IMPLEMENTATION OF ENTERPRISE RESOURCE PLANNING (ERP) SYSTEM IN THAILAND: A CASE FOR ELECTRO PLATTING INDUSTRY

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Abstract - This paper purposes the implementation of the Enterprise Resource Planning (ERP) System in an electro platting industry in Thailand. An ERP software was developed and specifically designed to suitable for a sample factory. The Material Requirements Planning (MRP) and the Master Production Scheduling (MPS) modules were selected to manage in warehouse and logistic departments. Then the cost and performance are two factors used to compare the benefit after ERP implementation. The results show that the ERP system can reduce huge amount of wasted time and error. The ERP system well fulfills and handles the complicated task such as inventory, planning, delivery and reporting. The operation time and cost can be reduced by 71 % and 50% respectively. The efficiency of the operation improves by 101.2%. In summary, the developed program obviously perform greater than the conventional process, which was relied on human related process.

Index Terms - Enterprise Resource Planning (ERP), Material Requirements Planning (MRP), Master Production Scheduling (MPS).

I. INTRODUCTION

Enterprise resource planning (ERP) systems make possible for organizations to reduce costs [1]. It offers plentiful benefits for organization [2] and provides a standardized and seamless integration of all the information flowing through the various business functions [3]. ERP system is a customizable software and includes solutions for critical business processes such as : finance, accounting, human resources, purchasing, manufacturing, and sales. Within ERP systems, these key operations are called modules and organizations traditionally purchase these modules individually based on their needs [4]. (ERP) systems represent an important backbone of the business which can control all organizational resources and transactions through one system [5].

Expectations from the use of ERP systems such as inventory storage to reduce inventory. Improve performance, increase productivity, and reduce production time [6]. In general, ERP systems was adopted in most large companies. Small and medium enterprise (SME) in almost countries including in Thailand, small still do not accept.

In Thailand, we continue to focus on customer support. It was found that the key factors to make ERP not generally used to apply are the difficulty to use, mismatch of the enterprise culture and its high cost. It is hardly used in Thailand (1). Most of company adopted ERP in Thailand focuses on only accounting section.

In this paper, ERP system will be first applied in electroplating in Thailand. The cost and performance measurement using the MRP MPS Module will be explained. The benefit of production cost and time reduction will be revealed.

II. THEORIES

A. ERP system

According to Davenport (1998), ERP systems generally comprise different software modules, which allow organizations to automate and integrate the majority of business functions by accessing, and sharing common information, data, and practices across the enterprise in real-time. The author further explains the anatomy of ERP systems being at "the heart of an [ERP] system is a central database that draws data from, and feed data into a series of applications supporting diverse company functions. Using a single database dramatically streamlines the "flow of information throughout a business". A defining feature of an ERP system is the integration of different organizational functions, so that information is entered only once, and is thereafter available across the organization with real-time updates (Davenport, 1998).

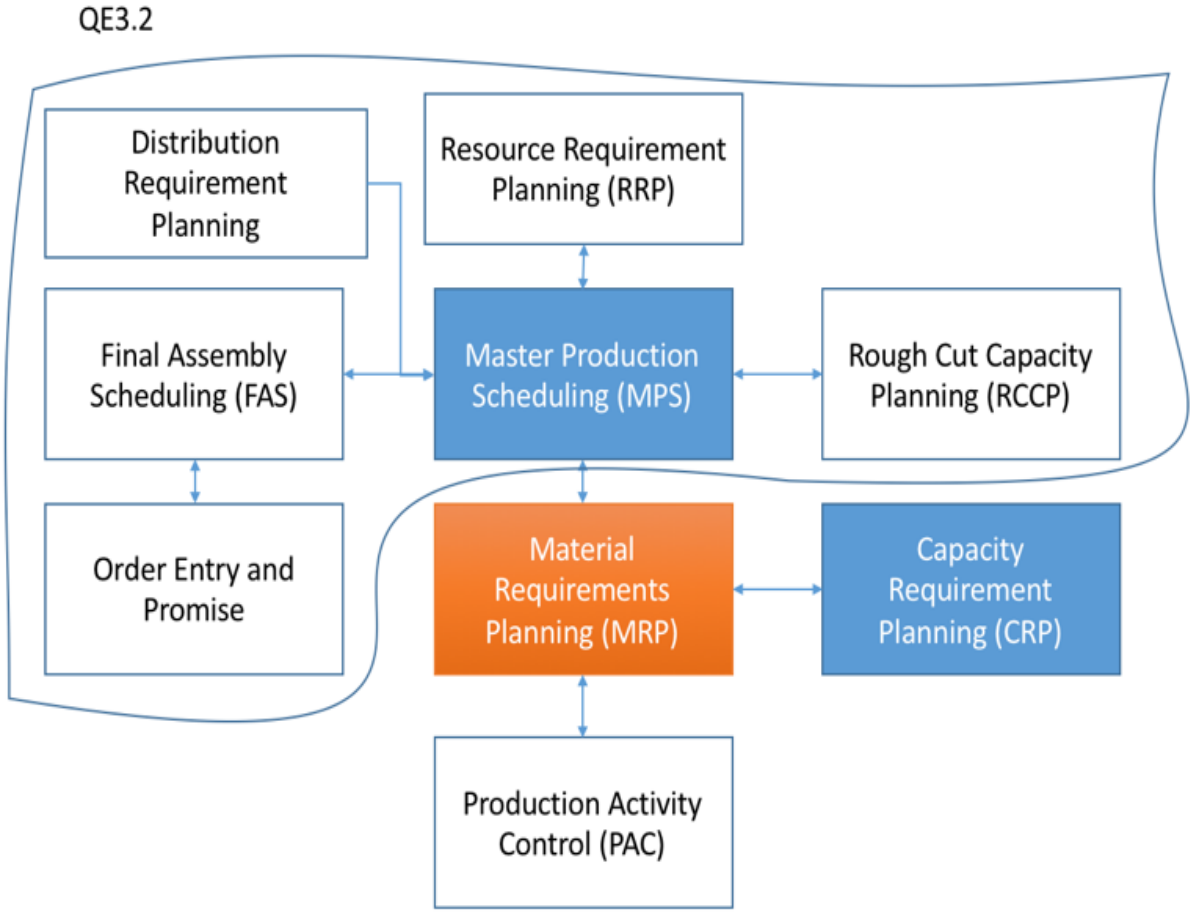
At the operational level, Gable (1998) defines ERP as a "comprehensive packaged software solution, which seeks to integrate the complete range of business processes and functions in order to present a holistic view of the business from a single information and IT architecture". Similarly, Nah et al. (2001) and Stemberger and Kovacic (2008) define ERP system as a "packaged business software system that enables companies to effectively and efficiently manage resources (material, human resources, finance, etc.) by providing a total integrated solution for an

organization's information-processing needs".

B. Linkage of MRP and MPS

The Material Requirements Planning (MRP) module enables you to display long-term "views" of material demands and projected supply actions to satisfy those demands (10). The Master Production Scheduling (MPS) module lets you shorten that view to a much narrower and immediate time horizon, and see the immediate effects of demand and supply actions. The MPS provides set up forms and a shorter range view of material demands. The diagram below shows the link between the MPS and MRP modules and the overview of the main modules of the ERP system. The Linkage of MRP and MPS is as shown in Picture 1.

Picture 1. Linkage of MRP and MPS



C. Cost efficiency and performance

Cost in this paper comprises three types of cost as follows;

- Direct materials are those materials and supplies that are consumed during the manufacture of a product such as Hydrochloric acid ,Zinc, Nitric acid. Direct materials are the cost of raw materials in the industry.
- Direct Labor is the labor cost in the Electro plating process.
- Overhead is costs other than direct materials and direct labor, such as electricity bill, rent, depreciation expense.

Production efficiency measurement consists of three category as follows;

Technical Efficiency (TE) is the effectiveness with which a given set of inputs is used to produce an output. A firm is said to be technically efficient if a firm is producing the maximum output from the minimum quantity of inputs, such as labor, capital, and technology (Output-increasing oriented technical efficiency).

Allocative Efficiency (AE) is a state of the economy in which production represents consumer preferences; in particular, every good or service is produced up to the point where the last unit provides a marginal benefit to consumers equal to the marginal cost of producing.

Economic Efficiency (EE) also known as cost efficiency, is the product of both TE and AE (Farrell, 1957).

D. Productivity

When Productivity is the ratio between inputs (labor, raw materials, machinery, energy and so on) and the output from the production process. Productivity can be calculated by the equation below.

$$\text{Productivity} = \frac{\text{output}}{\text{Input}}$$

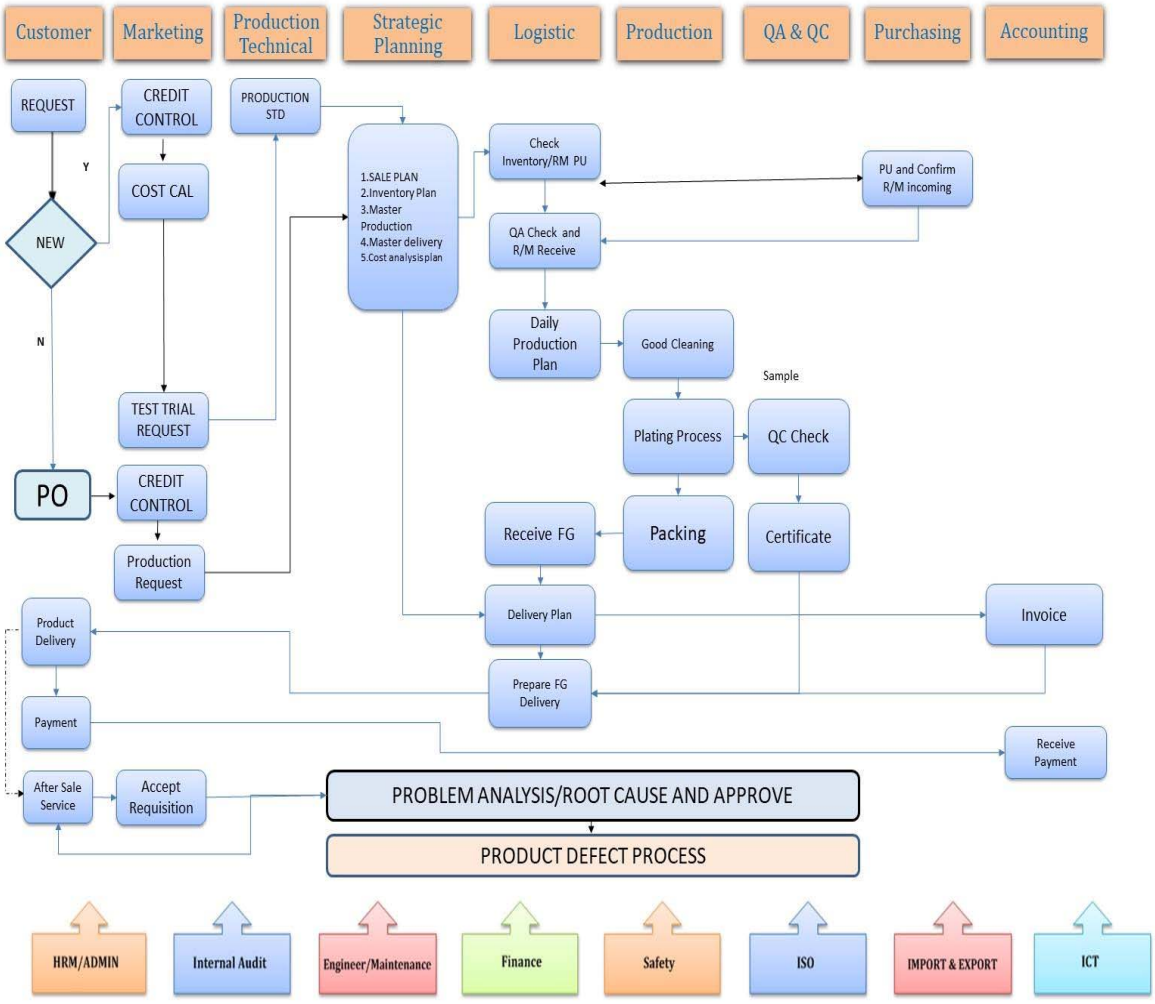
III. EXPERIMENT SETUP

Business Process and Electro Plating Process are shown in sections A and C, respectively.

A. Business Process

Business Process is/is the working process of the electroplating industry. Start from order processing to delivery to customers. Picture 2 shows the main workflow of each department.

Picture 2 Business flow of Electro Platting Industry

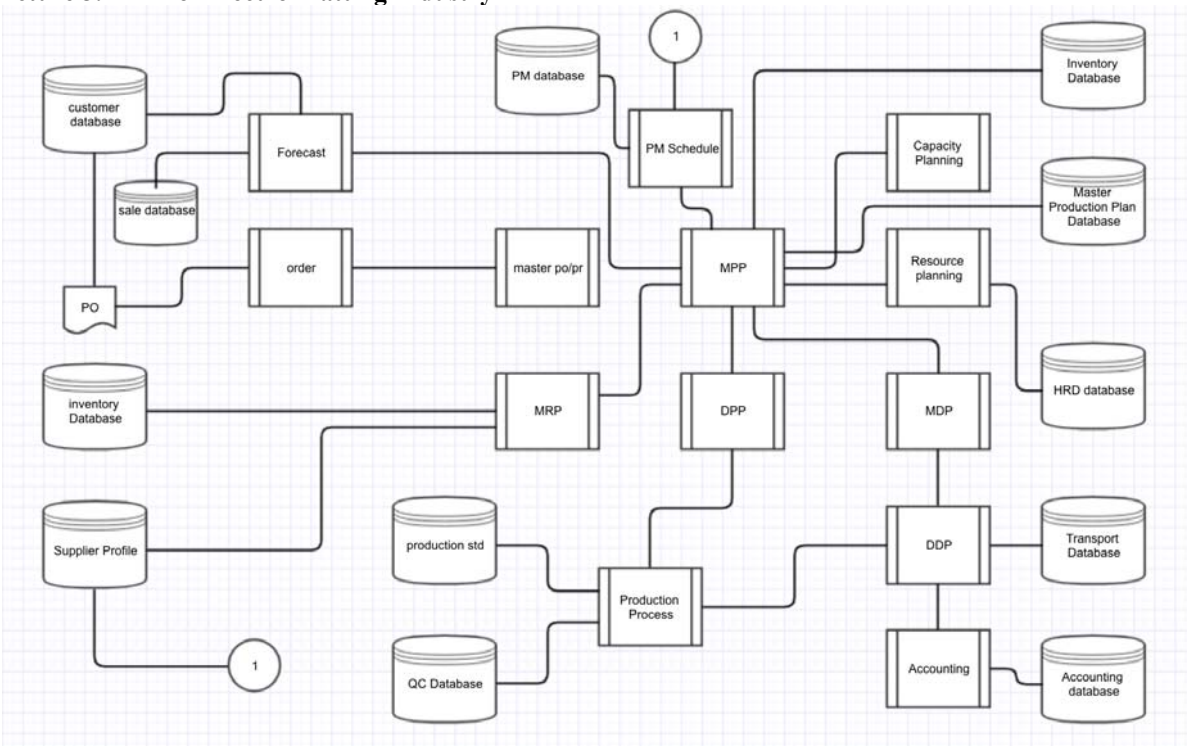


B. Data flow Diagram

A data flow diagram (DFD) is a graphical representation of the "flow" of data through an information system, modelling its process aspects. A DFD is often used as a preliminary step to create an overview of the system without going into great detail, which can later be elaborated. Data flow diagram (DFD) is an indispensable method to model data processing in software engineering. To analyze DFD rigorously, a formal semantics is demanded [13]

From business flow, we can write as DFD of the plating plant as follows.

Picture 3. DFD of Electro Platting Industry

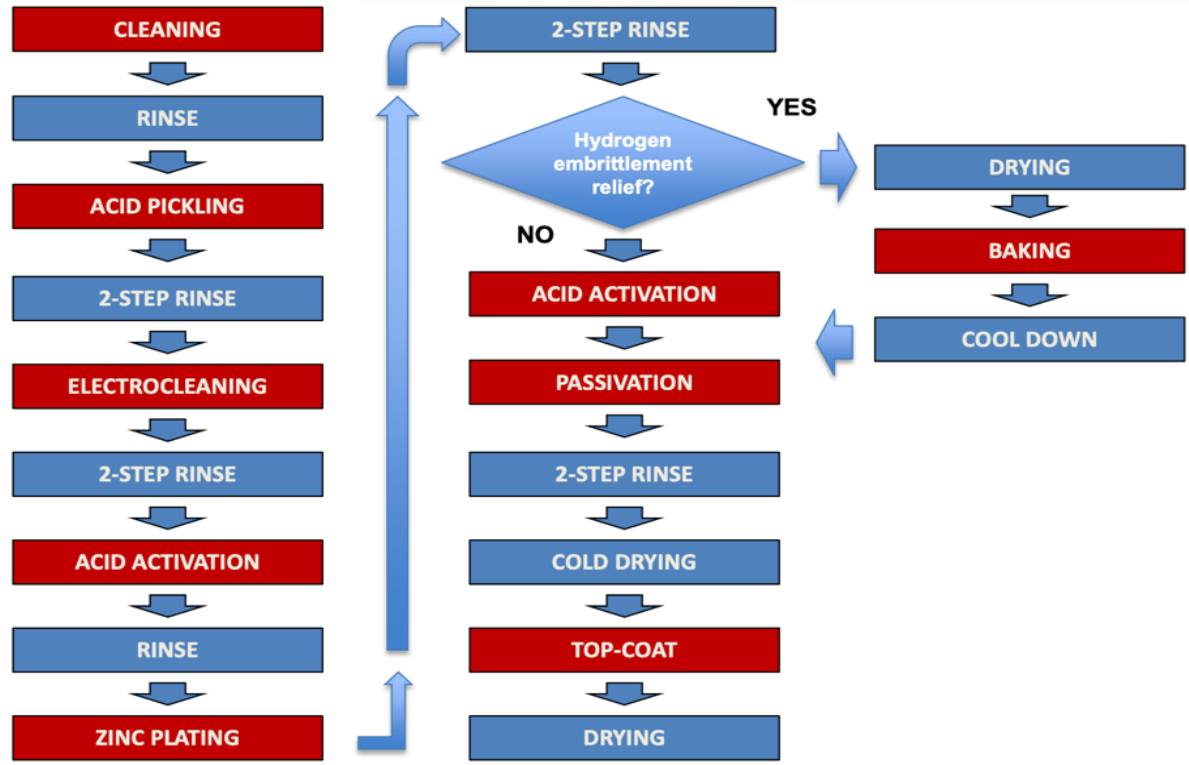


C. Zinc Plating Process

Zinc plating process also known as galvanization, is the deposition of a thin layer of aluminum onto a metal component to provide a protective layer. The outer surface of the zinc coating oxidizes to form zinc oxide, which results in a matte silver-colored finish. Zinc plating is often applied to iron or steel parts whose surface would rust when exposed to air or water.

Picture 3 shows the plating procedure. There are various episodes since the fat is removed from the workpiece that needs to be plated. The final step is to store the specimen in the packaging[11,12].

Picture 4. Plating process

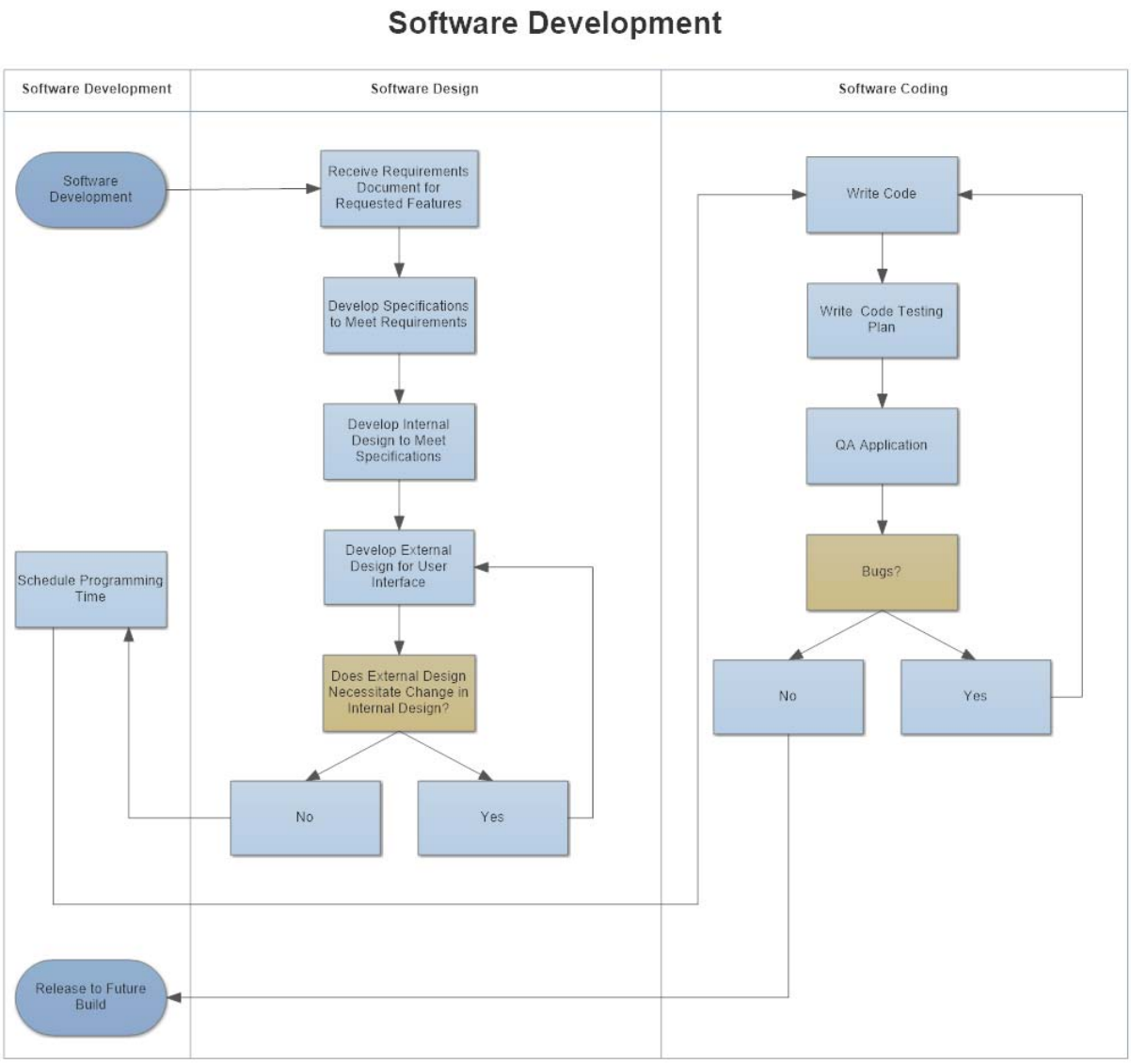


D. ERP programming using Delphi program

Delphi is both an object oriented programming language (OOP) and an Integrated Development Environment (IDE). Published by the Embarcadero company (formerly CodeGear and more formerly Borland), Delphi is an alternative to language such as Visual Basic offering development with both rapidity and good quality.

Delphi is the fastest way to write, compile, package and deploy cross-platform native applications.Delphi is the choice for developers wanting the power, readability and flexibility of the Modern Object Pascal language, coupled with native compilers and component libraries for fast single source code development on Windows, macOS, iOS, Android and Linux. The process of developing an ERP system with the Delphi program as below.[14]

Picture 5. Software development process



E. Problems in the system before using ERP in electro platting industry.

Problems caused by working in the production system are the delay of data storage and calculation by human being. Every step which are searching data and material, filling data and storage data consumes plenty of time. More over the huge amount of mistake such as mismatch of actual inventory and calculation are always raised.

The complicate of production reports (delivery, receipt and daily production) is one of the main of the delay time. It makes inefficiency operation.

F. Sample data collection and comparison of exist work systems with new systems

Sample data was collected for proving the ERP performance. The sample data are as follows;

- 300 raw material of receipt documents
- documentation of raw material withdrawal for 200 copies
- inventory balance document for 48 sets
- planning Document for 60 sets
- production planning documents for 60 sets
- 200 of delivery documents

Compare the results of ERP implementation in each activity. Use the timer method. The result will be used to approve the fulfillment of the objectives. The number of sample data size can be determined by the equation below,

- **A sample size can be determined using the Slovin's (1960) formula, which is as follows:**

$$n = \frac{N}{1 + Ne2} \qquad \text{Equation 1}$$

Where:

n is the sample size
N is the population size
e is the margin of error
1 is a constant value

IV. EXPERIMENTAL RESULTS AND DISCUSSION

After implementation MPS module in planning department and MRP module warehouse department and shipping departmen for a period of 3 months. It was indicated that, without ERP the average time for recording of 537 documents was 28.15 minutes. The error showed 37 missing data and 53 duplicate input data.

Document search is complicated. Raw material check takes a long period of time. There was a mistake data recording. This paper focuses on implementing ERP system. After applied ERP in delivery process, production planning process and inventory report, It was shown that the ERP system can reduce to half of the manpower accounted for 50% of expenditure. Furthermore, the ERP system can decrease processing time by 71.86% and deplete the chance of losing data completely, In this paper for improve efficiency we used Slovin's formula to figure out what sample size needed to take, which is written as

n = N / (1 + Ne2)

where n = Number of samples, N = Total population and e = Error tolerance (level)

Raw material receipts document 300 set , at 95 percent confidence level with a population size of 300.

n= $\frac{300}{1+300(.05)^2}$ = 171.428 ≈ 171 samples

Documentation of raw material withdrawal 200 copies , at 95 percent confidence level with a population size of 200.

n= $\frac{200}{1+200(.05)^2}$= 133.3 ≈ 133 samples

Inventory balance document 48 set at 95 percent confidence level with a population size of 48.

n= $\frac{48}{1+48(.05)^2}$= 43.85 ≈ 43 samples

Production planning document 60 set at 95 percent confidence level with a population size of 60.

n= $\frac{60}{1+60(.05)^2}$= 52.173 ≈ 52 samples

Delivery documents 200 set at 95 percent confidence level with a population size of 200.

n= $\frac{200}{1+200(.05)^2}$= 133.3 ≈ 133 samples

Take the results of the data collection of the population, the **Arithmetic Mean** μ can be found out from the formula

$$\mu = \frac{\sum_{i=1}^{n} x_i}{N} \qquad \text{Equation 2}$$

by $\sum_{i=1}^{N} x_i = x_1 + x_2 + \ldots + x_N$

Working process	Population	μ existing system	μ using ERP system	Comparison results	
	(set)	(min)	(min)	(min)	(%)
Raw material import	171	26.32	4.90	21.42	81.38
Production materials requisition	133	24.70	10.50	14.20	57.49
Materials balance audit	42	40.31	14.30	26.01	64.52
Production Planning	52	55.12	14.34	40.74	73.98
Delivery Schedule	133	7.57	1.37	6.20	81.90
μ value		30.80	9.08	21.72	71.86

Table 1 Show average comparison in% before using ERP and after using ERP system.

Table 1 Illustrates that the ERP system can reduce the total time to work up to 71.86%.
Therefore the ERP system can reduce half of employees or 50.00% as shown in Table 2

Activities	Total number of doc.	Existing system	ERP system	Productivity =output/input		Comparison results	
		(manpower)	(manpower)	Existing	ERP	(manpower)	Percent of productivity (%)
Input data and report	537	6	3	89	179	3	101.2
summary	537	6	3	89	179	3	101.2

Table 3 Comparison of the number of people using the existing system with the new system and represents % of productivity.

Productivity can be calculated from the formula.
Productivity = Number of documents / number of manpower
The efficiency of the work process increased from 89 to 179, representing 101.2%.

CONCLUSIONS

After implementation of MRP and MPS modules, the benefit can be summarized as follows;

a) ERP system improves efficiency 101.2% in operation.
b) ERP reduces 50% of labor cost.
c) Implementing of ERP system enable to reduce huge amount of the reporting time. The daily report production was down to 71.86% compared to the existing system.
d) The performance increases by reducing all errors in collecting and recording data.

REFERENCES

[1] Moutaz Haddara, Henrik Moen.,User resistance in ERP implementations: A literature review,Procedia Computer Science,Volume 121,2017,Pages 859-865,ISSN 1877-0509,
[2] A Elragal, M HaddaraThe impact of ERP partnership formation regulations on the failure of ERP implementations Procedia Technology., 9 (2013), pp. 527-535
[3] Davenport, T.H., Putting the enterprise into the enterprise system. Harvard Business Review, 1998. 76(4): p. 121-131.
[4] Hustad E, Haddara M, Kalvenes B. ERP and Organizational Misfits: An ERP Customization Journey. Procedia Computer Science. 2016;100 :429–439.
[5] Karoline B. Osnes, Julie R. Olsen, Polyxeni Vassilakopoulou, Eli Hustad,ERP Systems in Multinational Enterprises: A literature Review of Post-implementation Challenges,Procedia Computer Science,Volume 138,2018,Pages 541-548
[6] Rosemann, M., 1999. ERP-software-characteristics and consequences. In: Proceeding of the 7th European Conference on Information Systems, 1999-ECIS'99, Copenhaven, DK
[7] Yang, Y Helio; Varaiya, Nikhil; and Irwin, Sherry A. (2002) "Implementing Enterprise Resource Planning Systems: A Study of Benefits and Concerns," Journal of International Information Management: Vol. 11: Iss. 2, Article 6.
[8] Zhengzhong Shi, Gang Wang,Integration of big-data ERP and business analytics (BA),The Journal of High Technology Management Research,2018.
[9] R. John Milne, Santosh Mahapatra, Chi-Tai Wang.,2015.Optimizing planned lead times for enhancing performance of MRP systems,International Journal of Production Economics,Volume 167,Pages 220-231.
[10] Akkermans, H.A. and van Helden, K. Vicious and virtuous cycles in ERP implementation: a case study of interrelations between critical success factors. European Journal of Information Systems 2000;11:35-46.
[11] Erik Galdames Bach. of Eng. E-46800 Xativa (Spain).,2513. Zinc and zinc alloy plating.
[12] Rashmi Singh, Harshit Mahandra, Bina Gupta,Solvent extraction studies on cadmium and zinc using Cyphos IL 102 and recovery of zinc from zinc-plating mud,Hydrometallurgy,Volume 172,2017,Pages 11-18,
[13] Haocheng Zhang, Wei Liu, Hao Xiong, Xiaoju Dong,Analyzing data flow diagrams by combination of formal methods and visualization techniques,Journal of Visual Languages & Computing,Volume 48,2018,Pages 41-51,
[14] Embarcadero Technologies, Inc. All Rights Reserved.. Retrieved November 13, 2018, from Psi Phi: Bradley's Science Fiction Club Web site: https://www.embarcadero.com/products/delphi

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