USING AN INFORMATION SYSTEM STATUS MODEL FOR SYSTEMS ANALYSIS AND DESIGN: A MISSING DIMENSION

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ABSTRACT: Computer information systems instructors and students would benefit from the use of an information system status model as a conceptual framework when teaching and learning systems analysis and design concepts. Use of this or similar frameworks is a missing dimension in the discussion of systems analysis and design concepts found in many current CIS texts, which concentrate on the use of various process models and methods. Students could do a better job of identifying the activities, resources, and products of an information system if their instructors would teach them to use conceptual status models, i.e., models and methods that spotlight the status of the basic components of an information system. This would provide a comprehensive and cohesive conceptual framework which students could use as a checklist in guiding their analysis and design of an information system.

KEYWORDS: Status Models of Information Systems, System Component Matrix, Systems Analysis and Design.

INTRODUCTION

The information systems discipline could benefit from the use of both *process models* and *status models* of information systems in communicating systems analysis and design concepts. Other disciplines, such as accounting, emphasize the use of both types of models. A *process model* is a *dynamic* model that portrays the process that occurs in a system. That is, the components of a system are linked by dynamic relationships that reveal a flow of resources between system components. Thus, a process model allows us to view a financial system as a process of money flows, while an information system can be viewed as a process of data flows.

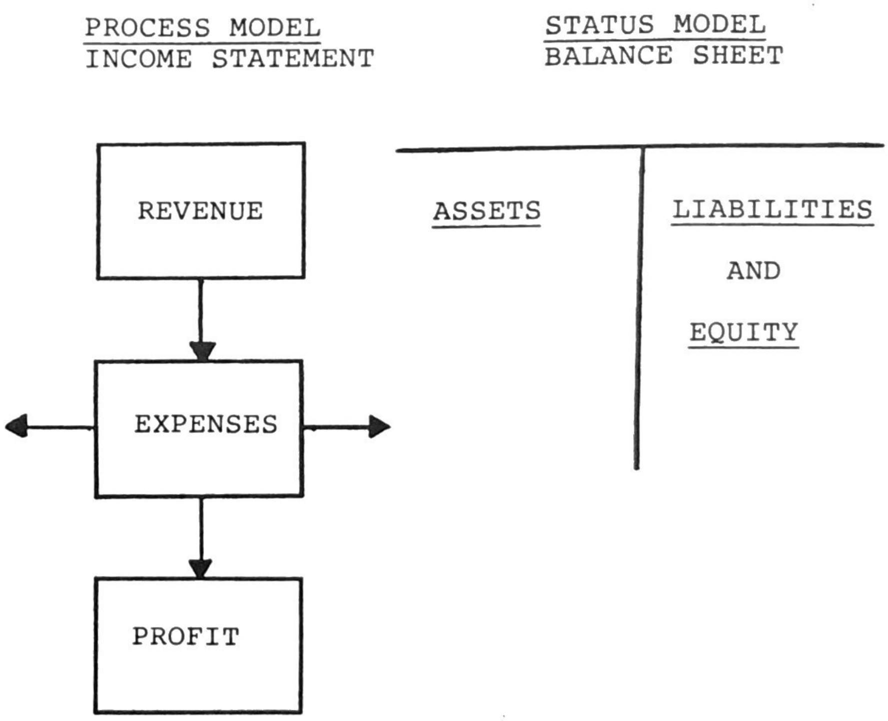
A *status model*, on the other hand, is a *static* model that portrays the status of the components of a system. It "freezes" the relationships that may exist in a dynamic system, thus viewing it as if it were a static system. This allows a status model to reveal the relative condition or composition, i.e. the "status", of each system component. For example, a status model could reveal the status of financial resources in an accounting system, or the status of hardware, software, or data resources in an information system.

PROCESS AND STATUS MODELS IN ACCOUNTING

Before discussing the use of status models of information systems, it might be well to look at examples from a related discipline. The field of accounting relies on many conceptual models, but two of them predominate. These are the models that underlie the balance sheet and income statement, the two fundamental financial statements of a business firm.

As Figure 1 illustrates, one can visualize the income statement as representing a process model; how revenue flowed into the firm, what expenses drained revenue away, and what profit if any, remained during a fiscal period. The balance sheet, on the other hand, represents a status model; the assets, liabilities and equity of a firm at an instant in time. Both models are vitally important to evaluating the financial performance and position of a business firm. Using one to the exclusion of the other would seriously impair the proper financial analysis and management of a firm.

Figure 1: Models For Financial Analysis and Design



PROCESS AND STATUS MODELS IN INFORMATION SYSTEMS

Many texts (and by inference, many courses) in information systems concentrate almost exclusively on process models or data models when discussing systems analysis and design concepts and the systems development life cycle. This holds true for introductory CIS texts, more advanced MIS texts, and systems analysis and design texts. In particular, they concentrate on the use of various systems development tools and methodologies, i.e., system flowcharts, data flow diagrams, and so on, which emphasize viewing an information system as process or sequence of data flows.

Figure 2 illustrates such a process model using a generic data flow diagram. Such vitally important concepts and methodologies are indispensable to effective information system development. The authors do not wish to suggest otherwise. However, something important is missed when such models are used exclusively.

For example, trying to explain the important parts of a real world information system to an end user, manager, or non-CIS student using a process model such as a data flow diagram is frequently a frustrating experience. Having them attempt to identify important system components using such tools is even more difficult.

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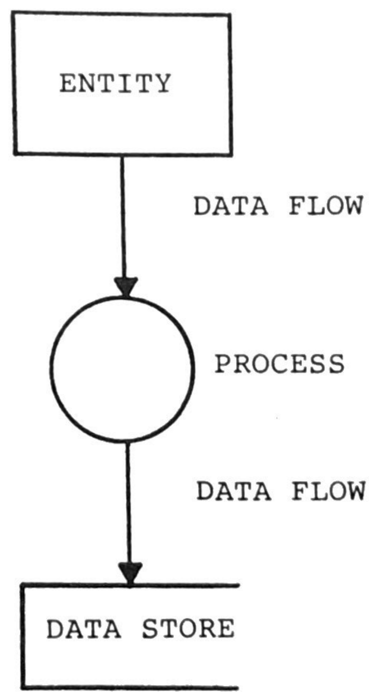
There must be another way to communicate (and understand) important facts about a present or proposed information system for persons who are not skilled in the use of process models or data models of information systems. There is, as Figure 2 also illustrates. It is the use of a *status model of information systems*, and in particular, a *system component matrix* as a tool to reveal the status of the basic components of an information system [4]. This can provide a comprehensive and cohesive conceptual framework which can be used to better understand and communicate the important features of an information system, especially for non-CIS students and end users.

COMPETING STATUS MODELS

There are several competing status models of information systems, including those by Davis [1], Kroenke [2], McLeod [3], O'Brien [4], Wetherbe [5], Whitten, Bentley, Ho [6], and others. They have some important similarities as well as some important differences. For example, Davis [1] introduced a *management information system model* in 1974 with five basic components: hardware, software, a database, procedures, and models. McLeod [3] introduced a model of the MIS in 1979 whose components included hardware, software, a database, information specialists, and managers. Also in 1979, Wetherbe [5] introduced a model of an information system whose five components consisted of hardware, software, files, procedures and personnel. In 1980, Kroenke [2] introduced a model which included hardware, programs, data, procedures, and personnel as the five components of a business computer system. Whitten, Bentley and Ho [6] introduced their model of an information system in 1986. Its components include input (information), processing (computer equipment programs, methods and procedures, and knowledge workers), data

Figure 2: Models For Systems Analysis and Design

PROCESS MODEL
DATA FLOW DIAGRAM



STATUS MODEL
SYSTEM COMPONENT MATRIX

Information System Activities	Hardware Resources		Software Resources		People Resources		Data Resources	Information Products
	Machines	Media	Programs	Procedures	Specialists	Users		
Input								
Processing								
Output								
Storage								
Control								

storage, and internal controls.

AN INFORMATION SYSTEMS STATUS MODEL

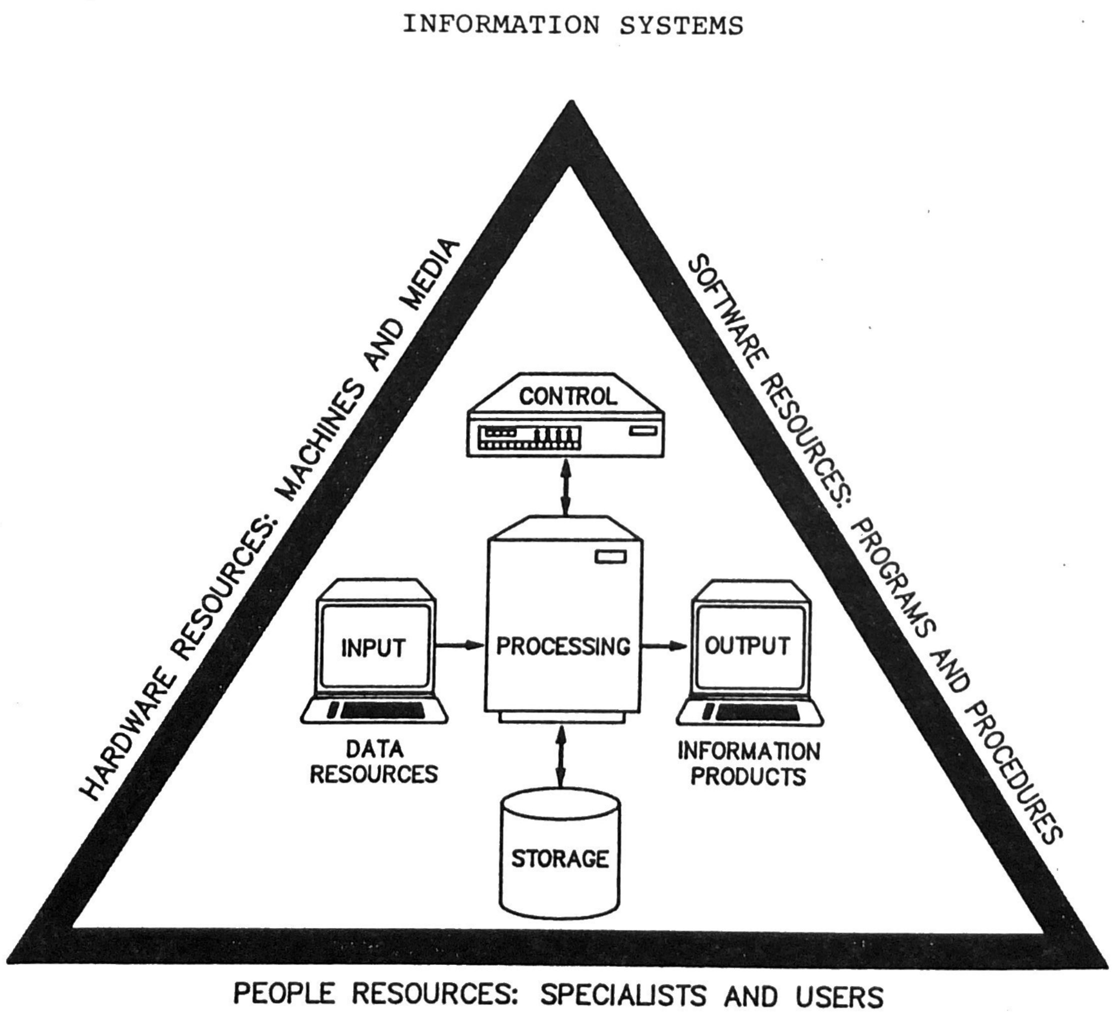
This article concentrates on the use of the information systems model, which one of the authors introduced in 1982 [4]. Figure 3 illustrates a basic form of this status model of information systems. Stated succinctly, this model holds that "an information system uses the resources of hardware (machines and media), software (programs and procedures), and people (specialists and users), to perform input, processing, output, storage, and control activities that transform data resources into information products."

THE STATUS MODEL AND SYSTEMS ANALYSIS

How are such status models applied to systems analysis and design? Fundamentally, the systems development cycle must include a process where information systems professionals and end users determine how the important information system components outlined in a status model are and should be accomplished for a particular business activity. Basic questions systems analysis and design must answer if the information systems model is used will then include:

* **Input.** How is data captured and

Figure 3: The Information Systems Model



prepared for processing? How should it be? What data resources are or should be captured?

* **Processing.** How is data manipulated and transformed into information? How should it be? What processing alternatives should be considered?

* **Output.** How is information communicated to users? How should it be? What information products are and should be produced?

* **Storage.** How are data and information resources organized, stored, updated, and retrieved? How should they be?

* **Control.** How are input, processing, output, and storage activities monitored and controlled? How should they be? What control methods should be considered?

* **Hardware, software, and people resources.** What hardware (machines, and media), software (programs and procedures), and people (specialists and users) are or should be used to accomplish each of the information system activities of this system?

DOCUMENTING THE USE OF A STATUS MODEL

The answers to such questions can be organized and documented several different ways. One method uses a simple outline of the activities, resources, and products of the information system being studied, organized according to the conceptual framework of the information systems model. Figure 4 is such an outline for the sales processing system at a hypothetical retail store. The outline contains only the information that an end user can easily discover (and digest) for this particular information system.

THE SYSTEM COMPONENT MATRIX

A more formal method to document the use of a status model is the use of a *system component matrix* based on the conceptual framework of the information systems model [4]. Figure 5 illustrates the use of a system component matrix to reveal some of the basic components of the same retail sales processing system example used in the previous outline. This method is more difficult to use, since it demands information for each cell of the matrix that may not be readily available or appropriate. Thus duplicate cell entries or blank cells may occur. However, one must realize that a variety of system resources and products are used to support each system activity. Therefore, duplicate cell entries and blank cells are understandable. This facilitates the task of constructing a system component matrix. Also, it must be remembered that the primary purpose of this tool is to emphasize that hardware, software, people, and data resources and information products may be needed to support each of the information processing activities of an information system. Thus the system component matrix can serve as a useful "checklist" in guiding the analysis and design efforts of students.

CONCLUSION

Information systems instructors and students would benefit from the use of a status model of information systems when teaching and learning concepts of systems analysis and design. Students should be better able to analyze the activities needed, resources used, and products produced by an information system if their instructors have stressed the use of a tool such as the system component matrix. This gives them a comprehensive and cohesive conceptual framework which they can us in their analysis.

The authors have been using information system status models when teaching systems analysis and design concepts for several years. This has occurred in introductory CIS courses, upper-division MIS and systems analysis and design courses, and MIS courses for MBA students. The use of a tool such as a system component matrix seems to help students do a more effective and efficient job of identifying the important aspects of real-world information systems, i.e., the major information processing activities, resources and products involved (systems analysis). It also helps focus their efforts to suggest improvements or alternatives to such information systems (systems design). This has been particularly true of non-CIS students at all levels who have a harder time understanding and using process models of information systems. But it has also helped CIS majors focus on these important system properties, giving them another perspective to complement process and data models and methods when analyzing and designing information systems.

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Figure 4: Outline of Information Systems Activities, Resources, and Products

I. Information System Resources and Products

1. **Hardware Resources** - (Machines and Media)

   Machines: point of sale terminals; store computer; personal computers; optical scanning wands; magnetic disk drives; video display terminals; printers.

   Media: magnetic disks, paper merchandise tags; plastic credit cards with magnetic stripe; paper sales receipts; paper reports.

2. **Software Resources** - (Programs and Procedures)

   Programs for sales transaction processing, sales analysis, system control, database management, and electronic spreadsheets. Procedures for POS terminal input, error correction, credit authorization, computer backup and recovery, and sales analysis interpretation.

3. **People Resources** - (Specialists and End Users)

   Specialists: computer operators; systems analysts; programmers; vice president for information systems. Users: customers, sales clerks; buyers; store manager.

4. **Data Resources** - (Captured and Stored Data)

   Customer data; product data; sales person data; department data; store data; company data. Some data are captured by input activities. Other data are stored in files on magnetic disks.

5. **Information Products** - (Displays, Reports, Documents, etc.)

   Video displays for sales clerks, buyers, and managers; paper reports for managers; paper sales receipts for customers; audible signals for sales clerks.

II. Information System Activities

1. **Input of Data Resources**
   Data describing sales transactions is collected by sales clerks using POS terminals and other devices and entered into the information system according to established procedures.

2. **Processing of Data Resources**
   The sales data is manipulated by a computer according to instructions contained in sales transaction processing and analysis programs and in other programs. Customer and sales data in storage is updated, and information products are prepared for output.

3. **Output of Information Products**
   Sales analysis displays and reports are produced for managers and buyers. These information products reveal important trends in sales activities organized according to such categories as: customer, product, sales person, and department. Audible signals and visual displays of data entry are provided to sales clerks. Sales receipts are produced for customers.

4. **Storage of Data and Information Resources**
   Sales data are stored as records and files on magnetic disk units. This data, along with historical sales data and sales forecast, are updated and retrieved by the processing function.

5. **Control of System Performance**
   Various methods are used to control information system performance. For example, hardware contains circuitry that can detect malfunctions during processing. Programs contain instructions that can detect errors during data entry and alert sales people with audible signals and video displays. Procedures help the sales clerks detect and correct errors and provide proper service. Sales receipts allow customers to monitor the accuracy of the system.

FIGURE 5: A System Component Matrix for Sales Processing System

INFORMATION PROCESSING ACTIVITIES	HARDWARE RESOURCES		SOFTWARE RESOURCES		PEOPLE RESOURCES		DATA RESOURCES	INFORMATION PRODUCTS
	MACHINES	MEDIA	PROGRAMS	PROCEDURES	SPECIALISTS	USERS		
INPUT	POS TERMINALS	BAR TAGS	DATA ENTRY PROGRAM	DATA ENTRY PROCEDURES		SALES-CLERKS CUSTOMERS	CUSTOMER DATA PRODUCT DATA	DATA ENTRY DISPLAYS
PROCESSING	MAIN-FRAME COMPUTER		SALES PROCES-SING PROGRAM SALES ANALYSIS PROGRAM	SALES TRANSAC-TION PROCEDURES	COMPUTER OPERATORS	SALES-CLERKS MANAGERS	COMPANY DATABASES	PROCESSING STATUS DISPLAYS
OUTPUT	POS TERMINALS MANAGEMENT WORK-STATIONS	PAPER REPORTS	REPORT GENERATOR PROGRAM GRAPHICS PROGRAMS	OUTPUT USE AND DISTRI-BUTION PROCEDURES		SALES-CLERKS MANAGERS CUSTOMERS		SALES RECEIPTS SALES ANALYSIS REPORTS & DISPLAYS
STORAGE	MAGNETIC DISK UNITS	MAGNETIC DISK PACKS	DATABASE MANAGEMENT SYSTEM PROGRAM		COMPUTER OPERATORS		COMPANY DATABASES	
CONTROL	POS TERMINALS MANAGE-MENT WORK-STATIONS	PAPER DOCUMENTS AND CONTROL REPORTS	PERFOR-MANCE MONITOR PROGRAM SECURITY MONITOR PROGRAM	CORRECTION PROCEDURES	COMPUTER OPERATORS	SALES-CLERKS MANAGERS CUSTOMERS	COMPANY DATABASES	DATA ENTRY DISPLAYS SALES RECEIPTS ERROR DISPLAYS & SIGNALS

AUTHORS' BIOGRAPHY

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