



A MRPII SURVEY STUDY OF THE CHINESE MANUFACTURING INDUSTRY

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ABSTRACT

This study, conducted jointly by researchers from the People's Republic of China and Canada, was motivated by the growing interest in MRPII implementation by Chinese manufacturing companies. Using data from a recent survey on Chinese managers' attitudes towards MRPII implementation, this paper identifies, for the first time, the critical factors and challenges in implementing MRPII in the Chinese manufacturing environment. The relative importance of organizational factors, system factors and technical factors are addressed in our study which aims to enhance understanding of perceptions and expectations that managers in the Chinese manufacturing industry might have of MRPII. Finally, the paper provides guidelines for Chinese manufacturing companies planning to implement MRPII, as well as for software companies wishing to explore this growing market.

Keywords: Manufacturing Resource Planning (MRPII); MRPII implementation; critical factors and challenges; Chinese manufacturing industry; survey study.

1. INTRODUCTION

Since its introduction by Oliver Wight in the early 1970s, Manufacturing Resource Planning (MRPII) has engaged the interest of researchers and practitioners alike. Though MRPII has been studied and adopted both in Western countries and in countries in the Far East (Singapore, Malaysia, etc.), it is still a relatively new concept and a new tool for Chinese industry [10]. The principles of MRPII were introduced into China no more than ten years ago. According to a recent study [10], the management of Chinese state-owned manufacturing companies is highly favorable towards the adoption of MRPII. The possibility of greater profits and increased competitiveness, coupled with market-oriented policies, is encouraging MRPII implementation in more and more companies.

A recent MRPII report [6] estimates that MRPII usage in the Chinese manufacturing industry is less than 1% – only 170 of more than 18,000 manufacturing companies. The combination of the current low utilization of MRPII and the possibility of great potential improvement in the competitiveness of Chinese manufacturing firms has led many MRPII software vendors to predict rapid growth in terms of their sales in the near future. At present two American MRPII software vendors – System Software Associates (SSA) and Fourth Shift – are the major players in the Chinese MRPII market. They both report [6] that they have achieved some degree of success in China, and they predict China to be their fastest growing market. Other MRPII vendors, including Oracle Corp., Redwood Shores, are also making great efforts to explore this potential market [6].

A recent study [10] discovered that despite efforts to implement MRPII, only a few Chinese firms have done so effectively, and these only partially so. MRPII is still unfamiliar and baffling to most Chinese manufacturing companies [10]. Conducting research based on companies that have already installed MRPII is virtually impossible at present because of their very limited number. Nevertheless, findings obtained from investigation of the current situation and of potential problems facing the growing number of companies who will be installing MRPII will be highly significant. After performing an extensive literature review, we have found that little research has addressed these issues so far.

Our current research was motivated by the growing trend towards MRPII implementation, which is fairly new in China. Using data from a recent survey of key Information Systems (IS) issues in China, this paper identifies for the first time the critical factors and challenges in the implementation of MRPII in the Chinese manufacturing environment. Our purpose in this paper is to provide increasing understanding of the perceptions and expectations that managers in the Chinese manufacturing industry might have of MRPII. The paper concludes with some guidelines both for Chinese manufacturing firms planning to implement MRPII in the near future and for MRPII software vendors so as to help them understand the environment they will be encountering.

2. LITERATURE REVIEW

Evolving from Material Requirement Planning (MRP), is a means developed in the 1960s to form inventory policy/strategy effectively in an environment of known demand. Manufacturing Resource Planning (MRPII) has developed into an integrated manufacturing system for effectively planning resources as well as coordinating and sharing information within a firm [7].

MRPII has extended its focus far beyond manufacturing and operations, to link various business functions, including business planning, production planning, capacity management, shop-floor control, purchasing, marketing, human resource management, finance and accounting [17]. MRPII has incorporated these functions into an optimized business process through an integrated information system.

It is generally acknowledged that a successfully implemented MRPII system can generate great benefits for an organization. Previous survey studies have reported tangible benefits in terms of increased manufacturing productivity, reduction in inventory control cost, and reduced lead times [8], as well as intangible benefits in terms of improved consumer service, better communication and more effective integration of planning [3]. These benefits can substantially increase a company's profits and competitiveness.

MRPII implementation issues have been widely addressed by numerous studies [1,2,4,5,6,8,9,10,11,14,15,16,17]. Such research was first conducted in Western countries. Some technical factors, such as data accuracy and high degree of computerization [16], were reported to be closely related to the success of MRPII implementation. Many of these studies further suggested that certain human and organizational factors should be emphasized during MRPII implementation. Those that have been most widely addressed are: management support [16], employees' resistance to implementation [15], people's knowledge and understanding of MRPII and organizational willingness to change [4], and adequate training [14]. Since the late 1980s, MRPII research has received considerable attention in some countries in Asia. In one study conducted in Malaysia [8], Hamid et al. reported that the major problems of MRPII implementation were 1) lack of company expertise, 2) lack of communication, and 3) lack of personnel support. In the Ang et al paper [1], the authors identified the problems encountered during MRPII implementation in Singapore companies as both operational, with data inaccuracy being the most critical, and organizational, described as 1) lack of company expertise in MRPII, 2) lack of MRPII training/education, and 3) lack of communication between managers and employees. In a recent study, Ang et al. [2] investigated the state-of-the-art application of MRPII in the Singapore context and reported that the critical success factors in implementation were 1) data accuracy and integrity, 2) top management support/commitment, and 3) clear goals and objectives.

Though MRPII is becoming increasingly important in Chinese manufacturing industry, very little research has been done to address the MRPII implementation issues. Based on Chinese managers' perceptions on important MRPII issues, the present study attempts to identify the critical factors and challenges of MRPII implementation and their relative importance in the context of the Chinese manufacturing environment. We hope to demonstrate how these factors and challenges are different from those of other countries.

The study is a continuation of an earlier field study [10,11]. In an attempt to identify the impediments to the implementation of MRPII in China, in 1995 our research group conducted an in-depth field study at one Chinese manufacturing firm and performed several interviews at four other companies. We accomplished two major tasks. The first involved the development of an integrated management information system for a Chinese custom manufacturer---Tianjin Metal Forming Machine Tool General Works (TMFTW). By clearly mapping out its major business processes and then re-engineering them into a MRPII-oriented information system, we attempted to provide a conceptual model for the adaptation of the information system of this firm to facilitate MRPII implementation. Second, we examined the understanding of and attitudes towards MRPII at a number of companies. In both instances we found that there was a general lack of support and understanding of MRPII [10,11]. With respect to understanding, we discovered that many firms initially went through the exercise of attempting to develop their own

MRPII codes. Furthermore, they had the attitude that the MRPII code would somehow be able to solve all their managerial difficulties without restructuring or reengineering their business processes.

The results of the above studies provided us with the foundation for an empirical study of MRPII implementation issues in the context of Chinese manufacturing companies.

3. RESEARCH METHODOLOGY

We selected a survey study to be our major research methodology. By conducting a survey of a variety of companies, we hope to obtain a certain degree of generalizability for the critical factors and challenges in MRPII implementation in the Chinese manufacturing industry. Our previous field study and interviews were used as one of the major sources to generate our questionnaire.

3.1 Target Population

Our target population was Chinese state-owned manufacturing firms, since this population is predicted to become the mainstream of the potential MRPII market [6]. Their perceptions and expectations on MRPII implementation are the fundamental determinants of success or failure of future application of MRPII.

3.2 Questionnaire Design

The questionnaire was designed jointly. The items in our questionnaire come from two major sources:

1. previous studies on MRPII implementation in other countries, and
2. our previous field study and interviews

The questionnaire was structured in the following manner:

3.2.1 Company Profile

We first investigated the demographic information of the surveyed companies, including characteristics of the respondents and firms, as well as the number of computers installed at each firm. We then examined companies' future plans and respondents' knowledge of MRPII. Our enquiries included questions about when the companies intended to install a MRPII system, how they would obtain MRPII software, and respondents' familiarity with MRPII concepts and commercial software. The questions and issues raised in this section are based on previous MRPII studies [1,8,12].

3.2.2 Perceived MRPII Critical Factors and Challenges

The respondents were then asked to identify the critical factors as well as the challenges in implementing MRPII in their own companies. When designing this part of the questionnaire, we attempted to associate critical factors with challenges so as to determine the extent to which they met. Items listed as critical factors were worded and grouped differently from those same items listed as challenges in order to avoid any artificial coincidences.

For the critical MRPII factors, respondents were asked to rate the importance of 12 items. Each item was measured on a 4-scale Likert scale, from not important (1) to very important (4). The

mean score was calculated for each item in order to identify its relative importance. For the MRPII challenges, respondents were asked to rank 19 possible challenges to the successful implementation of MRPII in order of their importance, (1) being the most important and (19) being the least important challenge. For each item, we obtained the highest, lowest and average ranking in terms of importance. The 19 items were placed in order of their average rankings.

Our list of perceived critical factors and challenges was based on other MRPII studies as well as our previous study. As indicated before, several MRPII studies have revealed the critical factors of MRPII implementation. Burns et al. [4] categorized these factors as environmental and implementational. Wacker et al. [15] and Safizadeh [14] argued that MRPII application is not only a technical issue, but is also directly related to human factors. Based on the results they generated, 13 items were included in the final list in Ang's study [2]. This study [2] also generated a list of implementation challenges in terms of technical problems, organizational problems and system problems. The items we selected were based on the above studies (please refer to Table 4 for description of each item). These items can be classified as 1) technical factors, 2) organizational factors, and 3) system factors. This classification is based on the three kinds of problems identified in [2], and is also suggested by the findings of our previous study [10,11].

We also included three external factors in our list of perceived challenges. Previous IS studies conducted in China [12,13] identified certain external factors, such as the planned economy and personnel management, as the major barriers to IS application. More recent studies [10,11] have found that these barriers are diminishing rapidly. We took three typical external factors: human resource management, material procurement flexibility, and government support, into consideration in order to ascertain whether they still remained major impediments to MRPII implementation.

3.3 Questionnaire Validation

The questionnaire was validated by means of several interviews and pretested by a pilot study. To perform the validation and pretest, we paid a second visit to TMFTW and the four companies we had interviewed previously. The questionnaire was reviewed by the senior managers and by the IS employees of those firms. Critical MRPII factors and challenges were the items most frequently checked to ensure they would be easily understood and answered by Chinese respondents. A pilot study was conducted at TMFTW and at the four firms where we had conducted interviews. After two rounds of refinement, the questionnaire was translated into a Chinese version, which was then translated back into English by three graduate students. We selected the Chinese version whose meaning is closest to that of the original one. Careful attention was paid to the translation to avoid any misunderstanding of the questionnaire.

3.4 Samples and Responses

Initially we intended to mail the questionnaire to a large sample that would be randomly chosen from a list of names of Chinese manufacturing firms. However, experienced Chinese researchers suggested that this was not a practical methodology. Instead, six MIS graduate students from Tianjin University undertook this challenging task of obtaining an adequate sample to complete our questionnaire. The first batch of 44 questionnaires was administered in November 1995, and the second in June 1996. To date we have 78 completed questionnaires. Due to budget constraints, all the interviews were conducted at manufacturing firms located in Beijing or Tianjin, which are respectively the second and third largest cities in China. Of the 78 completed questionnaires, 67 (86%) were filled out by IS managers or employees who were knowledgeable about the use of IS in their companies. The remaining respondents were: top management (6),

functional management (2) and engineers (3).

4. DATA ANALYSIS

4.1 Company Profile

Each company in our sample concurred with the profile of our target population. All the companies are located in eastern China, 70 (90%) of them being in the Beijing-Tianjin region, which has a relatively high degree of computerization. The survey results are therefore optimistic indicators of MRPII trends in China. The surveyed companies can each be classified as producers of one of the following categories of items: light industry (11), electronic and mechanical (56), chemical (7), and construction materials (4). They are generally considered to be four of the main pillars of the national manufacturing industry. In our sample, electronic and mechanical product companies predominated. Company characteristics are listed in Table 1. In terms of number of computers by type (see Table 2), we found that personal computers were overwhelmingly predominant. Mainframes were very rare, nor were minicomputers or workstations widely used (see Table 2). In a MRPII company profile reported by a Singapore researcher [1], no significant correlation was found between MRPII implementation outcome and the type of hardware used. Assuming this is also true of China, we can predict that PC-based MRPII will be the most appropriate direction for Chinese manufacturing firms to take.

Only two companies (2.6%) in our sample had already installed a MRPII system. Both systems were purchased from Fourth Shift Company, whose headquarters are located in Tianjin. Four (5.1%) of the companies were in the process of implementation, while thirteen (16.7%) were planning to install MRPII within the next year, eleven (14.1%) within three years, and fourteen (17.9%) within five years. Thirty-four companies (43.6%) had no such plans. Of the companies in the process of installation and those planning to install, those purchasing from a vendor (60, 78.9%) outnumbered those developing their own systems (11, 14.5%). The remaining three companies (6.6%) planned to develop MRPII systems with the help of consultants. Among the respondents, only three (3.8%) were very familiar with MRPII concepts and commercial MRPII software, fourteen (17.9%) were familiar, thirty-five (44.9%) were just slightly familiar and twenty-five (33.4%) were not at all familiar. This response shows a general lack of knowledge of MRPII. This seeming contradiction that forty-four firms are planning to introduce MRPII to their firms whilst at the same time admitting to having a limited knowledge of MRPII seems somewhat difficult to comprehend. This may be partially explained

Table 1 Firm Characteristics (N = 78)

	Number
(a) Production Assets (in thousands RMB)	
less than 10,000	19
10,000 to 49,999	35
50,000 to 99,999	13
100,000 to 499,999	9
500,000 or more	2
(b) Annual Sales (in Thousands RMB)	
less than 1,000	1
1,000 to 9,999	5
10,000 to 49,999	37
50,000 to 99,999	16
100,000 to 499,999	17

500,000 or more	2
(c) Annual Profits (in thousands RMB)	
less than 100	5
100 to 999	8
1,000 to 4,999	32
5,000 to 9,999	9
10,000 to 49,999	24
(d) Total Number of Employees	
less than 100	3
100 to 999	17
1,000 to 2,999	44
3,000 to 9,999	10
10,000 or more	4

*US\$ 1.00 = RMB \$ 8.31

Table 1 continued

Characteristics	Mean	Minimum	Maximum
Production Assets (in thousands RMB)	67136.7	3450	1,300,000
Annual Sales (in thousands RMB)	82241.24	707	860,000
Annual Profits (in thousands RMB)	8097.09	0	39,830
Total number of employees	2811	34	21,382

Table 2 Number of Computers by Firm (N = 74)

	Number
(a) Mainframe	
0	61
1	9
2	4
(b) Minicomputers + Workstations	
0	22
1 to 5	39
6 to 10	6
more than 10	7
(c) Personal Computers	
less than 10	6
11 to 29	35
30 to 49	15

50 to 100	12
more than 100	6

officials both learned of some stories of successful implementations of MRPII in Western countries and felt that MRPII would also help in gaining competitive advantages if installed in their own firms. So there is a concerted effort in China to address MRPII even with limited knowledge of it. In our previous field study and interviews [11], we found that even for those who were familiar with MRPII, there were some basic misunderstandings of its role. Our questionnaire enabled us to pinpoint two common misconceptions we had previously identified. First, a number of managers attempted to implement MRPII by simply installing MRPII commercial software without changing any of the existing business processes. Second, a number of other managers, although they recognized the implementation requirements of MRPII, did not fully understand its limitations and had unrealistic expectations of its effects [11]. The combined findings of our field and survey studies suggest that in order to implement MRPII successfully, it will be essential to improve people's knowledge and understanding of it.

4.2 Perceived MRPII Critical Factors and Challenges

On reviewing the 78 questionnaires, we found that certain items concerning MRPII critical factors and challenges were not completed by eight companies. These questionnaires had to be excluded when we performed data analysis of these items.

The ranking results for perceived MRPII critical factors and challenges are presented in Tables 3 and 4 respectively. The items are ranked in descending order of importance according to the mean scores they received.

In terms of perceived critical factors (see Table 3), support from top management and managers' knowledge of MRPII concepts are the most critical. These have also been identified as the critical determinants of MRPII success in several other studies [1,2,5,15]. It is essential for top management to provide full support and commitment to MRPII implementation, since the implementation process will inevitably bring about dramatic organizational changes. Top management support/commitment is the best way to overcome human resistance [15]. A thorough understanding of the benefits, limitations, and requirements of MRPII before its implementation is also crucial, as this will ensure that MRPII is appropriate for the specific organization. Here we see that these two human factors---top management support and people's understanding---become the most critical ones in the Chinese manufacturing industry. The cost of implementation is another major concern. The financial factor has been identified by researchers [1,2,8] in Singapore and Malaysia as the least important one. But with a few exceptions, most state-owned Chinese manufacturing firms cannot afford the huge cost of MRPII implementation. Nowadays an entire MRPII system generally includes over 20 modules. The key modules of Fourth Shift MRPII software normally cost \$20,000 to \$30,000 each [10]. Given such a high cost, MRPII software is too expensive for most Chinese manufacturing firms to buy. Thus, unlike manufacturers in other developing countries, cost for Chinese manufacturers is an important consideration. The next critical factor is training or education, also an organizational factor. For the successful implementation of a complex information system like MRPII, many senior-level system analysts and trained end users are required. From the above findings, we conclude that the most critical factors are organizational ones in most Chinese manufacturing firms.

Three of the next four factors involve business processes. Changing current management practices, redesigning current management practices and restructuring organizations are all

associated with the re-engineering of business processes based on MRPII principles. This issue was the major focus of our field study. Here we see that the system factor is yet another area of concern. If we use 3.00 as the cut-off level of importance, the company's capabilities for networking and integration are considered to be less important than the other two dimensions. This issue is discussed below.

Looking at the rankings in Table 4, we gain the impression that the perceived challenges differ considerably from company to company. This is demonstrated by the fact that so many of the challenges were ranked either No. 1 or No. 2 by different firms. However, if we compare the critical factors with the means of the anticipated challenges, we see that they demonstrate a very similar pattern. The first three challenges happen to be the first three critical issues in the above ranking, though the order is slightly different. That means the most critical factors are exactly what most Chinese companies lack.

Table 3 Perceived Critical MRPII Factors* (N = 70)

Critical Factors	Scores
Support from top-level management	3.7
Training managers in MRPII concepts	3.64
Cost of implementation	3.48
Extensive software training for end users	3.34
Changing current management practices	3.3
Existence of in-house technical expertise	3.14
Redesigning current management system	3.13
Restructuring organizations	3.05
Networking capacity	2.75
Integrating all the databases	2.59
Integrating all departments	2.45
Implementing a JIT inventory system	2.27

*scale : 1 - not important, 2 - somewhat important, 3 - important, 4 - very important.

Table 4 Perceived Challenges to the Successful Implementation of MRPH (N=70)

Order of Challenges	High*	Low**	Mean ***	Rank
Lack of understanding of MRPII by managers	1	14	4.9	1
Lack of financial support	1	17	5.4	2
Lack of support from top management	1	15	5.9	3
Lack of company expertise in information technology	1	16	6.4	4
Lack of qualified managerial personnel	1	15	7.5	5
Lack of interest from middle management	2	17	8.1	6
Lack of communication between managers and IS employees	1	16	8.2	7
Lack of clear goals for IS development	2	17	8.9	8
Lack of interest from junior management	2	19	9.4	9

Inadequacy of existing management system	1	18	9.9	10
Lack of ability to redesign the information system	1	18	10.9	11
Lack of flexibility of human resource management	2	16	11.4	12
Lack of qualified IS projector	5	18	11.6	13
Lack of suitability of commercial software	6	19	11.8	14
Lack of support from a software vendor	3	17	11.9	15
Lack of accurate data	5	19	12.5	16
Lack of training material	7	19	12.6	17
Lack of flexibility of material procurement	5	19	13.2	18
Lack of support from government supervisor	12	19	14.5	19

Note:

*highest ranking in terms of importance

**lowest ranking in terms of importance

***mean ranking in terms of importance

The next problem is the lack of company expertise in information technology. This was the most serious problem in the findings in [2]. The author argued that company expertise contributes significantly to the effectiveness of the implementation process. Though IT expertise is poor in most Chinese manufacturing companies, this shortcoming is overshadowed by more serious problems. Looking at rankings 1 to 9, it is apparent that with few exceptions, these items are closely associated with organizational factors. We have therefore concluded that the organizational issues are the most critical factor as well as the greatest challenge. Of the four subsequent items, three (rank 10, 11, 13) are related to the problem of existing business processes. From this we have concluded that the business process (system factor) is the second most critical factor and challenge in the implementation of MRPII. Technical issues, including data accuracy, training material, network capabilities, software suitability, and the ability to integrate, all fall into the third group of critical factors and challenges. Our findings diverge significantly from the ranking of MRPII success factors in [2], where data accuracy and integrity received the highest mean score, followed by top management support/commitment. Company expertise in information technology and amount of employees' knowledge of MRPII before implementation ranked the lowest. This inconsistency proves that in different settings the critical factors and challenges of MRPII implementation develop different patterns. The divergence can also be explained by the stage of IT growth model used in [13]. It was found that the stage of IT application in China demonstrated quite a different pattern from that of Western countries. Applying this model as well as an analysis of cultural issues, Ping and Grimshaw [13] concluded that the successful implementation of IT depends on "getting the managerial environment right much more than getting the technology right".

Finally, we checked the possible challenges coming from the external environment. We found that these factors all ranked lower than the average, with the lowest two being the lack of flexibility of material procurement and the lack of support from the government supervisor. Inflexibility of human resources ranked twelfth. This demonstrates that the external environment tends to be much more favorable to MRPII implementation than ever before.

5. RESEARCH IMPLICATIONS

5.1 Chinese Manufacturing Companies

Given that the organizational, financial, system and technical factors are of such importance, our study seems to suggest two different strategies for manufacturing companies wishing to implement MRPII in the near future.

1. For most companies that are neither financially strong nor highly computerized, a one-time full implementation plan is not feasible. There is no choice but to adopt a cautious step-by-step approach to implementation. The company can initially install a few MRPII modules suitable to its new structure. Then, as the business performance improves and more reengineering of the business processes take effect, appropriate MRPII modules can be installed and integrated into a whole system. The most important matter in this approach is to conduct continuous training programs in order to improve the management level of the organization based on MRPII principles. It might include the rationalization of functions of different departments, establishment of new regulations, consensus among managers, improvement of computer expertise, and consistency of data files. Although a partial implementation plan might take a long time, a great number of benefits could be realized gradually during the implementation process. According to this plan, organizational factor, system factor and technical factor will all be changed gradually. Since this is a long process, patience, full support and commitment of senior management are the most critical factors.
2. For companies that are highly computerized and in good financial health, a full implementation plan should be adopted, since this is the most effective way for MRPII potential to be fully developed [9]. To implement this plan, attention should first be paid to organizational factors. Only when top management has a clear understanding of the requirements and implications of MRPII and is prepared to provide full support/commitment throughout its implementation life-cycle to overcome all sources of resistance, can the success of this plan become possible. During the implementation process, tremendous efforts must be put into the education and training of employees at each organizational level. The purpose is not only to allow employees to acquire sufficient computer knowledge and skills, but also to make them understand the principles, benefits and limitations of MRPII so as to reduce resistance and ensure cooperation. The next task is to adapt the general principle of MRPII to the particular requirements of the specific organization. Full MRPII implementation will inevitably bring some radical changes to current management practices. Organizational structure and regulations will have to be modified, functional responsibilities adjusted and main business processes re-engineered. It will be necessary to have some high-quality IS project managers who are able to analyze and design the new system. The conceptual model developed in our earlier field study provided a general framework for the redesign work [10]. After the above-mentioned organizational and system factors have been addressed, technical requirements will have to be met. Accurate and complete data input, integrated database, consistent code design, network capability, training materials, etc. are the technical conditions for successful implementation.

5.2 MRPII Software Vendors

For MRPII software vendors, there is undoubtedly a large potential market to be tapped. Because microcomputers overwhelmingly dominate the type of hardware used, it is clear that PC-based MRPII technical modules, such as BOM (Bill of Materials) or MRP (Material Requirement Planning) are the ones most likely to be accepted at the present time. However, for MRPII systems to be used more extensively in the long term, it will be necessary for software companies to develop integrated MRPII systems particularly appropriate to the Chinese environment. On the other hand, software vendors must realize the critical factors and challenges in MRPII

implementation. A clear understanding of these issues will greatly help vendors to develop their potential market. First of all, prior to selling their software, they should take on the responsibility of helping top management gain a full understanding of MRPII, including its benefits, requirements, limitations and difficulties. A great deal of effort will then be required during the implementation process. Software companies should provide not only technical support, but also adequate training in order to improve the management practices of Chinese companies.

6. CONCLUSIONS AND LIMITATIONS OF THIS STUDY

This research represents our ongoing efforts to study empirically MRPII implementation issues in the Chinese manufacturing industry. The critical MRPII factors and challenges demonstrate patterns in China different from those in other countries. The most critical is the organizational factor, followed by the system factor, and finally the technical factor. This pattern can be explained by the underlying culture. The organizational factor plays a dominant role not only in IS application, but also in all other fields, extending even to the entire economic and political system. The organizational factor exerts its effects through the process of the structural system, whereas the technical factor merely provides technical support or tools for these effects. Even though technical expertise is in urgent need of improvement, since the technical factor is in a subordinate position its effect is dominated and encompassed by the effects of the organizational factor and the system factor.

Cultural issues have been addressed in detail in [13]. The pattern we have found is a typical manifestation of these issues. From our study we can see that the external environment is moving in a more favorable direction. In particular, MRPII has been identified by the Chinese government and a number of Chinese managers as a valuable tool for the more efficient management of manufacturing industries [11]. In fact, the Chinese government has strongly encouraged manufacturing firms to adopt MRPII as part of its plan for meeting certain requirements for joining GATT.

Finally, our research has provided certain guidelines for both Chinese manufacturing companies and MRPII software vendors. Two different strategies have been suggested according to the different organizational situations of those companies wishing to implement MRPII. In each situation, the implications of organizational, system, and technical factors must be considered seriously before MRPII is actually implemented. On the other hand, the growing number of MRPII vendors must also understand these implications in order to explore the potential market more effectively.

We should point out that the findings presented in this paper must be treated with a certain caution because of the limitations inherent in the study. First, due to the impossibility of conducting a large-scale survey, the validity of the study suffers from small sample size. To draw more general and valid conclusions, a larger sample randomly selected from a variety of populations is required. Second, it must be emphasized that this is a descriptive paper. We consider only the mean, which is the most basic statistical tool. To obtain more rigorous conclusions, we need to verify our results based on a large sample which will enable us to perform sophisticated statistical analysis. Despite these limitations, the contribution of this paper lies in the fact that it empirically demonstrates an interesting pattern of the three factors essential to MRPII implementation in China.

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