

# A Study on Material Requirement Project Implementation in Thai Automotive Organizations

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## Abstract

In response to ever-increasing regional and global competition, automotive manufacturing companies in Thailand are looking to improve the efficiency and effectiveness of their operations through the adoption of sophisticated manufacturing planning and control systems in general, and Material Requirements Planning (MRP) systems in particular. Despite its growing popularity, an in-depth review of the academic literature has revealed no systematic studies of how, and how successfully, Thai automotive manufacturers have managed to implement MRP in practice. Indeed, there appears to be general dearth of studies of this kind, at least as far as newly-industrialising countries are concerned.

This study begins this paper by presenting a brief literature review on MRP implementation, first in advanced industrial economies and then - as far as the evidence allows - in newly-industrialising countries. The major part of the paper concerns our empirical investigation of the way in which MRP systems are being implemented in Thai automotive manufacturing companies. The investigation is based on a major questionnaire survey of about 120 companies, of which about 67 companies are currently using some kind of MRP system. In addition to more general questions on the nature of the companies concerned and the production processes used, the survey posed specific questions on the (actual or expected) costs and benefits to be obtained from MRP, as well as the implementation process used.

The findings from the survey suggest that MRP implementation in Thai automotive companies is relatively similar to implementation in manufacturing companies in the newly industrialised countries and country in the west, however there is slightly dissimilar to MRP implementation in these countries.

**Keywords:** Material Requirement Planning, Implementation, Thailand's automotive industry

## Introduction

A new era of transformation is happening in Thailand and is at the core of its economic reform, changing organizations from losing to winning companies. This change increases the importance of the function of inventory and production management, where the future holds enormous opportunities and challenges. In addition, at national level, Thailand faces increasing regional and international competition, while at operational level, in most manufacturing companies especially automotive companies the following statement would sound all too familiar:

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“We have got too much inventory..., lost market share, high costs of production, deviation from on-time delivery, inconsistent quality, and unresponsiveness to sophisticated production technology”. In response, manufacturing companies should make their processes more efficient and effective. To do so, many manufacturing companies, especially automotive industry companies in Thailand, have implemented, are implementing or are considering the implementation of MRP systems.

However, while at present, there is wide acceptance of ERP system in many countries such as the USA, Canada, UK, and Australia, where MRP systems have been in existence for almost 25 years (Aghazadeh, 2003). MRP systems (MRPI/MRPII) are the heart of an ERP system. Studying MRP ((MRPI/MRPII) is the first logical step toward understanding ERP, because the ERP system encompasses MRPII, and the MRPII system in turn encompasses MRPI (Scott, 1994). Therefore, in this study focuses on MRP systems issues. Moreover, the current study's evidence shows that Thai automotive companies have implemented MRP (MRPI/MRPII) by 82.1%, while MRPII/ERP only by 17.9% (see Table 5.9). This also supports the reason why this study has studied MRP systems rather than ERP.

## Motivation and objective

Ever since MRP implementation is relatively new in developing countries such as Thailand, there is relatively little study on MRP implementation research which has seldom been conducted, particular empirical study in developing countries including Thailand. This may stem back from of knowledge about MRP systems in developing countries in general and in Thailand in particular. This research investigates and discusses the state of the art of MRP implementation in Thai automotive organizations. This describes the overall aim with three objectives which are (1) investigate MRP[1] project implementation in Thai automotive industry, (2) estimate the costs and benefits obtained from MRP implementation, and (3) identify the similarities and dissimilarities of the nature of MRP implementation in Thai automotive compared with other countries.

In pursuit of the above objectives this paper is established as follow: a review of literature, followed by the presentation of the methodology, then the main findings of the survey, and finally some implications of the findings and some suggestions for further research.

## Literature review

Today, competitiveness in the global market is increasingly severe. There are many factors which characterise the focus of the current manufacturing environment towards achieving a competitive advantage, such as: increased product variety, intensifying global competition, changing social expectations and rapid advancement of manufacturing technology (Ang, Sum & Chung, 1995); (Browne, Harhen & Shivnan, 1996); (Carrie et al., 1997). Manufacturing companies find themselves in radically changed environment, in



which they must improve the quality of their products and their productivity. It means that making the manufacturing processes more efficient and effective are vital dimensions to remaining competitive and a system of management that provides the means of gaining and sustaining this competitive advantage (Farquhar, 1991). An important factor for improving these processes is inventory and production control (Cooper & Zmud, 1989). A variety of information systems to support inventory and production control such as MRPI/MRPII have been developed to replace the traditional reorder point-based information systems. MRPI and its extension, MRPII have both gained the acceptance from academics and practitioners as important factors for improving manufacturing processes (Goh, 1984); (Aggarwal, 1985); (Browne et al., 1996); (Rabertson, Swan & Newell, 1996); (Lunn, 1996); (John and Charlotte, 1996); (Carrie et al., 1997). Well designed and successfully implemented MRP systems can help manufacturing plants reduce inventory, improve customer service and increase operating efficiency. The production management departments within manufacturing companies are responsible for achieving the successful implementation of such systems, however the MRP implementation systems is not easy (Ang et al., 1995).

Brown et al. (1996) suggested that the investigation of the state of practice of MRP systems relates primarily to understanding the effectiveness of such systems for the companies that use them. The review of literature reveals that the implementation of MRP systems may lead to achieving the effectiveness which measured by benefits obtained from MRP implementation as follows:

- *Tangible benefits* MRP benefits can be measured by improvement in tangible measures of manufacturing performance. These are *inventory turnover*, *delivery lead time*, *percent of time meeting delivery promises*, *percent of order requiring "splits"* because of unavailable material, and number of expeditors. However, there is a difficulty in obtaining measures of actual use (White et al., 1982), because companies usually cannot keep track of the performance measures over time (Sum et al., 1995). Hence, to assess improved performance the respondents (MRP users) are often asked to provide the experience that they would expect operating in today's economic environment with their pre-MRP production system, then to state the current experience given their stage of MRP development and finally state the future experience that they anticipate given total completion of their MRP development plans as in Anderson et al. (1982) and Laforge & Sturr (1986).

- *Subjective benefits* With regard to the difficulties in obtaining improved performance measures, several studies have decided to measure MRP subjective benefits using user satisfaction only. The data are interpreted as expressing user perceptions of the successful implementation of MRP systems (Duchessi et al. 1988); (Sum Yang, 1993); (Sum et al., 1995). The subjective benefits are increased BOM/inventory/MPS accuracy, better production scheduling, reduced safety stock, reduced informal systems for material management/inventory/production control, better ability to meet volume/product change, increased throughput, increased productivity, better cost estimation, improved job performance ability, improved responsiveness to customer, improvement purchase control and management, improved competitive position and so on.



However, the relevant literature reveals many problems still occurring with MRP implementation (Brown et al., 1996); (Ploss, 1995), some of these problems are

- MRP users involved in the implementation process do not have a clear understanding of the approach to implementation;
- MRP users do not comprehend the main goals for MRP implementation;
- MRP users have not had previous experience in the implementation of complex information systems (Burns, Turnipseed & Riggs, 1991); (Sum & Yang, 1993); and
- Inaccurate data records in the supporting files such as Bill of material file, inventory records and Master schedule Master Production Schedules (MPS);
- The issue of schedule instability of MRP systems (i.e. significant changes in master production schedule including changes in quantity or timing of planned orders or schedules receipts) has been considered as a major concern for MRP practitioners;
- MRP did not attempt to address the design of the manufacturing process. This leads to a situation where activities take place ignored (which are counter productive to good manufacturing practice and hence to manufacturing system performance). For example, the BOM concept tended to encourage the development of many process stages, each with buffers separating them from the next stage. Now, this is not required because MRP structures seem to guide users in this direction;
- MRP II has grown too large. It has tried to address too many problems in too many domains with the same basic approach. For example, now the shop floor control module of MRP II is not a viable alternative for complex manufacturing environments. The BOM concept may have had too much influence on the design of shop floor routings, and the result is the lack of clarity in representing manufacturing process routings;
- The failure to involve other functions such as marketing and purchasing, and finance (Westbrook, 1995).

The literature review reveals that there are numerous studies that have dealt with the various aspects of MRP implementation. However, these studies were conducted either in developed countries such as the USA or in the newly industrialized countries such as Singapore (Sum & Yang, 1993). Moreover, most of these studies are based on case studies or personal experience (Duchessi, Schaninger & Hobhs, 1989). The obstacle with case studies is that the failures are rarely documented because the authors are basically employees or consultants to the companies described in the cases (Burns et al., 1991), as such the lessons may not be applicable in other cases (Ang et al., 1995). In contrast, empirical studies on the state of practice of the MRP systems within manufacturing companies have been limited (Ang et al., 1995); (Sum & Yang, 1993). Furthermore, seldom of these studies has been conducted in developing countries such as Thailand and automotive industry companies in particular. Therefore, this paper has attempted to fill the



gap relating to the scarcity of the empirical studies in the developing countries. It is also provide useful information which may authorize MRP managers and users to get a better understanding on how to implement the MRP systems. This is done by identifying the state of the art of MRP implementation from the perceptions of MRP users within the Thailand's automotive companies.

### **Methodology**

As the precise number of companies which having at least basic MRP modules such as inventory control, bill of materials were not known, the primary intention of this study was to collect information from as many companies as possible. Therefore, survey has been the principle methodology in this MRP implementation studies which concerning the survey of both MRP- companies and non MRP-companies in Thai automotive industry. Typical designations of the respondents included the production manager, material manager, inventory control manager, master schedulers and management information system manager (Sum & Yang, 1993); (Ang et al., 1995); (Sum et al., 1995). However, the position of respondent in each company might be called by a different name through they might have the same duty. A pilot questionnaire was tested by academicians, the managers in a small number of companies and practitioner which well-known to the researcher. After relative few amendments the final questionnaire was produced and sent to the companies which were taken from companies' data held by the Thailand Automotive Institution and Federal of Thai industries.

Only one survey questionnaire was sent to each company, to be completed by production manager, material manager, inventory control manager, master schedulers and management information system manager. A total of 120 responses (44.6 percent which was regarded as a good response to mail survey) were received, of which 67 were from MRP companies and 53 were from non-MRP companies. Data from these will be investigated and compared with findings from previous studies elsewhere, such as Sum and Yang (1993) in Singapore (as a newly industrializing country), and Anderson et al. (1982) and Laforge & Sturr (1986) in the US (as a developed country).

### **Analysis**

A number of statistical techniques were used as following: (1) Frequency Analysis was used to show a count of the number of occurrences that fall into each of several categories; (2) Mean Value was used to provide differences between items; (3) Standard Deviation was used in order to state the degree of consistency in responses among the sample companies i.e. when the Standard Deviation is low the degree of consistency is high and vice versa; (4) The Median Test was used to find out if significant differences exist for the main obstacles that impede MRP implementation reported by non-MRP companies; and finally (5) Kendall's Tau and Spearman's correlation Coefficient were used to find out the strength of the relationship between MRP installation costs and company size factors.



## Comparison

Since there is seldom a publication of a similar nature of material requirement planning systems implementation in developing country such as Thailand, Thai automotive companies in particular, the findings are compared with those obtained by previous study elsewhere such as Sum and Yang (1993) in Singapore as a newly industrializing country, Anderson et al. (1982), and Laforge and Sturr (1986) in the USA as a developed country.

## Results and Discussion

The main findings of the survey are presented in this section. These will be compared with the previous studies whenever possible and meaningful.

### ***Company Profile***

#### **Company characteristics**

The findings in Table 5.1 indicate that the majority of MRP companies are joint ventures that have similar ownership arrangements as were found in the Sum and Yang (1993) study, which points out that 59.3% of MRP manufacturing companies in Singapore are multinational corporations. The majority of MRP automotive companies' main customers are assembly companies, dealers and directly to customers, and companies supplying assembly companies (3rd supplier), 76.1%, 28.4%, and 4.5% respectively. It appears from Table 5.1 that the majority of MRP companies embraced a production strategy combination of make to order and make to stock products. But this is a similar trend in relation to production strategy which MRP companies used in the US and Singapore as showed by Anderson et al. (1982) and Sum and Yang (1993) respectively. MRP systems are also more often adopted by automotive companies that work with a complicated production process (assembly and continuous/process flow) than in companies with fabrication. To some extent, this result is slightly different to those of Anderson et al. (1982) and Sum and Yang (1993) concerning the type of manufacturing associated processes which work in assembly and fabrication operations with the successful implementation of MRP systems by American and Singapore manufacturing companies, successively.



Table 5.1 Company characteristics reported by the total sample.

Characteristics	MRP companies (N) (%)		Non-MRP companies (N) (%)		Overall (N) (%)	
Ownership						
– Thai owned	18	26.8	29	54.7	47	39.2
– Joint Venture (Multinational corporation)	43	64.2	23	43.4	66	55.0
– Foreign owned	6	9.0	1	1.9	7	5.8
<b>Total</b>	<b>67</b>	<b>100.0</b>	<b>53</b>	<b>100.0</b>	<b>120</b>	<b>100.0</b>
Main Customer**						
– Dealers and directly to customers	19	28.4	3	5.7	22	18.4
– Assembly companies	51	76.1	46	86.8	97	80.8
– Companies supplying assembly companies	3	4.5	10	18.9	13	10.8
<b>Total</b>	<b>73</b>	<b>109.0<sup>a</sup></b>	<b>59</b>	<b>111.4<sup>a</sup></b>	<b>132</b>	<b>110.0<sup>a</sup></b>
Type of production policy*** (Mean value)						
– Make-To-Order	–	95.4	–	79.9		
– Make-To-Stock	–	95.4	–	21.1		
<b>Total</b>	<b>100.0</b>		<b>100.0</b>			
Type of production process**** (Mean value)						
– Assembly only	–	50.2	–	40.1		
– Fabrication only	–	14.1	–	4.5		
– Continuous/ process flow	–	35.7	–	54.8		
– Others	–	–	–	0.6		
<b>Total</b>	<b>100.0</b>		<b>100.0</b>			

<sup>a</sup> percentages do not add up to 100 because several companies gave multiple answers.



### Company size.

Figure 5.1 illustrate that MRP implementation is inclined to increase as one moves from small companies with gross sales less than 10 million Baht to big companies with gross sales greater than 500 millions Baht. This result supports the results of the Anderson et al. (1982) study, and the Sum and Yang (1993) study, which concluded that as companies increase in size, as measured by gross sales, they have a greater inclination to implement MRP systems.

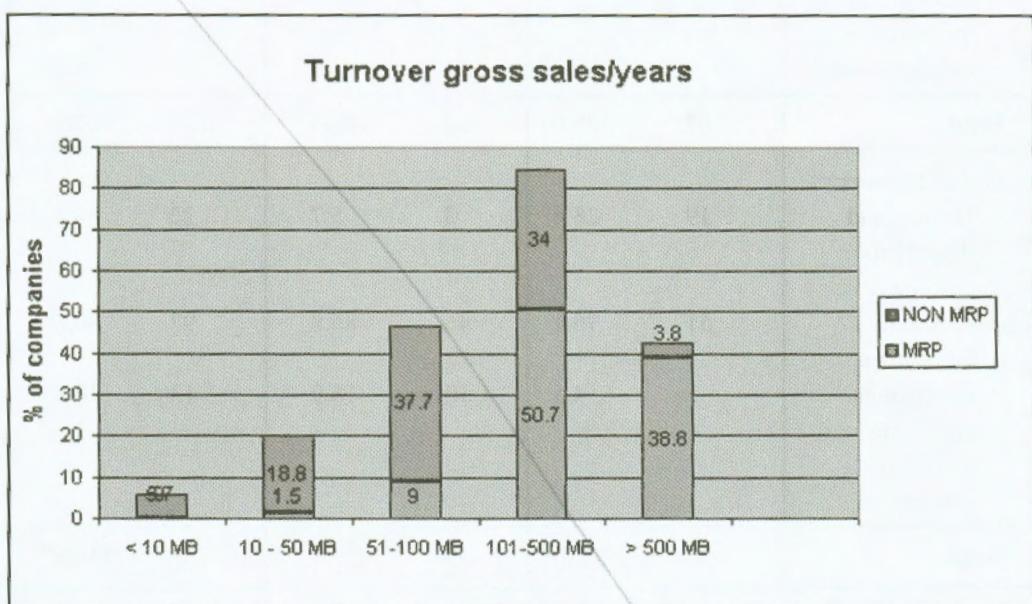


Figure 5.1 : Gross sales

### Company complexity

Table 5.2 suggests that MRP systems are more often adopted by manufacturing companies with a complex product structure (number of levels in the bill of materials-BOM). This result supports Puttick's grid (1987) concerning key manufacturing techniques. This supposes that when manufacturing companies engage in complicated manufacturing processes, the need and opportunity of implementation of MRP systems is increased to manage and control the whole operation. In general terms, Table 5.2 indicates that the product complexity as measured by BOM levels in Thai automotive industry companies is smaller than those in the US, whether in MRP companies or Non-MRP companies.

**Table 5.2** Number of Bill of Material levels (Mean values).

Study	BOM levels in MRP companies	BOM levels in Non-MRP companies
The current study*	6.2	4.5
Anderson et al., study	6.9	5.8

### *Obstacles that impede MRP implementation in Thai automotive companies*

The findings indicate that about 44.17% of companies participating in the empirical study had not implemented the MRP systems. They reported that the traditional systems (Manual and Reorder Point Systems - ROP spreadsheet computer based) have been used for manufacturing planning and control for more than 6 years (about 77.4%). To some extent, this result concurs with the findings of Newman and Sriharan (1992), who found that 59 out of 185 manufacturing companies surveyed in the US still implemented the Reorder Point Systems - ROP based on computer or manual systems.

Cost too high and limited knowledge about the MRP was reported as the biggest obstacle impeding MRP implementation for non-adopters (Table 5.3), with a high level of agreement between respondents ( $SD = .454$  and  $.553$ ). To a large extent this result is similar to Ang et al. (1995), who found that the main reason for not implementing MRP systems is a lack of company expertise in MRP in Singaporean companies. Nevertheless, it is less important than the cost too high in the Thai automotive companies.

**Table 5.3** The main obstacles that impede MRP implementation reported by non-MRP companies.

Items	Median Score (Mean score)*	SD*
a). Cost too high	3.0 (2.79)	.454
b) Limited knowledge about MRP	3.0 (2.66)	.553
c) Successful without MRP implementation	2.0 (1.92)	.703
d) Not applicable to this business	2.0 (1.87)	.627
e) Not felt to achieve enough benefits	2.0 (1.81)	.652
f) Potential staff attitude problems	1.0 (1.28)	.495

\* Based on a 3-point scale - "1" for no significant and "3" for very significant

\*\* The standard deviation presents an adverse measure of agreement among the respondents which means that a high standard deviation refers to a low level of agreement while a low standard deviation indicates a high level of agreement (as in White and Wharton, 1990).



Furthermore, Table 5.3 indicates that the main obstacles can be classified into three sets, based on the questionnaire responses. The first set of main obstacle: (a) and (b) was regarded as indicated by their median score of 3.0 (i.e. strongly significant). The second set of obstacles; (c), (d) and (e) was viewed as some significant; as indicated by their median score of 2.0 (i.e. neither significant nor insignificant). But the third set of obstacles – (f) received the mean score of only 1.0 (not significant), signifying that the respondents saw them as unimportant. Also, to find out if there were significant differences between each of obstacles in the reasons given by non-MRP companies, it appears from the symmetric Table 5.4 below, that a nonparametric statistic test namely a “median test” was carried out (Conover, 1999). This shows that the differences in the median scores were statistically highly significant. There are real differences exist between “Cost too high and Limited knowledge about MRP (as median score 3)” and “Not applicable to this business, Not felt to achieve enough benefits (median score 2)” and “Potential staff attitude problems (median score 1)” Also, there are strong significant differences between potential staff attitude problems and the main tabulated.

**Table 5.4** Significant levels (P values\*) for the significant obstacles that impede MRP implementation reported by non-MRP companies.

Items	Cost too high	Limited knowledge about MRP	Successful without MRP implementation	Not applicable to this business	Not felt to achieve enough benefits	Potential staff attitude problems
a) Cost too high	NA	NA		0.000**	0.000**	0.000**
b) Limited knowledge about MRP	NA***		0.083	0.000**	0.000**	0.000**
c) Successful without MRP implementation	NA	0.083		0.321	0.301	0.000**
d) Not applicable to this business	0.000**	0.000**	0.321		0.969	0.000**
e) Not felt to achieve enough benefits	0.000**	0.000**	0.301	0.969		0.000**
f) Potential staff attitude problems	0.000**	0.000**	0.000**	0.000**	0.000**	

\* Using Median Test and Significant at level .05

\*\* Highly significant differences

\*\*\* Median test cannot be performed as all values are less than or equal to the median.



### ***Organizational arrangements for implementation***

It appears from Table 5.5 that two-thirds of MRP companies set up a formal steering committee to oversee the implementation of MRP systems, and in half the cases it met at least once a month and a project team met weekly. MRP companies in the Thai automotive industry set up a formal steering committee to oversee the implementation of MRP systems more than their peers in Singapore (68.2% in Thailand against 47.4% in Singapore) (Ang et al., 1995) but these arrangements were less formal than those made by MRP companies in the US (69.35%) (Duchessi et al., 1988).

### ***MRP implementation process***

#### **Years in implementation**

This shows a sharply growing trend in the implementation of MRP systems by the Thai automotive industry. Implementation has been recent, 38.8% within last five years and 91.0% within last ten years. There has been increasing Thai government support for implementing new production technology within the Thai automotive sector, such as incentives, and the provision of education. To a large extent, the previous result is similar to Sum and Yang (1993), concerning the degree of growth of MRP systems, and the government's role in introducing MRP systems in Singapore. Furthermore, the survey findings also indicate that 83.5% of MRP companies had installed their systems for more than 2 to 10 years. This can be seen to be synchronized with the current version stage of implementation (according to Table 5.9, 67.2% of MRP companies claimed to be second version which is computerized materials/production planning and control system including detailed capacity requirement planning). This may imply that Thai users do just begin at intermediate level. Voss (1986) has said that manufacturing companies need ten years to learn how to implement MRP systems. This result can be interpreted to suggest that Thai automotive companies need more experience with MRP implementation in order to be ensuring successful adoption.

#### **Initiator of MRP effort**

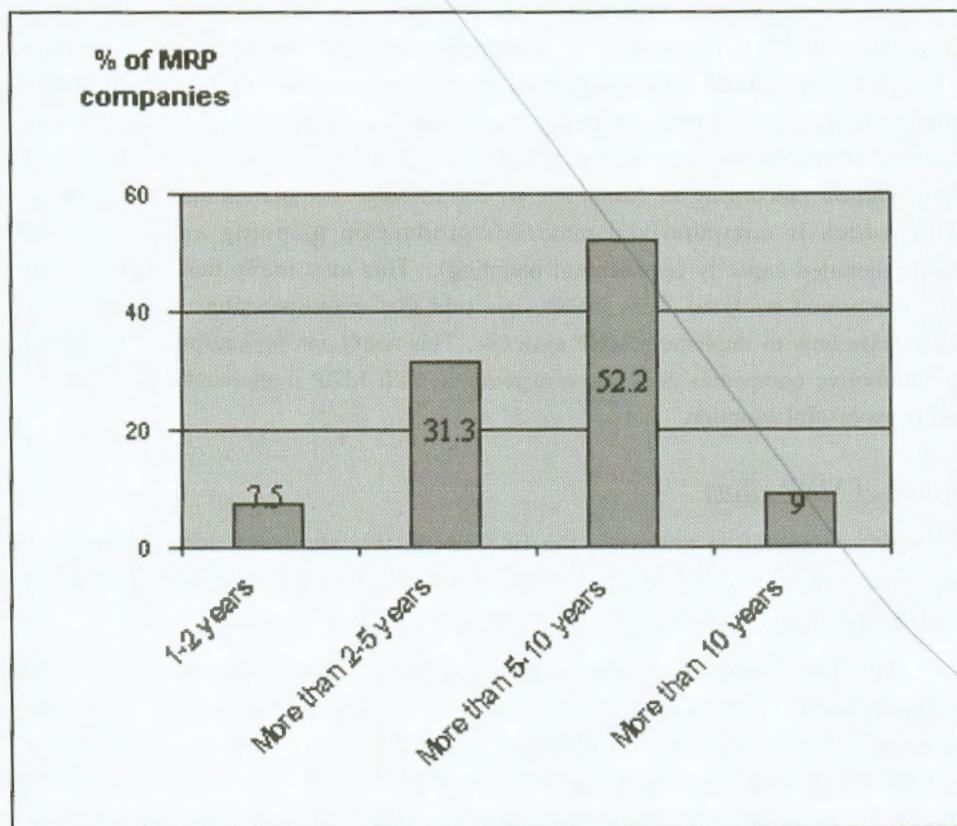
For comparative purposes, the findings in this study are compared with White et al. (1982) and Sum and Yang (1993) studies are concerning the initiator of MRP systems in the US and Singapore respectively, as shown in Table 5.6 in the belowing page:

The Thai automotive and Singaporean top management are more involved in introducing MRP systems into their companies than their peers in the US companies. This result can be interpreted in the light of the fact that MRP users in Thailand and Singapore are relative beginners compared with the US users. This may mean that the top managers are more informed about implementing MRP systems in Thailand and Singapore than their peers in US companies. It is interesting from the results, that Thai and American production & inventory control (P & IC) managers play more important roles than Singapore. This may imply that the (P & IC) manager is more informed about implementing MRP systems in Thailand and US than in Singapore.



**Table 5.5** Organizational arrangements for implementing MRP systems reported by MRP users\*

Items		Yes	No	Total
A Steering committee was formed	N	45	21	66
	%	68.2	31.8	100
A Steering committee met at least once a month	N	38	29	67
	%	56.7	43.3	100
The project team generally met weekly	N	36	30	66
	%	54.5	45.5	100



**Figure 5.2** : The growth of MRP users in Thai automotive industry companies.

**Table 5.6** Initiator of MRP effort in different contexts (% of companies).

Initiator <sup>a</sup>	Thailand	(present study) Singapore	United States <sup>a</sup>
a) Top management	64.2	67.8	18.0
b) Production and inventory control (P & IC) management	3.0	6.8	31.0
c) Both top management and P & IC management	28.4	18.6	31.0
d) Data processing personnel	0.0	3.4	10.0
e) Software/hardware vendors	3.0	5.1	NA <sup>b</sup>
f) Others	1.4	0.0	10.0
<b>Total</b>	<b>100.0%</b>	<b>101.7<sup>c</sup> %</b>	<b>100.0%</b>

<sup>a</sup> Results extracted from White et al., (1982).<sup>b</sup> "NA" means response is not available because option was not reported in White et al., (1982).<sup>c</sup> Percentage do not add up to 100 because several companies gave multiple answers.

### MRP implementation strategy

As can be seen in Table 5.7, demonstrates that the majority of MRP companies in Thailand (67.2%) have been following a parallel implementation strategy for implementing MRP systems. This is a good sign, reflecting that manufacturing companies in Thailand are aware of the importance of introducing new technology based on a parallel approach, not only to know to what extent the people will be familiar with the new system, but also in order to reduce the results derived from the failure of the implementation. This result does not concur with Burn et al. (1991) findings regarding the implementation of MRP II by 80% of the American users using a phased strategy.

**Table 5.7** The implementation strategy used by the Thai automotive industry companies.

Conversion Strategies	N	%
Direct	11	16.4
Pilot	1	1.5
Parallel	45	67.2
Phased	10	14.9
<b>Total</b>	<b>67</b>	<b>100.0</b>



### ***MRP Implementation Problems***

The major implementation problems are high cost of MRP, lack of company expertise in MRP and poor training/education on MRP respectively. This contrasts the literature review concerning the cost of MRP systems was not cited as major obstacles for MRP implementation (Plossl, 1995); (Correll, 1994). Nevertheless, there are some similarities from the results in Table 5.8 with a previous study concerning the need to expertise have in MRP and to design MRP education programmes, which were major obstacles for MRP implementation and which reflect the important ingredients of MRP implementation (Plossl, 1995); (Correll, 1994).

**Table 5.8** MRP implementation problems.

Problems	N	%
High cost of MRP system	49	73.1
Lack of company expertise in MRP	43	64.2
Poor training/education on MRP	39	58.2
Lack of information technology expertise	31	46.3
Lack of communication	27	40.3
Lack of data accuracy of MRP system	21	31.3
Lack of suitability of software	20	29.9
Lack of involvement and support from vendor	17	25.4
Lack of vendor knowledge on MRP	13	19.4
Lack of clear goals for MRP effort	8	11.9
Lack of support from marketing	7	10.4
Lack of support from production	4	6.0
A lack of support from top management	3	4.5
Lack of support from supervisor or foreman	3	4.5
Lack of support from finance	3	4.5
Lack of suitability of hardware	2	3.0
Other	2	3.0

### ***MRP system characteristics***

#### ***Definition and version of MRP***

The majority of the Thai users indicate that the MRP system is regarded as a tool for materials/production planning and control system including detailed capacity requirement planning (Table 5.9). This result suggests that MRP users in the Thai automotive industry companies are relatively understand the extensive scope of MRP systems. In the same trend, this finding concurs with Sum and Yang (1993) who reported in their study about MRP practices in Singapore, that the majority of MRP companies had apprehended the extensive scope of MRP systems.



**Table 5.9** Definition and version of term “MRP” reported by MRP users in different contexts.

Definition	Thailand		Singapore	
	N	%	N	%
a) Computerized materials/production planning and control system without detailed capacity requirement planning (MRPI)	10	14.9	10	17.2
b) Computerized materials/production planning and control system including detailed capacity requirement planning	45	67.2	40	67.2
c) Computerized materials /production planning and control system including detailed capacity requirement planning and integrated with other business functions (MRPII/ERP)	12	17.9	7	12.1
d) Others	0	0.0	2	3.5
<b>TOTAL</b>	<b>67</b>	<b>100.0</b>	<b>59</b>	<b>100.0</b>

#### Hardware and software

The findings indicate that 52.2 % and 38.8% of MRP users run their systems on network PC and minicomputer in respectively while 12% of MRP systems run on mainframe and microcomputer. Furthermore, a majority of companies (61.2%) indicate that the MRP user companies in Thai automotive industry prefer to buying-in and customized in-house against 10.4% of MRP companies who bought some turnkey systems from vendors. For comparative proposes, this result to a extent is similar to the finding of the Sum and Yang (1993) study, which found that 49.2% of the MRP systems in Singapore run on minicomputers, on the other hand, there is a little extent is dissimilar indicated that of 71.1% MRP companies source their MRP software from vendors, and only 13.6% develop the entire software in house (Sum & Yang, 1993).

#### The degree of computerization of MRP modules

The findings in Sum and Yang (1993) are displayed alongside our findings in Table 5.10 in the following page:

**Table 5.10** Degree of computerization of MRP modules in different contexts.

Modules	Thailand (Current study)*	Sum & Yang Study*
Inventory control	4.20	4.26
Bills of materials	4.10	4.18
Purchasing and receiving	4.05	3.74
Material requirements planning (parts explosion)	4.05	3.57
Routing/work centers	2.16	2.98
Customer order service	2.06	N.A. <sup>a</sup>
Cost accounting	2.04	3.20
Sales order processing	2.02	3.18
Master production scheduler	2.02	2.56
Shop floor control	1.62	2.12
Financial analysis	1.40	2.73
Payroll/human resources	0.97	2.61
Rough-cut capacity planning	0.96	1.27
Forecasting	0.90	1.31
Operations scheduling	0.86	1.79
Capacity requirements planning	0.80	1.53

\*Based on a six-point Likert scale, score "0" for "not at all", "1" for "1-20%", "5" for "81-100%"

Overall, Table 5.10 shows that the degree of computerization of MRP modules associated with the MRP implementation in Thai automotive industry and Singapore extends only to basic MRP modules such as an inventory control, bill of materials, purchasing and receiving, and material requirements planning (parts explosion). In other words, these findings indicate that the Thai automotive users and Singaporean users had implemented the basic modules such as BOM, MPS, MRP and inventory control. The sophisticated modules such as capacity requirements planning and rough-cut capacity planning were little used. This result can be interpreted in light of the fact that both the Thai and Singaporean users (Ang et al., 1995) are still relatively beginners with the implementation of MRP systems. Therefore, this degree of computerization meets their requirements for the current period.

### ***MRP users' profile***

#### ***Previous experience***

The respondents were asked to indicate their previous experience with automated complex information system base on a five point Likert scale, with 1=very little and 5=very high. The findings indicate that the MRP users in Thai automotive industry companies had received



a moderate experience with automated complex information systems before implementing an MRP system. Nevertheless, this result contrasts with the claim that operation/production managers responsible for the implementation of MRP systems in US companies have not had previous experience in the implementation of complex information systems (Burns et al., 1991).

### MRP Users support

Getting people support, whether top management or manager, is a very critical factor for implementing MRP systems by manufacturing companies (Dilworth, 1993). Table 5.11 illustrates that 91.0% of MRP users were at least supportive of the decision to implement an MRP system. This highly level of support from user can also reflect to highly willingness of user. This result, to a large extent, is very similar to the finding of the Turnipseed et al. (1992) study which found that 90.0% of MRP users in the US were at least supportive of implementing MRP systems. This is a good sign as the level of users support has often been identified as one of major implementation prerequisites (Callarman and Heyl, 1986); (Dilworth, 1993).

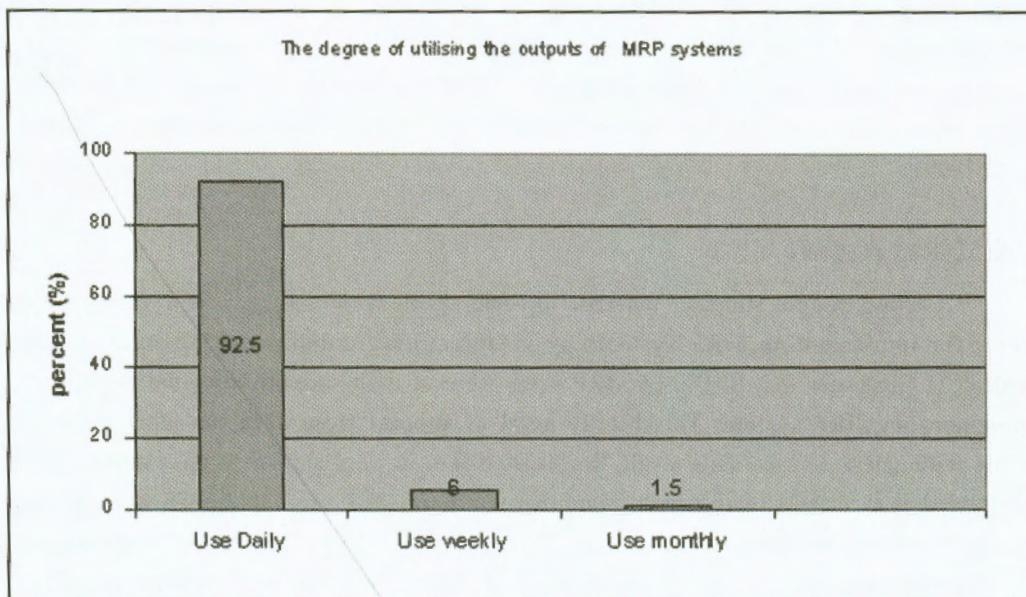
**Table 5.11** Level of support of MRP implementation by MRP users in different context.

Items	Thailand		US	
	N	%	N	%
• Total support	21	31.3	28	38.0
• Very supportive	32	47.8	18	24.0
• Supportive	8	11.9	19	27.0
• Neutral	6	9.0	7	10.0
• Opposed implementation	0	0.0	0	0.0
<b>TOTAL</b>	<b>67</b>	<b>100.0</b>	<b>59</b>	<b>100.0</b>

### The degree of utilizing the outputs of MRP systems

The MRP users were asked about the extent to which they utilized the outputs of MRP systems.

As can be seen in figure 5.3, show that the majority of MRP users in Thai automotive industry companies (92.5%) use the MRP system output on at least a daily basis. Similarly, Turnipseed et al. (1992) found that 75.0% of MRP companies in the US used the MRP system outputs on at least a daily basis. This result may help explain why a majority of MRP users in the two studies were at least supportive of implementing MRP systems.



**Figure 5.3** The extent to which MRP users utilize the outputs of an MRP system.

### ***MRP benefits/costs***

#### ***MRP benefits***

The present study, the effectiveness of MRP implementation is measured by (1) tangible benefits or improved performance measures, and (2) subjective benefits or user satisfaction.

Table 5.12 shows the tangible benefits of MRP implementation in the Thai sample and companies with two previous studies conducted in the USA (Anderson et al., 1982); (Laforge & Sturr, 1986). These show a substantial improvement in performance as a result of MRP implementation by Thai automotive companies. In generally terms the results of the three studies (the current study, the Anderson study and the Laforge study), as a group strongly provide further evidence that MRP companies had experienced significant improvements in manufacturing performance with MRP implementation. These results suggest that MRP systems have been helping managers to determine what components are needed, how many are needed, when they are needed, and when they should be ordered so that they are probably available when needed.

Furthermore, the respondents were asked to give their opinions about the degree of the subjective benefits of MRP implementation based on a four-point score as "1" for little benefit, "4" for greatest benefit. Table 5.13 concludes these for the Thai automotive sample.

It appears from Table 5.13, that reduced inventory costs received the highest rating by MRP users. This supports the claim that a common complaint in most automotive companies in Thailand is "we have got too much inventory". In additional, improved



competitive position was a less commonly recognized outcome of implementing an MRP system, receiving the next to lowest rating's by MRP users. This means that improved competitive position was not one of the major reasons for MRP implementation by Thai automotive companies. To a large extent, this finding is different from Sum and Yang's findings (1993). The highest mean value for Thai automotive companies is for reduced inventory costs, while Sum and Yang's study is for better production scheduling. This result concurs with the findings of Anonymous (1996), who reported that the biggest benefit obtained from MRPII implementation by the company James Coney was lower costs for holding stocks of obsolete inventory. However, in general term, researcher can say that most of the benefits obtained from MRP implementation match the implementation reasons except for improved competition measure, whereas only a few companies reported some significant increase in such calculate.

**Table 5.12** The comparison of the tangible benefits of MRP systems implementation in different contexts.

Item		Pre-MRP Estimate	Current Estimate	Future Estimate	The Achieved Improvement*	Progress**
a) Inventory turnover	Current	1.5	2.8	6.2	86.7	27.7
	Anderson	3.2	4.3	5.3	34.4	52.4
	Laforge	4.5	7.9	11.2	75.6	50.7
b) Delivery lead time (days)	Current	23.5	11.6	4.9	50.6	64.0
	Anderson	71.4	58.9	44.5	17.5	46.7
	Laforge	55.6	41.7	31.8	25.0	58.4
c) Percent of time meeting delivery promises (%)	Current	89.3	95.5	98.2	6.9	69.7
	Anderson	61.4	76.6	88.7	24.8	55.7
	Laforge	73.9	88.6	94.6	19.9	71.0
d) Percent of orders requiring "splits" because of unavailable material (%)	Current	17.2	14.4	9.9	16.3	38.4
	Anderson	32.4	19.4	9.1	40.1	55.8
	Laforge	29.0	13.5	5.5	53.4	65.9
e) Number of expeditors (number of people)	Current	36.4	29.6	24.3	18.7	56.2
	Anderson	10.1	6.5	4.6	35.6	65.5
	Laforge	10.8	5.1	2.1	52.8	65.5

\* Improvement = Current improvement = (Current estimate - Pre estimate) / (Pre estimate)

\*\* Progress = 
$$\frac{\text{Current Estimate} - \text{"Pre - MRP" Estimate}}{\text{Future Estimate} - \text{"Pre - MRP" Estimate}}$$



**Table 5.13** Comparison of subjective benefits of MRP systems implementation in different contexts. (Mean value\*).

Items	Current Study	Sum and Yang Study	Schroeder Stndy
Reduced inventory costs	3.81	3.65	N/A**
Better production scheduling	3.80	3.87	2.7
Increased BOM/inventory/MPS accuracy	3.57	N/A	N/A
Reduced informal system for material Management /Inventory/Production control	3.52	3.48	N/A
Better cost estimation	3.19	3.69	2.2
Increased throughput	3.14	N/A	2.4
Reduced safety stocks	3.03	N/A	N/A
Improved productivity	2.89	3.46	2.4
Improved co-ordination with marketing &finance	2.87	3.66	N/A
Improved your ability to perform in job	2.74	3.83	N/A
Better ability to meet volume/product change	2.70	N/A	N/A
Improved quality of products	2.46	N/A	N/A
Improved competitive position	2.39	3.40	2.1
Increased information on which to base decisions since implementation of MRP	2.38	N/A	N/A

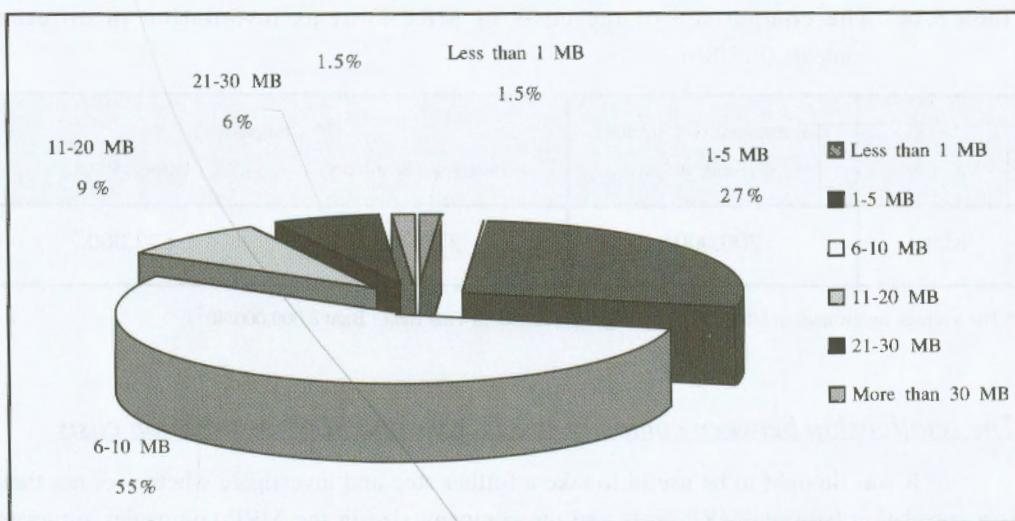
\* The comparison was built on the mean score for each subjective benefit measure in the three studies and based on four-point scale, score "1" for little benefit, "4" for greatest benefit.

\*\* N/A means a response is not available because the option was not reported in the other two studies.

### *MRP system costs*

- The analysis of the costs of MRP installation

Since it is generally believed that MRP implementation benefits are not without considerable costs (Schroeder et al., 1981); (Laforge & Sturr, 1986); (Sum & Yang, 1993); (Ang et al., 1995), one question in the survey that related to MRP implementation costs which was: "How much has your company spent to install MRP in your facility?"



**Figure 5.4** The current MRP investment (hardware, software and personnel costs). Investment (MB = Million Baht).

According to Figure 5.4, we can categorize MRP users into three groups in terms of range of how much is spent on MRP system installation. The smaller group who comprised 29% of companies who had spent less than 6,000,000 Baht (or approximately £81,081.08 at an exchange rate of £1 = 74Baht). The Medium group of 63.0% spent between 6,000,000 and 20,000,000 Baht or approximately £270,270.27.08 (£1 = 74 Baht). The larger group comprised 8% of the total, who had spent more than 20,000,000 Baht.

- The comparison of the costs of MRP systems installation in different contexts

The current average investment of MRP system of the three studies is shown in Table 5.14. It indicates that Thai automotive companies spent less than their peers in the US. This result may concur with other finding in this study which indicates that the majority of Thai automotive users (61.2%) selected then source of MRP software package from buying-in and customized in-house rather than from vendors so that they would have cheaper costs of MRP systems installation.

However, the Thai investment in MRP is less than their peers in the US, where an advanced stage of MRP system has already been reached.



**Table 5.14** The comparison of the costs of MRP systems installation in different contexts (in US\$).

	Thai Automotive Companies (Present study)	US. Companies	
		Anderson&Schroeder	Laforge&Sturr
Mean	200,000*	375,000	623,000

\* The average investment in US\$ = (The average investment in Thai Baht : Baht 8,000,000/40<sup>1</sup>)

***The relationship between company size factors and MRP installation costs***

It was thought to be useful to take a further step and investigate whether or not there is a correlation between MRP costs and the company size in the MRP companies surveyed. Company size was measured by total company sales, total number of employees, and the number of employees in production and inventory control. Therefore, the Kendall's Tau and Spearman correlation coefficient analysis was employed to state the association between each of the company size factors and the costs of MRP implementation as it is illustrated in Table 5.15 belows.

**Table 5.15** Correlation between MRP costs and company size factors.

Item relationship	Kendall's Tau ( $r_k$ )	Spearman ( $r_s$ )	Significant Level
Total company sales	0.240	0.255	.000 (S)
Total number of employees	0.608	0.71	.000 (S)
Number of employees in P&I C	0.523	0.579	.000 (S)

S : Significant at .05 level

As can be seen from Table 5.15, both techniques showed the same results as the relationships between the costs of the MRP system (MRP installation cost + the additional investment). The company size factors are strong ( $r_k = 0.240$ ,  $0.608$  and  $0.523$  and  $r_s = 0.255$ ,  $0.71$  and  $0.579$ , and  $P < 0.05$ ). This result is rather predictable, and can indicate that larger companies are more likely to spend more on implementing MRP systems. This may stem from the fact that the majority of MRP companies in the survey are joint venture or multinational (64.2%)

<sup>1</sup> For comparative purposes the cost of MRP implementation in Thailand was calculated in US\$ currency. US\$ 1 (approximately) = 40 Baht (The average investment in Baht = 8,000,000).



(See Table 5.1), with the parent company/ headquarter providing them with huge investment in the implementation of new technologies.

This result concurs with that of the Sum an Yang study (1993). Their results show a strong relationship between the company size and the costs of MRP implementation among the Singaporean manufacturing companies.

### Conclusion and direction for further research

The main contribution of this study is the adoption of a more comprehensive approach than previous studies to investigating the state of the art of MRP implementation, namely this study has a wider coverage of the vital subjects that embody the state of the art of MRP implementation such as MRP user's profile, MRP benefits and costs in particular objective and subjective benefits obtained from MRP implementation. This study contributes to what is currently a very limited amount of empirical research on MRP projects especially on Thai automotive companies. A very significant contribution of this study is the undertaking of an extensive comparison of results with those obtained by the previous studies elsewhere. The results of this study suggest that the implementation of MRP systems in Thai automotive companies is relatively similar to those of Sum and Yang (1993) and Ang et al., 1995 in Singapore as a newly industrializing country Anderson et al. (1982) and Laforge and Sturr (1986) in the USA. as a developed country. The current study reveals that most MRP companies in the Thai automotive industry are joint ventures (between Thai and foreign company). This is similar to Singapore and the US, where the majority of MRP companies are multinational owned. This reflects that the Thai automotive companies are dominated by overseas countries. Moreover, the survey findings suggested that in Thailand, Singapore and the US, larger and more complex companies are more likely to implement MRP systems. Their production strategy is a combination of make to order and make to stock products in the three countries. On the other hand, the interesting differences that emerged can be summarized as follows:

- a) The survey findings suggest that high cost of MRP system and lack of expertise can be considered as the most important obstacle that impedes MRP implementation among Thai users, while lack of MRP training and expertise were identified as the most critical problems encountered in the implementation process in Singapore and the US.
- b) This study reveals that top management support in Thailand and similarly in Singapore, has had a great impact on the extent and rate of the acceptance of MRP systems, more than their peers in the US.
- c) The findings indicated that the formal training from Headquarter/parent Company, software Vendor Company, IT/computer department within a company, and government institutions plays a vital role in the implementation of MRP systems. In contrast, in the US, formal training from a college graduates plays a very important part in their MRP implementation. There is no mention of training from any other source such as a software vendor company or government institutions.



- d) The study reveals that the current usage of MRP systems is not very widespread in the Thai automotive industry. Despite the Thai government's support (e.g., grants, incentives) in promoting use of MRP systems, 67 of 120 companies that participated in the empirical analysis had implemented MRP systems but 53 had not.
- e) Additionally, the analysis of the relationship between MRP cost and company size provides evidence that larger companies are more likely to spend more on implementing MRP systems.

With the survey result, one of the main implications of the current study is that it shows that competitive position was not one of the major reasons and benefits for MRP implementation by the Thai automotive companies. A majority of MRP companies in Thai automotive industry indicated that the most important reasons for implementing MRP systems were operational and not strategic. Better inventory control, lowering inventory cost and reduced informal system for material management/inventory/production control were the kinds of reasons given, suggesting that MRP systems were not viewed as a competitive strategy weapon.

Another implication of the survey empirical study is that the governmental role area highly salient factor for developing the automotive sector in Thailand. Automotive companies indicated that they rely on the government, not only to promote MRP systems but also to provide support (e.g., grants, incentives through Board of Investment (BOI), Thailand Automotive Institute and etc.), as well as to run the relevant education/training programmes for achieving successful implementation. This reflects the extent to which the automotive sector still dominates control structures over industry in Thailand.

Very significant implications are that high cost of MRP system and Lack of company expertise in MRP and poor training/ education (people support) on MRP were viewed as be crucial to implementing MRP systems. Therefore, the need for MRP education and training is highly stressed. Alternately, MRP vendors, and consultants, whether from outside or parent company, educational institutions and government training agencies can meet this need through preparing appropriate programmes and courses for MRP users.

Since the current study have been relatively little study to investigate the state of the art of MRP implementation in developing countries in general, and in Thailand in particular, there are several directions in which future research is recommended. 1) It should investigate fuller MRP implementation in the manufacturing sector organizations rather than in only one industry; 2) Further research should be undertaken to monitor the progress and status of MRP usage in Thailand over time. This may provide useful insights into the current trend and development in the implementation of MRP systems by the Thai users; 3) Comparative studies be made with other developing countries which to explore similarities and dissimilarities concerning MRP implementation; and Finally, there is a trend toward a hybrid MRP with the other new production management such as JIT and OPT systems within the CIM context and extended MRP such as ERP systems. Future studies can therefore be based on the evaluation of such systems to identify the state of the art of these implementation systems.



### Note:

- The term “MRP” in this research is used as a general term to include all MRP version, namely MRPI (i.e. materials requirements planning), Closed-loop MRP (with detailed capacity requirement planning), and MRPII/ERP (with detailed capacity requirement planning and integrated with other business functions).

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