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PREVIEW

Order Number 8824918

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Chung, Soong-Hwan, Ph.D.

The University of Nebraska - Lincoln, 1988

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PREVIEW

**AN ANALYSIS OF FACILITATORS
FOR JIT PRODUCTION IN A JOB SHOP : AN EMPIRICAL STUDY**

BY

SOONG-HWAN CHUNG

A DISSERTATION

**Presented to the Faculty of
The Graduate College in the University of Nebraska
In Partial Fulfillment of Requirements
For the Degree of Doctor of Philosophy**

**Major: Interdepartmental Area of Business
(Management)**

Under the Supervision of Professor Sang M. Lee

Lincoln, Nebraska

August, 1988

TITLE

AN ANALYSIS OF FACILITATORS FOR JIT PRODUCTION

IN A JOB SHOP: AN EMPIRICAL STUDY

BY

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PREVIEW

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**AN ANALYSIS OF FACILITATORS
FOR JIT PRODUCTION IN A JOB SHOP : AN EMPIRICAL STUDY**

**Soong-Hwan Chung, Ph.D.
University of Nebraska, 1988**

Advisor: Sang M. Lee

A Japanese manufacturing approach known as Just-in-time (JIT) has attracted considerable attention from many US manufacturers as a means of improving the manufacturing process. However, implementation of JIT production has been limited to a certain manufacturing environment, particularly the repetitive manufacturing environment. If the Japanese manufacturing approach is such an improvement in the manufacturing process, then it should also be applied in the non-repetitive manufacturing environment.

In considering the application of JIT in job shop manufacturing, four critical questions may arise: 1) What is the current status of the Japanese manufacturing approach in US job shops?, 2) What are the critical operational factors that a job shop should consider to facilitate JIT production?, 3) What are the critical organizational requirements a job shop should consider to facilitate JIT

production? and 4) What are the problems job shops encounter in carrying out their manufacturing improvement activities so that they can move toward ideal JIT production?.

A cross sectional field survey was conducted to answer the above research questions. The analyses of the returned questionnaires revealed several important points. First, the Japanese manufacturing approach has been generalized and become a basic production philosophy among US job shop manufacturers. Second, implementation of the Japanese manufacturing approach differs based on the size of the firm, even in a same manufacturing environment. Third, this research also revealed that a job shop should implement those aspects of JIT which effectively improve productivity and flexibility.

-- to the memory of Major O Rang Kim

ACKNOWLEDGEMENTS

I am deeply indebted to Dr. Sang M. Lee, committee chairman, whose guidance and assistance made the completion of my doctoral degree an enjoyable learning experience.

Special thanks go to Dr. Marc J. Schniederjans, Dr. Lester A. Digman, and Dr. Morris H. Schneider for their numerous suggestions and comments to improve the quality of this dissertation.

I would like to thank my parents who provided a special kind of support and understanding.

The warmest expression of appreciation is reserved for my wife, Moon Im, and two wonderful daughters, You Sun and Jee Sun, whose continuing support and love made the completion of this dissertation even more meaningful.

C.S.H.

CHAPTER I

INTRODUCTION

A. Overview

A Japanese manufacturing approach known as Just-in-time (JIT) has attracted considerable attention from many US manufacturers as a means of improving their manufacturing process. The Japanese manufacturing approach has been shown to improve both flexibility and productivity simultaneously. Japanese manufacturing concepts have contributed to productivity through increased machine and labor utilization, higher product quality, and reduced inventory levels [Finch and Cox, 1986]. The Japanese manufacturing approach has improved flexibility through simplification, flexible workforce management, and effective use of computerized manufacturing and information systems [Schonberger, 1986; Hall, 1981a].

It is commonly believed that flexibility has an inverse relationship with productivity, i.e., the higher the degree of flexibility, the lower the level of productivity.

However, productivity and flexibility are not opposing goals, but complementary operational facets exhibiting some deviations in popular implementation methods. The relationship between flexibility and its productivity is contingent upon the production system and management [Gustavsson, 1984]. A properly focused and managed system can improve both productivity and flexibility simultaneously, while a less well-designed and administered system could increase flexibility at the cost of productivity. For example, the JIT system is intended to concentrate organizational resources toward improvements in both flexibility and productivity, while a faster dedicated machine would result in increased productivity but diminished flexibility.

In the US, Japanese manufacturing concepts have been implemented primarily in large size manufacturers in repetitive manufacturing environments, since they have been most successful in this manufacturing environment in Japan [Schonberger, 1982a]. If the Japanese manufacturing approach is such a wonderful concept for productivity and flexibility improvement, the application of this concept should not be limited to the repetitive manufacturing environment. Ways should be found to apply it to other manufacturing environments, wherever possible.

A job shop manufacturing environment, which lies at

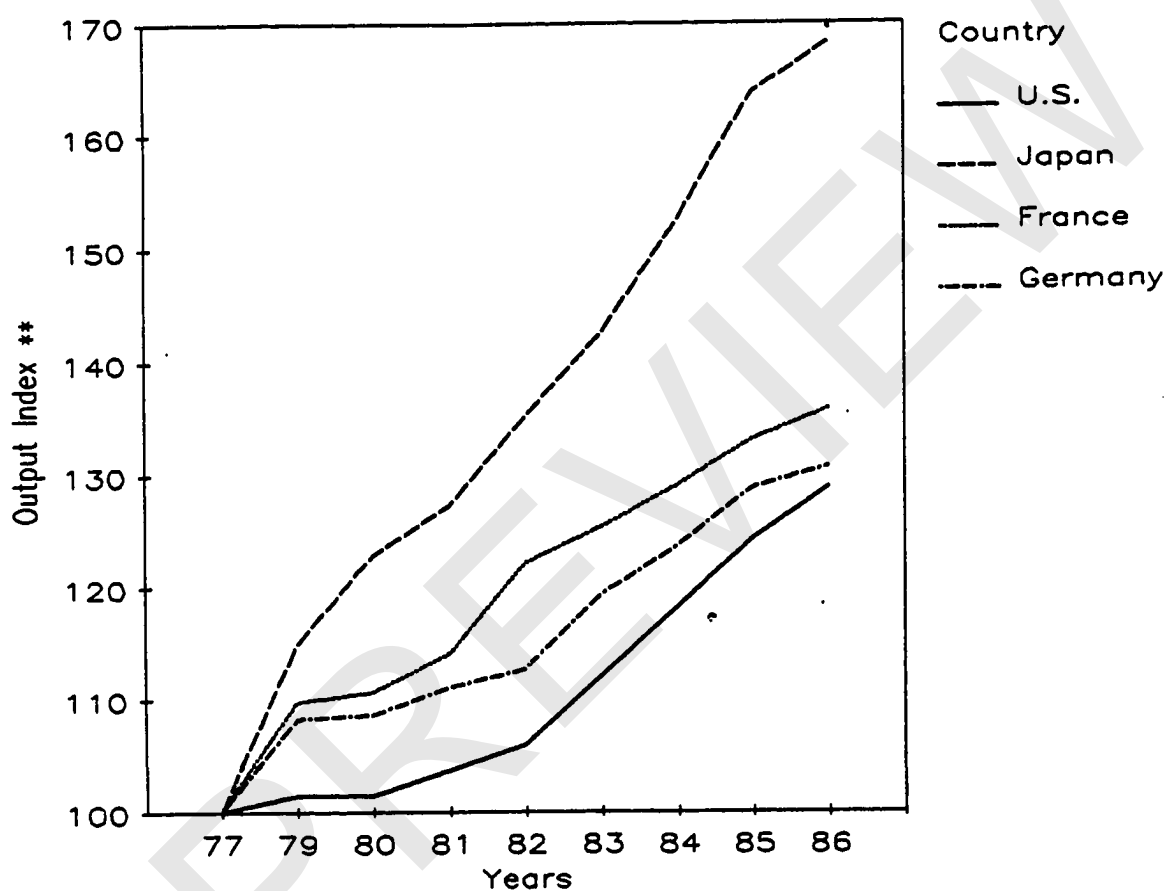
the opposite end of the spectrum from the repetitive environment, should not be neglected in the implementation of Japanese manufacturing concepts.

According to Schonberger's list of US firms implementing Japanese manufacturing concepts [1986] and the results of Youngkin's research [1984], manufacturing companies implementing aspects of the JIT philosophy are not all engaged in what can be characterized as repetitive manufacturing. Some are traditional job shop producers involved in manufacturing customized products. This evidence indicates expansion of the JIT philosophy into the job shop environment, and implies that US job shop manufacturers have begun to realize the importance of application of Japanese manufacturing concepts to improve their manufacturing systems and competitiveness.

Current research in this area reveals many important reasons as to why job shop manufacturing should also consider implementing certain aspects of Japanese manufacturing concepts or philosophies. However, all of the reasons revealed through a literature review can be condensed into rising demand for increased productivity and flexibility.

There has been increased demand for productivity improvement by the US manufacturers during the last few decades. The productivity improvement of US industries, as shown in Figure I-1, is inferior to that of other leading

Figure I-1. US and Foreign Growth in Productivity *



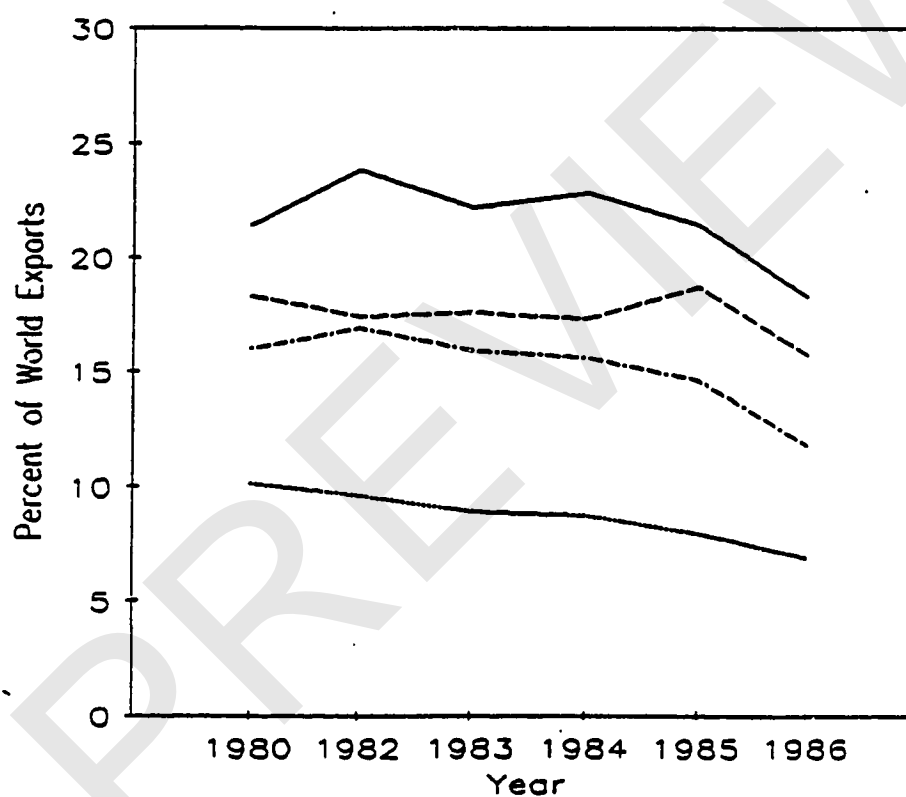
* Source: "Annual Indexes of Productivity and Related Measures, Twelve Countries," Monthly Labor Review, May 1988

* Output index is based on a ratio of manufacturing output per hour of labor, where our base year is 1977=100.

countries such as Japan, West Germany, etc. The average annual change of US productivity improvement was 2.3 percent in the 1970s and 3.7 percent for the 1980s, while Japanese industries showed a 6.6 percent increase in the 1970s and a 5.9 percent increase in the 1980s (Statistical Abstract of the US, 1988). This slower increase in US productivity means that the US has been losing its competitive edge in the international market as shown in Figure I-2 illustrating percentage of world exports held by the US in machinery, transportation equipment, basic manufactures (including semimanufactures of various materials, such as metals, fibers, wood, glass, leather, rubber, and certain finished products of metals), and miscellaneous articles (including mainly nondurable consumer goods and professional and scientific instruments) between 1980 and 1986.

When considering productivity at a national level, the productivity improvement of US job shop manufacturers becomes even more important. According to "Statistical Abstract of the US", there exist 358,000 manufacturing establishments in the US as of 1986. Among these, at least 100,000 are job shops [Brandt, 1986]. This approximately 30 percent of total manufacturing establishments can not be ignored when considering national productivity improvement. In addition, considering that these job shop manufacturers supply an estimated 75 percent of all the machined parts used in products made by their bigger industrial customers

**Figure I-2. US Share of World Exports of Manufactures:
1980 - 1986 ***



LEGEND

— Machinery — Basic Mfg.
 --- Transport - - - Miscell.

* Source: Statistical Abstract of the US, 1988

[Brandt, 1986], the impact of job shop manufacturers on the overall US manufacturing picture is thus far more significant than their relatively small proportion of total manufacturers would indicate. Thus, productivity improvement in US job shop manufacturers will engender significant overall improvement in national productivity.

Traditionally, US job shop manufacturers have emphasized automation of the factory to improve productivity, and it seems that this trend will become more serious in the future. Boston Yankee Group predicts that purchases of factory computers by job shops will outpace those of large repetitive factories, increasing nearly 35 percent a year through 1990 [Brandt, 1986].

However, US job shop manufacturers should recognize that automation itself is not enough to improve productivity sufficiently so that US job shops can compete with Japanese job shop manufacturers in the international and the domestic market. Recent surveys of selected Japanese automobile industries indicate that automation has provided only about 30 percent of their productivity improvements over the past 10 years. 70 percent can be attributed directly to implementation of unique operational approaches combined with specially developed managerial systems [Suzaki, 1985]. These survey results imply that the automation trend of US job shops should be combined with implementation of

effective operational approaches, such as selected Japanese manufacturing approaches.

Another major reason for the adoption of the Japanese manufacturing approach by job shops is the increased demand for flexibility. Winter [1983] writes that job shops are being forced to participate in JIT production procedures by their customers.

The Japanese manufacturing philosophy is well spread among many large manufacturing firms in the US. Results of the survey by the Lincoln Plating Company in Lincoln, Nebraska, characterized as a job shop manufacturer, indicate a continued trend toward JIT programs by its customers. According to the results, 58 percent of the customers surveyed indicated they were currently using JIT or were planning to [Lincoln Plating Company News, Summer 1986]. This result stresses the increased need for flexibility improvement by a job shop, since the customers of job shops demand flexible Just-in-time delivery of ordered items with consistent high quality.

Manufacturers implementing JIT philosophies typically leave it up to their suppliers to figure out how to produce and deliver materials just in time, usually under threat of losing the business if they do not comply [Hutchins, 1986]. Therefore, if a job shop does not improve flexibility to meet the demand of JIT delivery, a job shop has but two alternatives: either lose business or keep a finished goods

inventory at its own expense.

In fact, the benefits from JIT production can be maximized when a whole industry, from suppliers to customers, can participate as if it were one factory [Schonberger, 1984]. Therefore, selected features of the Japanese manufacturing philosophy should be implemented in job shops in order to improve US competitiveness in the international and the domestic markets.

B. Problem Statement

There have been indications that many US job shops have implemented some Japanese manufacturing concepts. There are published case studies involving JIT implementation in a job shop [Hatch, 1984; Spurgeon, 1984], and several conceptual articles concerning the potential benefits of JIT in the job shop environment [Hall, 1983; Rewa, 1984; Youngkin, 1984; Discasali, 1986; Walleigh, 1986]. However, most of the articles published with regard to Japanese manufacturing approaches in a job shop seem to concentrate on the applicability of Japanese manufacturing concepts to a job shop environment.

There has been little research concerning the critical factors that facilitate JIT production in a job shop. There are several fundamental differences between job shop manufacturing and repetitive manufacturing. A job

shop is usually characterized by discrete unit fabrication which is planned and controlled based on the customers' orders. In addition, the use of alternative routings and high cost general purpose machinery is common. The job shop lies at the opposite end of the spectrum from the repetitive manufacturer. Hence, we can not guarantee the effectiveness in a job shop situation of the Japanese manufacturing approach, which works as intended in the repetitive environment for which it was designed. Therefore, it is necessary to identify a set of critical features of the Japanese manufacturing approach applicable in the job shop environment. Also, no empirical examination has been done in exploring those activities that are critical for a job shop to facilitate JIT production.

If Japanese manufacturing concepts could indeed be applied to the job shop manufacturing environment, the following questions would need to be answered:

1. What is the current use of the Japanese manufacturing approach in US job shops?

A job shop can apply two types of Japanese manufacturing approaches. One is the application of the elements of the JIT production system, such as set-up time reduction, preventive maintenance, group technology, JIT purchasing, etc. [Hall, 1984; Youngkin, 1984]. The other approach is to follow Japanese manufacturing success factors such as simplification, effective use of a computerized

manufacturing and information system, and flexible workforce management [Schonberger, 1986; Hall, 1981a]. One of the purposes of this study is to identify the current implementation status of the elements of the JIT production system and the Japanese manufacturing success factors in US job shops.

In addition, this study will reveal the factors and the elements influenced by the size of the firm. Even in the same manufacturing environment, there may be some factors whose implementation are influenced by the size of the firm. Therefore, this study will examine some implications concerning this topic.

2. What are the critical operational factors of job shops that are important for facilitating JIT production?

Even though the same manufacturing philosophy is applied, the implementation strategy or program selected should differ according to variations in the manufacturing environment. However, the previous studies have limited their discussions to implementation guidelines for JIT manufacturing concepts in a broad sense, and failed to establish a clear set of requirements for any specific manufacturing environment. The primary objective of this study is to provide effective guidelines for traditional job shop manufacturers to move toward JIT production

successfully. In order to provide such a clear set of requirements, each element of the JIT production system and each of the Japanese manufacturing success factors will be statistically tested to identify their impact on JIT production.

3. What are the critical organizational requirements for job shops to facilitate JIT production?

It is believed that successful implementation of JIT production requires the total organization's commitment. Therefore, the critical organizational supports for JIT production should be identified so that they can be used as guidelines in US job shop manufacturers. requirements such as top management commitment, training and education, support of supplier and customer, engineering support, etc. will be discussed.

In addition, the problems that job shop manufacturing firms would most likely encounter in carrying out their manufacturing improvement activities will also be discussed and identified in terms of organizational requirements.

C. Research Methodology

The research design for this study consists of a field study of selected job shop manufacturing firms operating in the US. Data was collected using survey questionnaires. Analysis techniques used in this research

were descriptive, Analysis of variance (ANOVA), cross tabulation with Chi-square test, and regression analysis. For the analysis of collected data, SPSSX at the University of Nebraska-Lincoln was used.

D. Organization of the Dissertation

This dissertation is divided into five chapters, as presented in Table I-1. Chapter One serves as an introduction, providing a brief explanation of the importance of the implementation of the Japanese manufacturing approach in the US job shop environment and a problem statement for the study. It also outlines the research methodologies employed.

Chapter Two is devoted to discussion of the related literature. Chapter Two consists of five parts. Part One focuses on the evolution of the Japanese manufacturing approach in the US. In Part Two, JIT production in a job shop is defined. In addition, items used to measure JIT production level are also discussed. Parts Three and Four focus on the operational facilitators of JIT production in a job shop. Part Three deals with implementation of elements of the JIT production system. Part Four focuses on implementation of the Japanese manufacturing success factor approach. Part Five discusses the organizational requirements for JIT production.

The research design and methodologies of this study