

# Planning Problems of Flexible Manufacturing System

이 국철(국민대학교)

## Abstract

A Flexible Manufacturing System(FMS) is an automated batch manufacturing system which is designed to produce different part types with the efficiency of mass production systems and the flexibility of job shops. There are various design, planning and control issues surrounding an FMS, which are quite different from traditional operations management problems. In order to fully exploit the advantages of this new technology, these issues need to be addressed carefully throughout the life cycle of an FMS.

In general, FMS problems are grouped into four stages: design, planning, scheduling and control. At each stage, several important decisions must be made. The focus of this paper is to analyze the problems associated with the planning stage of an FMS including batching and machine loading problems which exist as smaller subproblems of the planning function. In this paper, a comprehensive integer

program (IP) is formulated for the FMS planning and is solved using the LINDO program package which yields an optimal solution to relatively small problems. In addition, for use in the solution of real industry cases, two heuristic batching methods are developed as substitutes for the exact IP method.

"Heuristic GC (Group Compatibility)" is developed based on the concept of group compatibility. This new concept is defined and measured quantitatively. "Heuristic SIP (Simplified Integer Program)" is also developed as a simplified version of the original integer program. In this case, the parts-tools-machines relationship is aggregated as a higher level function.

The performance of the two heuristics is tested through two stages of experimental study. First, for small problems, the solutions found by the two heuristic methods and one exact method are compared. The computational experience is also examined. Secondly, an evaluation of the performance of heuristic methods for larger problems based on data collected from an existing FMS is undertaken. The results of this experiment provide valuable information for practitioners who are considering FMS planning problems.

Intelligent Production Planning System  
Using the Post-Model Analysis Approach

Jae Kyu Lee \*  
Byung Sun Kang \*\*

(Dept. of Management Science  
KAIST)

ABSTRACT

This paper proposes the use of the Post-Model Analysis(PMA) approach to handle qualitative factors in aggregate production planning problems. The PMA approach excludes qualitative factors such as employee's morale and customer's goodwill from the optimization model. Instead, these factors are represented in a rule-type knowledge base. This approach automatically evaluates the optimal feasible solution that minimizes the cost function in terms of employee's morale and customer's goodwill. If any of the currently achieved goals are unsatisfactory, the tradeoffs may be invoked under the support of the non-dominated opportunity costs that are generated.

The formulation and solution process of the aggregate production planning problem by the PMA approach and its decision support system named IPPS(Intelligent Production Planning System) is described. The IPPS consists of a model management system, a knowledge management system, a PMA controller, and a data management system. The paper also demonstrates an illustrated dialogue using IPPS.

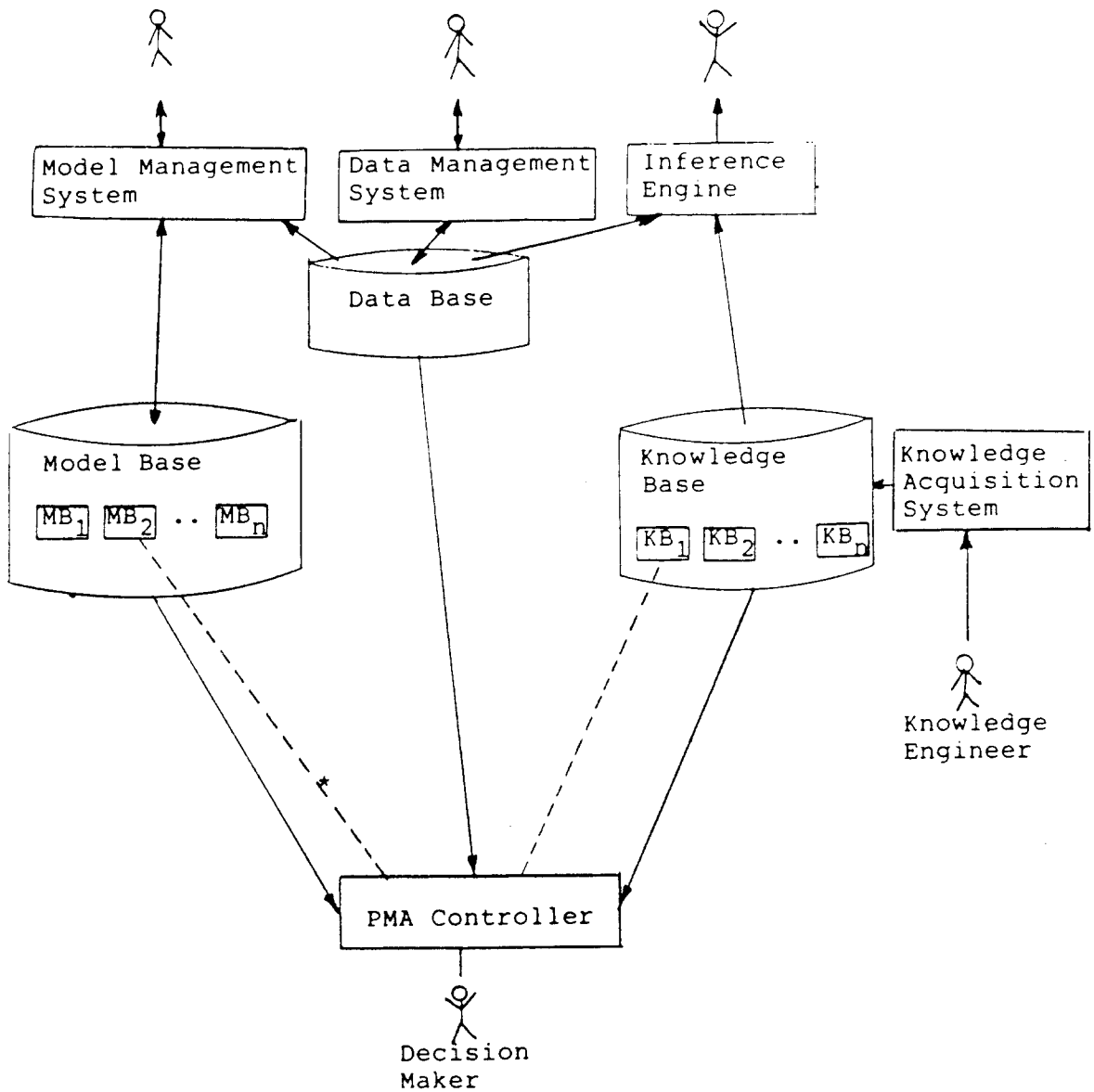


Figure 1. Overall Architecture of the Intelligent Production Planning System

---

\* The dashed lines imply that the Model 2 and the Knowledge Base 1 are currently selected for a particular PMA process.

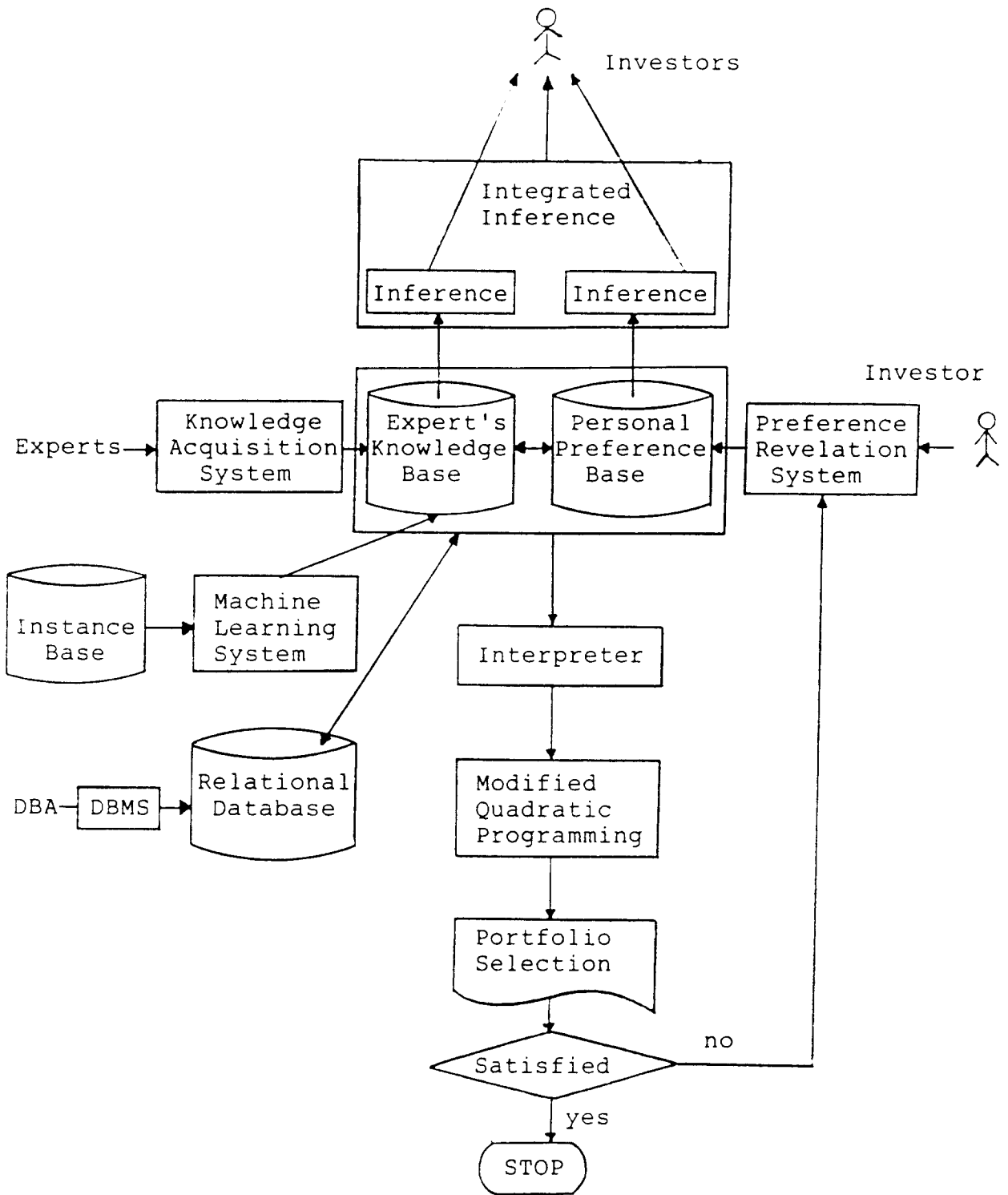
Intelligent Stock Portfolio  
Management System

Jae Kyu Lee  
Seok Chin Chu  
Hyun Soo Kim

Department of Management Science  
Korea Advanced Institute of Science and Technology  
P.O. Box 150, Cheongryang, Seoul, Korea

Abstract

For the selection of stock portfolio, the optimization models or expert systems are utilized separately. To take advantage of both approaches, the integration of optimization model and expert system is attempted. The proposed architecture - ISPMS (Intelligent Stock Portfolio Management System) - accomplishes the integration by interpreting the knowledge as a part of the formulation of optimization model. The other generic issues in the ISPMS are the integration of personal preference with the expert's knowledge and the knowledge acquisition by machine learning. This paper thus describes the representation and the inference of an expert's knowledge, the representation of personal preference and its integration with the expert's knowledge, and the interpretation of the knowledge and the preference to associate with optimization model, and solution algorithm of modified model accordingly.



Architecture of ISPMS

# An Inductive Learning in Time Series Modeling :

## Pattern Recognition Approach

Kun-Chang Lee & Sung-Joo Park

*Department of Management Science  
Korea Advanced Institute of Science and Technology*

### ABSTRACT

We deal exclusively with an autoregressive-moving average (ARMA) model, that is, ARMA( $p, q$ ). Major emphasis of this paper is focused on the specification of  $p$  and  $q$ , what is called *time series modeling*, with the aid of the concept of pattern recognition. Statistical modeling methods developed so far have following disadvantages in common- 1) they usually relies upon complex statistical derivations and 2) they have no mechanism for accumulating knowledges about input series which will be helpful later in the case of modeling the series of similar properties. We propose an inductive learning process to overcome two drawbacks above. The learning is based on nonparametric and iterative process, in which a conclusion is derived on the basis of learned examples. The approach proposed differs drastically from traditional statistical methods in view of the fact that  $p$  and  $q$  are specified by matching the pattern of input series with one of ARMA models. Experiments with a prototype system demonstrate that the learning presented shows a satisfactory performance in suggesting a correct model for input series. Conspicuous contributions of this approach can be summarized such that 1) it considerably reduced the possibility of over- or under-identification problem which has been frequently debated in statistical time series modeling methods and 2) its heuristics that the system can be adapted to new patterns could eliminate complexities involved in statistical modeling methods.

## 제 4 발표장



## Abstract

### A NEW ALGORITHM FOR THE MAXIMAL CLOSURE PROBLEM

by Kiseog Kim

A closure in a graph is defined as a subset of nodes such that if a node belongs to the subset, then all its successor nodes also belong to the subset. The maximal closure problem is the problem of finding a closure whose sum of node mass is the maximum among all closures. It has been shown that the maximal closure problem defined in a graph can be converted to the maximal flow problem (or the minimal cut problem) in a corresponding network. Thus, the maximal closure problem can be solved by any maximal flow algorithm (or any minimal cut algorithm).

We propose a new algorithm for the maximal closure problem. The new algorithm finds a maximal closure directly in a given graph while other algorithms first convert the graph to a corresponding network and then find a maximal closure from the network. Instead, our new algorithm employs the notion of the supply and the demand of a node in the given graph. The new algorithm finds the maximal closure through a series of iterations, each of which involves a last-labeled first-scanned search for flow augmenting paths from a different supply node. Although the new algorithm was originally designed to solve maximal closure problems, it is flexible in the sense that it can be

extended to the general maximal flow problem or specialized to the selection problem.

To examine the practical efficiency of the new algorithm, we implemented and tested it on selected classes of the maximal closure problem. We also implemented several other competing algorithms and compared their computing times. Based on our computational experience, we conclude that the new algorithm is superior or comparable to other best algorithms in computing times. In particular, our new algorithm was significantly faster in solving the problem of scheduling tasks under due dates.

# On Sensitivity Analysis for Shortest-Path Dynamic Programming Models

by

In-Soo Lee

## ABSTRACT

This paper concerns sensitivity analysis for shortest-path dynamic programming models. We develop a theoretical framework for this sensitivity analysis. A basic concept behind such framework is a *penalty network* that preserves the special structure of acyclic networks. Several operational propositions are derived under practical assumptions. A comparison to LP sensitivity analysis is discussed. The sensitivity analysis for deterministic production planning problems is demonstrated as an application of our approach to sensitivity analysis.

대부분의 意思決定過程에서 여러가지 가능한 事象이나 몇 가지 대립된 假說들에 대한 確率을 推定해 주어야 하는 경우가 흔히 있는데, 경우에 따라서는 意思決定者나 혹은 專門家の 主觀的 判斷에 의존할 수 밖에 없는 경우가 종종 발생한다. 이 때에 제기되는 자연스러운 질문중에 하나가 "과연 이러한 主觀的 判斷이 얼마나 正確한가?"하는 것이다.

理論적으로는 철저한 主觀確率論者의 입장에서 보았을 때, 確率이란 주어진 假說의 眞爲에 대한 不確実性を 數值化한 것에 불과하므로, 確率은 "옳다" "그르다" 거나 "중다" "나쁘다" 를 말할 수는 없다. 그러나 경우에 따라서는, 主觀的으로 確率값이 주어진 假說들의 眞爲를 실제로 가려낼 수 있는 경우가 있는데, 이럴 때 우리는 그러한 確率判定이 얼마나 正確한지의 與否를 客觀的으로 測定해 볼 수 있을 것이다.

예를 들어, 어떤 사상이 일어날 確率을 0.9라고 判定하였으나 실제로 그러한 事象이 일어나지 않았다고 할 때, 이 確率값을 틀렸다고 말할 수는 없다. 그러나 만약 0.9라는 確率은 주어진 1000개의 假說에 대해 그 眞爲를 알아 보았을 때 실제로 그 중 60%만이 옳았다고 한다면 이러한 確率값들이 무언가 잘못되었다고 말할 수 있을 것이다. "正確히" 確率을 判定할 수 있는 사람 (well calibrated person)이라면 이와 같은 경우 실제로 90% 정도의 假說이 옳아야 할 것이다.

인간의 直觀的 確率判定이 calibration 이라는 面에서 얼마나 正確한가 하는 문제를 여러가지 다른 상황에서 實驗心理學的 方法을 통해 많은 학자들이 연구하였는데, 여기서는 그 結果를 간략히 소개하고 몇 가지 보편적으로 나타나는 現象에 대한 가능한 설명을 제시해 보고자 한다.