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What should be taught on Knowledge Formulation: Current Situation of Information Systems Education in Japan

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WHAT SHOULD BE TAUGHT ON KNOWLEDGE FORMULATION

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Abstract

It is our standpoint that Information Systems as a discipline can be characterized by three points, from control to support, from tacit knowledge to formulated knowledge and from system side to used side. In this paper, we focus on the second point.

Based on the current situation in information systems education, we discuss on what should be taught on knowledge formulation.

1 Introduction

Though "management information systems" as a discipline is recently called "information aystems" in this field[Sprague et al., 1993], it is generally accepted to call it as "management informatics" or "management information theory" in Japan. It is because there is a big need to utilize I/T(Information Technology) in management in Japan. In this paper, we use both terms interchangeably.

Current situation in higher education among colleges, universities and graduate schools on information systems in Japan can be stated as follows[Fujita et al., 1993],

- It becomes popular to establish departments and/or faculties called "management informatics".
- Current curricula for management infomatics education are in chaos.
- It is a serious issue for students in the field to learn mathematics.

Based on the above recognition for the current situation in higher education on management informatics, we have been studying to characterize "management informatics" as a discipline. As a result at the present stage, we recognize that management informatics can be characterized by the following three points[Iijima et al., 1993]

1. from control to support,
2. from tacit knowledge to formulated knowledge, and
3. from system side to user side.

In this paper, we focus on the second point.

Firstly, we state our viewpoint on management informatics as a discipline. Then we show the necessity of teaching knowledge formulation. Finally we show an idea on how to teach knowledge formulation in the curricula of management informatics.

2 Information Systems as Discipline

There are several discussions on how we recognize information systems as a discipline. For example, Banville and Landry states that Management Information Systems is a pluralistic scientific field[Banville et al., 1989].

We have been studying to characterize management informatics as a discipline in the SIG for the research on curricula on management informatics in the Japan Society for Management Information(JASMIN). We recognize that management informatics can be characterized by the following three points[Fujita et al., 1993].

1. From Control to Support

   It can be said that twentieth century is named by "the century of control". Most important point in control is how to control units in order to achieve the overall objective.

   The first characteristics of management informatics should be against it. That is, we should move stress from the concept of control to the concept of support.

2. From Tacit Knowledge to Formulated Knowledge

   According to the information paradigm in organization theory, the central topic in business is problem solving. Therefore it is quite important how

to formulate problematic situation into a explicit problem.

The traditional management forcused on tacit knowledge or knowledge which is not the object of being handled with computers. Formalization is necessary in order to link problem solving with I/T including computers and it is also important to design something based on the knowledge obtained in Management Informatics. That is, it is necessary to generalize several types of I/T applyance in different business enterprize, and make it as public knowledge in the sense of Popper. It is of course that knowledge on systems including human activity cannot become as a public knowledge in real sense, we should proceed our research towards to organize knowledge in order to design something based on them. The suggestion by IFIP/BCS also insists on the importance on formalization and abstraction[Buchingham et al., 1987].

What methodology is appropriate to formulate knowledge in order to construct public knowledge in Management Informatics? There are several alternatives. One of alternatives is the formal approach in systems theory. The approach is to formulate the hidden structure of phenomena with set theoretical notation and abstract mathematics. It is clear that the concept of "structure" and "homomorphisms" are one of key concepts in systems theory from its origin.

3. From System Side to User Side

   According to the water fall approach in software development, management informatics mainly focused on the upper part in the lifecycle, that is, analysis of business and construct a specification of information systems appropriate to the analyzed system. In this sense, the third characteristic of Management Informatics is user oriented approach.

There are several research on the curricula on information systems[Buckingham et al., 1987, Nunamaker et al., 1982]. There is, however, quite few research that starts the characterization of Information Systems as a discipline and suggests a curricula based on it.

3 Knowledge Formulation

Management informatics can be considered as a discipline obtained by the result of the paradigm shift from management in the sense that management informatics lay more stress on I/T usage than management. Therefore formulation of knowledge is an indispensable activity in order to link problems in the real world with I/T including computers.

As in the reference[Fujita et al., 1995, Fujita and Watanabe, 1995], we would like to suggest a curriculum with five islands. In this paper, we state the island of "Knowledge".

It is necessary to formulate problems if we are to solve them with I/T. And therefore the aim of this island is to provide concepts and techniques for formulation. Systems theoretical thinking and modelling techniques are the entrance of the island for they are considered as basis for knowledge formulation in Management Informatics. Adding that, it is necessary to teach conceptual foundations for problem solving and practical methods in order to formulate and solve problems. It is of course necessary for students to use computers in order to understand the necessity of formulation.

We would like to propose the following four points to be taught on knowledge formulation.

1. Knowledge Formulation and Information Systems
2. Knowledge Formulation
3. Methodology in Knowledge Formulation
4. Knowledge Representation, Transformation and Utilization

4 Methodology in Knowledge Formulation

In this section, we state on the section of "methodology in knowledge formulation" that can be thought as one of characteristics in our approach.

As stated before, several algorithms have been taught as central topics in this field. And it is rarely taught why these algorithms are useful in problem solving in the real world. If management informatics are user oriented as mentioned, it is necessary to teach them from the viewpoint of problem solving based on problems in the real world. Adding that, mathematics in the curricula of management informatics should be placed as a basis for understanding why it can be solved with these algorithms and what is the conditions to apply these algorithms.

There are a lot of varieties in real world problems. Therefore it is impossible to explain how to solve all of those problems. Then it is necessary to use an abstract model. We propose input-output system models and goal-seeking systems models that are well-known in systems theory for that purpose. Using those abstract models, we can explain specific models and algorithms to get a solution for problems described in those models. Consequently, we propose to teach it in the phases consists of problem description, models and algorithms.

In order to clarify the idea, we use mathematical programming as an example.

Example 1 *mathematical programming*

1. *Problem Description*

   A typical problem description is as follows,

   "X Co. produces two products P_1 and P_2. Three sorts of materials M_1, M_2 and M_3 are neeeded to produce those products. Minimum required amounts of each materials to produce P_1 and P_2 are given and maximum amount of those materials are given. Then management wishes to konw how much of each products should be produced to maximize profit."

   If we considere maximum amounts of resources as external variables, production amounts as decision variables and consumption of resources as a process, it is a problem to get an alternative that maximiza profit. That is, an objective function is profit and decision principle is maximization.

2. *Model*

   Since all of the objective function and constraints are linear, this type of problem is knoum as a linear programming problem. And generally a problem to find a solution that maximize(minimize) objective function(s) subject to several constraints is called a mathematical programming problem. And nonlinear programming, integer programming and dynamic programming are known as mathematica programming problem.

3. *Algorithm*

   The simplex method is well-known linear programming. While for nonliear programming, Newton's method, steepest descent method and conjugate direction method are known.

As mathematical background, it is necessary to have fundamental knowledge in linear algebras for linear programming.

5 Conclusion

In this paper, we state on what should be taught on knowledge formulation based on the current situation of information systems education in Japan and our standpoint on what information systems is as a discipline. We show the necessity of teaching knowledge formulation and suggest an idea on how to teach methodology in knowledge formulation in the curricula of management informatics. Especially, we propose what and how should be taught on methodology in knowledge formulation.

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