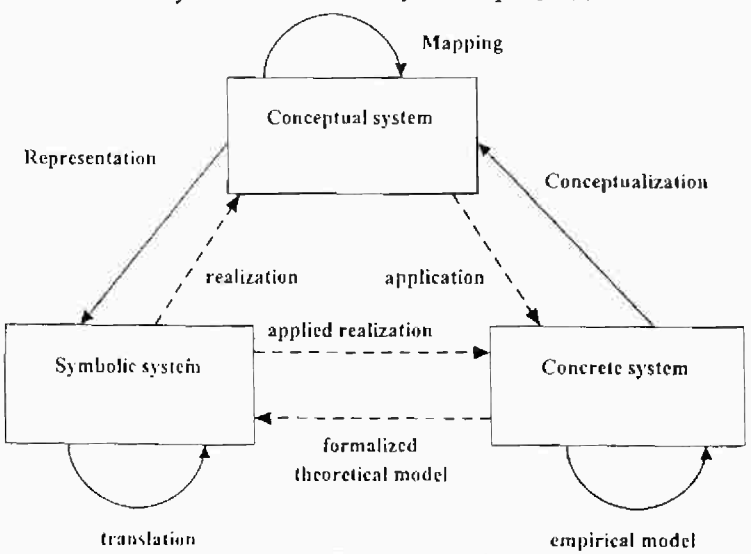

Figure 3 : The model triangle

This clarifies the use of models during the development of information systems and their study with the help of meta-modelling. [7]. This will lead to the following definition as the very first step to use the set theory as the basis of a "mathematics" of the analysis phase.

Definition (7) :

"A Universe of Discourse (UoD) is a system of concrete entities which were, are, or will be relevant to a given objective. An information system is a manual, partially automated, or fully automated system of symbolic entities, representing facts about concrete entities, that are recorded because of their relevance with respect to a given objective, and that can be updated, retrieved, and from which other facts, can be derived". Figure 4 clarifirs the above definition.

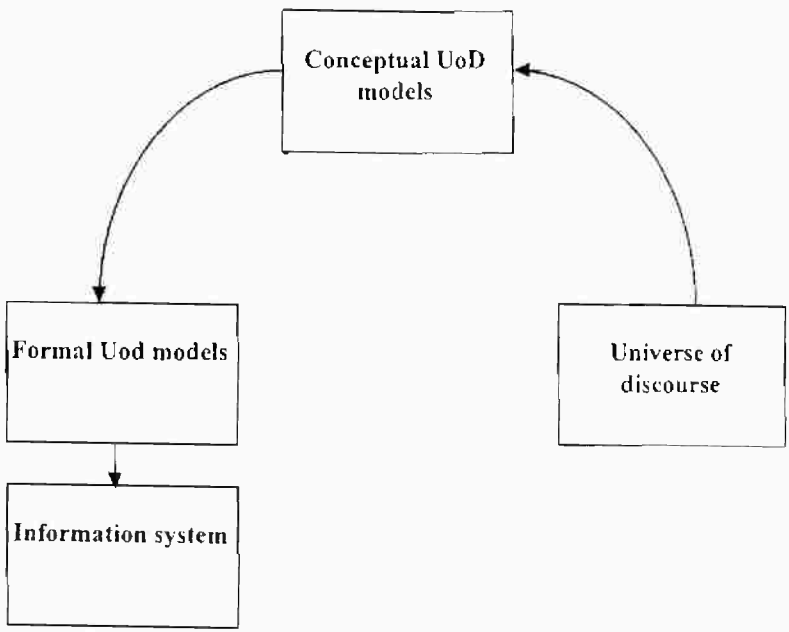

Figure 4 : Information systems modelling

8. FORMAL VISUALS

Many diagrammatic techniques are used for representation in the information modelling process. An overview of the most popular ones can be found in [11]. A modelling technique is a visual formalization if it is based on mathematical theory with a corresponding graphical notation, i.e. the existing techniques can be extended with a rigorous definition of their semantics which formalizes the visual techniques.

9. FUTURE WORK AND EXTENSION

This paper may be considered as an introduction to a series of research work concerning the formalization of information systems. Although, there exist a variety of methods, techniques and tools which can be used during the system development life cycle, their wide range of rules, and use may now cause problems than they may solve. Mathematical modeelling needs precise definitions of every and each aspect of information system developing process.

In this context, further work is currently done to include meta modelling, mathematical data models, models of context diagrams, Data Flow Diagrams, Tasks, Processes and Activities.

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