

# A design for a management information system with consideration for stochastic variability

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## Abstract

A management information system (MIS) is one of the important systems to control materials and information harmoniously. The previous design approaches dealt with it qualitatively. Therefore, it was impossible to smooth the office works in the management system. In this paper, we design the MIS using a stochastic Petri net (SPN). First, we describe a typical MIS and explain the concept of SPN. Next, we construct the MIS as the SPN model and obtain the total expected sojourn time of documents in each section. Finally, we propose the design for the MIS with consideration for the smoothing of the office works. © 1999 Elsevier Science B.V. All rights reserved.

*Keywords:* Information technology; Management information system; Smoothing of office works

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## 1. Introduction

A management information system (MIS) is one of the important systems to control materials and information harmoniously. The MIS is now expressed by the following keywords: (1) network, (2) open system, (3) down sizing, (4) multi-vendor and, that is to say by the other words, as “4F and 1R”, (1) Fast, (2) Flexible, (3) Flat, (4) Fusion, (5) Real. Today, most people say that the data should be processed at the place where the data occurs, and should be returned and fed back quickly with real time. In addition, network and database are required in order to utilize the huge volume of data

effectively. Such an information system should not be constituted by the style of a conventional batch system, but by the form of an integrated or total system.

Now, we shall imagine a small-scale retail store, e.g., a fruit store, a vegetable store, a drag store, and a fresh fish store, etc. In such stores, originally the master would be a system like the random and real-time access information processing. On the other hand the master deals with sales commodities, schedules of purchasing plan and checks the amount of stock, and so on. Then, he could get all the required information only by his own activities, and therefore would be able to make accurate decisions. The master becomes equivalent to the integrated management system or the total management system itself. As we know from the case above, when we do not use a computer in

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conventional business, it is quite natural to deal with and control the management and/or the production information by the form of an integrated or total system. In this way, as long as the size of the business is small, the manager can control management organization or function intuitively and easily.

However, after the computers and electronic data processing system (EDPS) became the standard tools in business, according to the progress of factory automation and office automation, the management organization became separated and specialized. Furthermore, the data processing interval becomes long, and the unprocessed management information increases in accordance with the increase of the computer's processing capacity. Consequently, the remarkable delay of the feedback information which is required for managers or foremen would also occur. Recently, a data and function oriented approach (DFOA) has been proposed as a concept of a design for the MIS [1,2]. This approach enables the designers to easily design and understand the huge MIS without expert knowledge for the management. The style of the analysis and design has been proceeded from the static point of view. That is, it was not a quantitative, but a qualitative method. Hence, it was impossible to smooth the office work load in the system.

In this paper, we investigate the MIS using a stochastic Petri net (SPN). The SPN is recognized as a modeling tool for analyzing the performance of discrete-event systems with stochastic variability. It enables one to find the existence of imbalances in such a system, and to improve on those points. In Section 2, we consider a typical MIS which consists of four sections in a model company. Furthermore, the MIS is expressed by an office flowchart. In Section 3, we explain the concept of the Petri nets. The SPN is introduced as a kind of Petri net where each transition is associated with an exponentially distributed random variable which expresses the delay from the enabling to the firing of the transition. In Section 4, we model the typical MIS as the SPN. In Section 5, the expected sojourn time of documents in each place is obtained by simulation. Moreover, we reconstruct the framework of the sections of the MIS, and propose the design for the MIS with consideration for the smoothing of the office works.

## 2. Description of the MIS

The ideal style of the integrated or total management system should be constructed so as to gather the required information easily and quickly by the form required in each field. That is to say, data do not exist to be recorded and accumulated in files but also to feedback or feedforward in order to circulate all over the management organization and utilized for all purpose, like the blood in the body. Blood plays an important role to change energy, to refresh and to restrict our body, day by day. Management organization is also changeable to a company with management circumstances as well as in the case of human organization. When the circumstance of management changes, the company should acquire the data in order to know its changes. Furthermore, the data should be utilized to restructure the management organization in the same way as the blood in human organization. For the purpose of clearing those problems, there are various approaches to investigate the office works. The office flowchart is one of the effective approaches in the previous studies. It is known as a qualitative approach to the data flow analysis. The office works and the corresponding notations of a typical flowchart are shown in Table 1.

We now consider a typical MIS in a model company. The system consists of four sections, i.e., the sales, the process management, the material purchasing and the production section. Each section has the work shown in Table 1. For example, Fig. 1 illustrates the sales section and the process management section of the MIS denoted by the office flowchart.

Table 1  
Notations of office works

Meaning	Notation
Posting	
Check	
Collection	
Custory	

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