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Just-in-Time System: An Assessment on its Application in the Manufacturing Industry in Pampanga

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INTRODUCTION

Businesses in the 21st century economy demands that organizations should explore diverse methods and approaches in their processes to cut operating costs and offer competitive prices in the market in order to survive and grow. According to Talha (2002), in order to compete effectively, companies must be capable of producing high quality products at a low cost, and also provide a first class customer services. Confronting these challenges, effective linkage of disparate business functions like demand planning, sourcing and logistics can often yield positive results by reducing costs and improving performance in operations. Looking at these business functions in concert and getting them to work together might be the only way to achieve the desired effective output (Larson, 2005).

Most of the cases that the companies experience either in manufacturing or service, are inefficient and unproductive time on production, poor quality of product or service, inadequate or excess of outputs, increase on waste or errors in the production and even improper inventory management. Consider the production system of quarter pounder burger in a fast food restaurant. The burger maker is the person responsible for producing the quarter pounder burger. For the process, the burger patties must be grilled or fried first, buns must be toasted and then dressed with ketchup, pickles, mayonnaise, lettuce, and cheese, and the patties must be inserted into buns and put on a tray. The final assembler takes the tray, wraps the burgers in paper, and restocks the inventory. Inventories must be kept low because any burgers left unsold after seven minutes must be destroyed. The flow of materials can be done by two ways. The first method will be from the burger maker, to the final assembler up to the customer. In this method, the receipt of all the materials will be scheduled and the management will give authorization to start the production. The burger maker will now start the production of the burgers, say 24 burgers. Once completed, the burgers will be then pushed to the final assembler. The packaged burgers will be placed in warming tray and wait until the customer will purchase one.

In order to gain or maintain the company's competitive advantage, one of the approaches that has long been proven effective in the use for Just-in-time (JIT) principle can be a big help. Just-in-time system is known for different names, including zero inventories, synchronous manufacturing, lean production, stockless production (Hewlett-Packard), material as needed (Harley-Davidson), and continuous flow manufacturing (IBM). JIT is a management approach which originated in Japan in the 1950s. It was subsequently adopted by Toyota and many Japanese manufacturing establishments with considerable success in raising productivity by eliminating

waste (Kaneko and Nojiri, 2008). Since its wide application in manufacturing in the 1970s, JIT has been widely recognized as an operations management approach designed for manufacturing firms to improve performance through waste reduction. The basic presupposition of JIT is to have the accurate quantity of inventory, either raw materials or finished goods, available to meet production process requirements and the customers. For some companies, JIT is difficult to define since various business organizations believe that they are using the concept, but actually, they are not (Mladen Radisic). However, realizing JIT must be incorporated in every company's philosophy. JIT is a manufacturing philosophy which goal is to eradicate waste. It is linked with labor, space requirements and uptime. The basic concept is to produce only what and when is needed and the accurate quantity. The company will only produce goods that are based on the customer's demand, which will definitely match actual orders. No more, nor less (Larson, 2005). Under the philosophy, businesses are encouraged to eliminate inventory which doesn't add value to the product. Another, the way how it sees poor management due to inventory believed to hide problems such as machine breakdowns, poor designs, poor quality, long set-ups and insufficient layout. Moreover, it is also defined as producing the necessary units, with the necessary quality and quantities. Company must managed their resources and allocate them properly (Radisic). JIT is a business strategy that requires a cross-functional team working in a coordinated approach with common and overlapping goals and objectives. Sounds simple, but it's not (Larson, 2005). JIT is not just a simple method that whenever the company wants it has the influence to engage into it straightaway, rather it is seen as whole philosophy that the company must observe and obey. The underlying principles are: how the inventory is looked upon, the

management of the company and the main principle behind JIT (Radisic).

JIT system focuses on reduction of inefficient and unproductive time in production, to continuously improve the quality of product or service. Moreover, JIT advocates the elimination of waste by simplifying production processes, reductions in set up times, controlling material flows, and emphasizing preventive maintenance are seen as ways by which excess inventories can be reduced or eliminated, and resources utilized more efficiently (Kannan and Tan, 2005). Likewise, it reduce lead times and work-in-process inventories. Since the main objective of this system is to obtain low-cost, high quality, and on-time production, the system should minimize any idle equipment, facilities, or workers. JIT can be seen as a new way of thinking, planning, and performing with respect to manufacturing. JIT is simplicity, efficiency, and minimum waste (Hernandez, 1989). The basic principle of JIT is to eliminate all forms of waste, defined as anything that does not add value to the product (Burnham, 1987).

The first step is to identify activities that are waste-producing. The major areas for different forms of waste that may be present in many departments are (Hernandez, 1989; Stonebraker and Leong, 1994): 1) Waste in the production line. 2) Waste in the materials department. 3) Waste involving suppliers.

According to Radisic, JIT is having the "right material, at the right time, at the right place, and in the exact amount." Moreover, it can improve business performance and efficiency. Research has shown several benefits obtained by implementing JIT production but the most cited JIT benefit is cost reduction. In addition to this, JIT also considers workforce an important asset and resource of the company and its success is reliant on coordination and effort within the organization (Reid and

Sanders, 2010). Therefore, JIT manufacturing depends on the overall strength of an organization (Sakakibara et al., 1997).

A manufacturing company is a commercial business that converts raw materials or components into finished products. These products are intended to meet the expectations and demands of customers. The work at repair and maintenance area at automotive companies take place around potentially dangerous machinery, tools and chemicals, that automotive repair poses certain dangers to mechanics which makes them more vulnerable to injury.

Below are the most-common problems encountered by manufacturing firms:

- A supplier that does not deliver goods to the company exactly on time and in the correct amounts could seriously impact the production process.
- A natural disaster could interfere with the flow of goods to the company from suppliers, which could halt production almost at once.
- An investment should be made in information technology to link the computer systems of the company and its suppliers, so that they can coordinate the delivery of parts and materials.
- A company may not be able to immediately meet the requirements of a massive and unexpected order, since it has few or no stocks of finished goods.

JIT is not the new concept in production sector (Stevenson, 2001). It started during 1920 and being used by Henry Ford at the automation industrial. JIT is one of the Lean Manufacturing that had been introduced by Toyota Motor Corporation to increase the work quality and production. The application of JIT in Lean Production will give good return in production process. These philosophies would make the production even faster and to reduce the inventories stock.

The notion of JIT production was described by Taiichi Ohno, the godfather of Toyota production system, as" All we are doing at the time line from the moment the customer gives us an order to the point when we collect the cash, and we are reducing that time line by removing the none value-added wastes" (Liker, 2004). One motivating reason for developing JIT and other better production techniques was that after World War II, Japanese people had a very strong incentive to develop good manufacturing techniques to help them rebuild the economy (Cheng, 1996). There are seven forms of waste were identified by Toyota engineers: Waste of overproduction, Waste of inventory, Waste of repair/defects, Waste of motion (unnecessary movement), Waste of processing, Waste of waiting, and Waste of transport (Womack and Roos, 1990; Imai, 1997; Taylor and Brunt, 2001; Liker, 2004). There is no agreement on a clear definition of JIT. The complex subject is usually summarized in a very brief statement, this result in information being omitted and causes confusion (Hallihan et al., 1997). Voss and Robinson (1987) defined JIT as: "JIT may be viewed as a production methodology which aims to improve overall productivity through the elimination of waste and which leads to improved quality.

In the manufacturing/assembly process JIT provides the cost-effective production and delivery of only the necessary quality parts, in the right quantity, at the right time and place, while using a minimum of facilities, equipment, materials and human resources. JIT is dependent on the balance between the stability of the user's scheduled requirements and the supplier's manufacturing flexibility. It is accompanied through the application of specific techniques which require total employee involvement and team work".

Many researchers have tried to identify the main elements of JIT. However, there is little consensus among researchers regarding the relative importance of these elements

in the JIT implementation process (Ramarapu et al., 1995). However, the potential synergic benefits are not fully realized until all elements of a JIT system are integrated (Goyal and Deshmukh, 1992). Research has shown several benefits obtained by implementing JIT production. According to Hay (1988), JIT not only provide companies with great increases in quality of their manufactured goods, but also help a company to cut response time to market by as much as 90 percent. The most cited JIT benefit is cost reduction. Other benefits included: inventory reduction, increased quality and productivity levels, improved relationship with suppliers, improved customer service, reduced lead time, reduced work in process and raw materials, increased inventory turnover, downtime reduction, workspace reduction (Mehra and Inman 1992; Sohal et al., 1993; Markham and McCart 1995; Yasin and Wafa 1996; Sriparavastu and Gupta, 1997; Imai 1997).

There are also barriers that may potentially impede successful implementation of JIT production. The absence of senior management commitment and support was the most frequently reported reason for JIT failure. Supplier education is an often neglected part of JIT implementation, and companies seeking to implement JIT fully would benefit greatly by addressing this issue (Sohal et al., 1993). One important barrier is local culture in countries other than Japan. Many researchers insisted on Japanese culture as one of the main reasons for JIT success in Japan (Ramarapu et al., 1994). Other barriers include lack of formal training/education for management and workers, and lack of cooperation with suppliers (Salaheldin, 2005), obstacles to employee participation (Lawrence and Lewis, 1993), schedules may be more complex because changeovers are frequent (Brown and Mitchell, 1991), and lack of accurate forecasting system (Wafa and Yasin, 1998).

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Based on the literature review, the researchers focus on the following dimensions of JIT:

1. Daily Schedule Adherence: Measures whether there is time allotted for meeting each day's schedule including catching up after stoppages for quality considerations or machine breakdown.

2. Equipment layout: Measures use of manufacturing cells, elimination of forklifts and long conveyers, and use of smaller equipment designed for flexible floor layout, all associated with JIT.

3. JIT Delivery by Suppliers: Measures whether vendors have been integrated into production in terms of using kanban containers, making frequent (or Just-in-time) delivery and quality certification.

4. JIT Link with Customers: Measures whether the plant has applied the JIT delivery concept and the pull concept in the operational link with its customers.

5. Kanban: Measures whether or not the plant has implemented the physical elements of Kanban/pull system.

6. Setup Time Reduction: Setup Times/Lot Size Reduction measures whether the plant is taking measures to reduce setup times and lower lot sizes in order to facilitate JIT.
Dimensions put related lit

JIT is one of the elements in Lean Manufacturing. Meanwhile Lean Production is known as Big JIT. It is the philosophy of management operation that act to terminate the waste in every aspect in production such as industrial relationship, vendor relationship, technology, raw material management and inventories (Chase, et al., 2001). Lean Production can use to reduce time, inventories, space, employees and production cost. Usually, JIT process being implemented in the organisation that reached the highest application of JIT. Wagner M. S and Silveira- Camargos V, 2009). This is because organization and the supplier should have a good relationship and believe because when there is demand from factory, the suppliers can supply them on time.

The first way to implement JIT is build a good relationship with the suppliers, customers and also sub-contractor to reduce inventory "buffer" to few hours. According to Canel, et al., (2000), JIT aims is to reduce time waiting during production process. Therefore, the cost of inventories not only can be minimized but also the time for the production also shortens. JIT concept is not saying about the standardization or the way of managing but it really focusing on the zero inventories

Arnout Pool et al. (2011) studied how the principles of 'flow' and 'pull' production – suggesting a regular, demand-driven product flow – may be implemented for the (semi-) process industry by introducing cyclic schedules. Cyclical scheduling helps to realize regularity in the continuous part of production. Its simplicity and transparency lead to a closer coordination of the planning and control processes with the production processes. Rachna Shah et al. (2003) examines the effects of three contextual factors, plant size, plant age and unionization status, on the likelihood of implementing 22 manufacturing practices that are key facets of lean production systems. plant size, unionization and plant age, matters with regard to implementation of lean practices, although not all aspects matter to the same extent. Second, applying synergistic bundles of lean practices concurrently appears to make a substantial contribution to operational performance over and above the small but significant effects of context. Ma Ga (Mark) Yang et al. (2011) explores relationships between lean manufacturing practices, environmental management (e.g., environmental management practices and environmental performance) and business performance outcomes (e.g., market and financial performance). Hung-da Wan et al. (2009) presents an adaptive lean assessment approach that provides an effective way to guide the lean implementation process. Using the web-based program, an assessment model is generated adaptively for each user to evaluate the current status of the

system, pinpoint the urgent targets for improvement, and identify the appropriate tools and techniques for developing action plans. Yi-fen Su et al. (2010) studied the Enterprise Resource Planning (ERP) and SCM represent important information technology investment options for operation or IT managers, and have been acclaimed in the practitioner and academic literature for their potential to improve business performance. John (2009) The studies found that changes to the IT system would lead to significant changes to many other aspects on the shop floor. Experience from the showcases and other literature showed that these non-IT related issues should be handled separately by a lean manufacturing project. Kevin B Hendricks et al. (2007) ERP, SCM, and Customer Relationship Management (CRM) systems on a firm's long-term stock price performance and profitability measures such as return on assets and return on sales. Cheri Speier et al. (2011) developed the framework to examine the threat of potential disruptions on supply chain processes and focuses on potential mitigation and supply chain design strategies that can be implemented to mitigate this risk. The framework was developed by integrating three theoretical perspectives— normal accident theory, high reliability theory, and situational crime prevention. Michael Knemeyer et al. (2009) studied the effect of the catastrophic events in supply chain systems. The planning process provides a systematic approach for managers to identify key locations subject to catastrophic risk and then estimate both the probability of occurrence and the financial impact of potential catastrophic events. In addition, the proposed process provides managers with information to assist in the generation and selection of appropriate countermeasures designed to mitigate the potential effect of catastrophic events on supply chains. Christopher S Tang (2006) studied the various quantitative models for managing supply chain risks. He found that these quantitative models are designed for managing operational

risks primarily, not disruption risks. These strategies can make a supply chain become more efficient in terms of handling operational risks and more resilient in terms of managing disruption risks.

De Xia et al. (2011) studied the supply chain risk management system. He concluded a decision-making model based on the internal triggering and interactive mechanisms in an SC risk system, which takes into account dual cycles, the Operational Process Cycle (OPC) and the Product Life Cycle (PLC). A strong bilateral influence-imposed relationship is the key of SC risk management while there are internal circulations among elements of OPC, which make the risk system more complex. Gonca Tuncel et al. (2010) studied the Petri nets framework that can be used to model and analyze a Supply Chain (SC) network which is subject to various risks. They studied that that PN can be used effectively to model dynamic and stochastic nature of SC. They provide a thorough understanding of the control logic of the network structure, and can assist the evaluation of various operational strategies. PN can potentially play a significant role in risk modeling and analysis. Petri Niemi et al. (2007) studied the effect of improving the impact of quantitative analysis on supply chain policy making. They concluded that the impact of quantitative analysis on supply chain policy making can be improved by adapting the different roles of the analysis in the different stages of the policy-making process. Melo et al. (2009) studied the supply chain performance measures and optimization techniques. He studied that the role of facility location is decisive in supply chain network planning and this role is becoming more important with the increasing need for more comprehensive models that capture simultaneously many aspects relevant to real-life problem.

The questions arise from the researchers':

1) Does this approach is being applied in the manufacturing industry, particularly in Pampanga?
2) What are the factors that impede the integration of JIT models by manufacturing industry?
3) What are the important characteristics that make the JIT system a good one?

Providing recommendations and resolutions to these questions through empirical investigations is the focus of this study.

The study attempted to achieve the following objectives:

1) Explore the application of Just-in-time (JIT) system among selected manufacturing industry in Pampanga.

2) Examine the different aspects that challenges and which impede the application of the JIT system among selected manufacturing industry.

3) Explore the most important characteristics in making a good JIT system.

4.) Give recommendations on possible solutions in improving the concept of JIT system.

This study focuses on the assessment of Just-in-time (JIT) system and strategy to manufacturing companies and their efficiency in their operations. This will be beneficial to the other manufacturing companies that are not practicing and would like to integrate into their operations this strategy. This will give businesses an idea to benchmark on how to improve the efficiency in their company.

The list below are the questions that the researchers will use for gathering primary data that will help to analyze possible problems.

1. Is the Just-in-time system is being applied among the selected manufacturing industries in Pampanga?

2. What are the barriers that may probably impede the successful application of JIT in supply chain management on the selected manufacturing industries?
3. What is the influence of JIT application among the selected manufacturing industries?

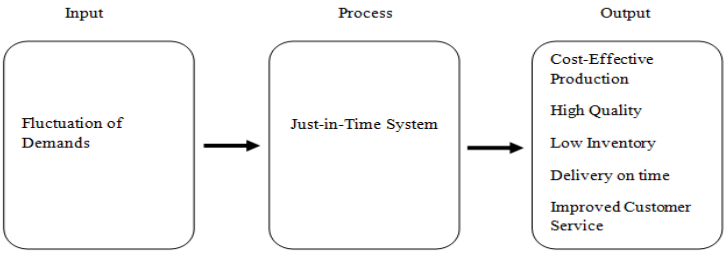

Figure 1. Paradigm of Just-in-Time Model

The paradigm shows that cost-effective production, high quality of products, low inventory for both raw materials and finished goods, deliveries on time of products, and improved customer service are resulted through a just-in-time system despite of fluctuation for demands in the manufacturing industry.

The researchers assume that the respondents under study are highly qualified to be included in the study, thus, are reliable sources of data. The scope of this study will only focus on the assessment of Just-in-time principles on the productivity, cost efficiency and quality on operations among the selected manufacturing companies in Pampanga. It also aims to identify the factors that impede the successful JIT application therefore the researchers will likewise include recommended solutions.

The research will be carried out through structured interview and adapted questionnaires from previous published studies will serve as an instrument. Company team leaders or supervisors, either male or female, are the eventual interviewees.

METHODS

Three main purposes of research are to describe, explain, and validate findings. Description emerges following creative exploration, and serves to organize the findings in order to fit them with explanations, and then test or validate those explanations (Krathwohl, 1993). As widely considered, descriptive method of research is fact-finding study and one of the most accurate ways to design a study. According to Creswell (1994), the descriptive method of research is to gather information about the present existing condition. Since this study is focused on the assessment of JIT system in the efficiency of selected manufacturing companies, the descriptive method is the most appropriate method to use.

Specifically, this study will use a descriptive survey method of research. A descriptive research describes the present condition of the subjects and conclusive in nature. This means that it gathers quantifiable information that can be used for statistical inference on the target audience through data analysis. The word survey on the type of research design signifies the gathering of data regarding present conditions. The survey may be qualitative or quantitative, or both. The survey research employs applications of scientific method by critically analyzing and examining the sources of materials, by analyzing and interpreting data, and by arriving at generalization and prediction.

Since one of the concerns of the researchers is to assess the factors that impede the successful integration of JIT system among the manufacturing industries, therefore, the researchers will use direct and indirect methods for data collection. Definitely, the two common direct-data collection methods applied to questions within the realm of descriptive research includes questionnaire survey and interview. On the

other hand, indirect data collection method is through portfolios, if possible.

Just-in-time improves the efficiency of the company, especially its production. JIT eliminates wastes from the production process and entails the sourcing of required raw materials or items for processing of demand and setting the schedule of work on demand for the product. This synchronization of supply with production, and production with demand improves the flow of goods and processes by eliminating redundant tasks, and minimizing the transportation of product across the workplace.

The setting of the study is within the province of Pampanga and the target respondents must have minimum job description in a supervisory level or not less than 5 years of service in the company.

The instrument to be used in this study is both questionnaire and interview. The researchers will use adapted instrument from the previous studies. The instrument will be developed to formulate as questionnaire and interview guide to the respondents of this study.

To gather data, the researchers will do the following procedures:

- The researchers will use adapted instruments which are proven and tested from the previous published studies.
- Once the questionnaire and interview guide are prepared, as well as the respondents, these instruments will be distributed in executing the questionnaire and conducting the interviews.
- Then, gathered data will be analyzed with the aid of tabular and graphical data presentation.
- Lastly, the conclusion of the results of the JIT principle will be accomplished.

The data that will be gathered from the respondents will be tallied and tabulated. Collected data will be categorized and measured. Data processing will be accomplished in tabular or graphical form for better understanding of data.

Thus, the interviewees' point of views, opinions, insights, and responses will be kept with upmost confidentiality. No personal information shall be published and their names will remain anonymous throughout the study. Hence, this study shall be free from any nature biases.

RESULTS AND DISCUSSION

This chapter covers the presentation, analysis, and discussion of the data gathered. Being a descriptive survey, the interview guide questions and interview results were analyzed and there is no attempt to test any hypothesis. Thus, the results presented are based mainly on the data obtained from the 4 manufacturing companies in Pampanga as the respondents of this study.

Content analysis, particularly content analysis, is the method that was used in analyzing data collected during the interview. According to Bernard (2000), content analysis identifies the intentions, focus or communication trends of an individual, group or institution, and conceptual analysis can be thought of as establishing the existence and frequency of concepts most often represented by words of phrases in a text. Conceptual content analysis method involves reading and rereading transcripts, the researcher will look for similarities and differences by assigning codes that reflect various categories and sorting them into groups of like substance or meaning.

The coding process generates categories that must be fleshed out by seeking out the relevant data bits that inform the category. Boyabits (1998) stated that a good code has these

five elements: (1) a label, a description or a name, (2) definition of what the theme concerns (3) a description of how to know when the them occurs, (4) a description of any qualifications or exclusions to the identification of the theme and (5) a listing of examples, positive and negative, to eliminate confusion.

The categories done by the researcher will reflect the purpose of the study, exhaustive, mutually exclusive and sensitive to category content (Merriam, 1998). This will serve as the basis in creating a conceptual framework, a model of the study.

Numbers are typically used to interpret quantitative data, however, numbers can also be used to analyze qualitative data. The use of numbers or counting can be used to provide frequency counts or generate meaning, and that it can be a tool for identifying patterns in a data. (Beck, 2003)

The data presented in figure 1 are the results from the binomial questions asked in the questionnaire. It shows in the figure that 3 out of the 4 respondents (75%) experience seasonality on their products. Every year, most manufacturing companies experience seasonal demand fluctuations as well as fluctuations due to disasters or unforeseen events. Even with the fluctuation of demand, the JIT system should still perform its job by helping the company to achieve the output's quota. With the growing demand of products, especially during the peak seasons, all of the respondents (100%) agreed that there is a need in extra work. This is because of the extra bulk orders from the customers. According to one of the respondents, workers spend an average time of ___ for their overtime works. Moreover, it also showed that workers are flexible when it comes to performing other tasks. This is a major need for every company to make workers adapt to new environment easily and help the company in achieving its goals, especially when there is a lack in manpower.

The suppliers deliver supplies on time in all of the cases and there is an effort to reduce set-up times. Deliveries on time of the supplies play a vital part in the company's production to complete all the orders and deliver products on the right amount at the right time. Additionally, preventive maintenance is being done to avoid machines breakdown within the production. One of the respondents said that they conduct a preventive maintenance once a month when the production stops for a day to check and inspect the condition of equipment being used. With this, the goal of JIT system can be achieved by avoiding the risk of machines breakdowns. Since the study is about the application of JIT system, it is important to note that the respondents are knowledgeable about the system. This can be proved by having a hundred percentages of the respondents' answers with this question. With the knowledge of JIT system, hundred percentage of the respondents confirmed that they implement the said system in their companies specifically in the inbound section where materials are being ordered, delivered, received, stored, and placed in the production area.

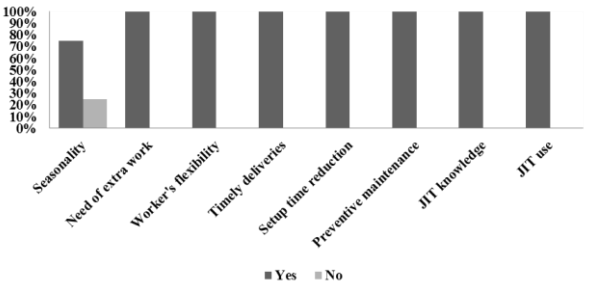

Figure 2. Answers to Yes-No Questions

One of the questions asked to the respondents is if the JIT system is being applied in their companies and if they are aware about the principles of JIT system. Since all of the respondents' answers were affirmative, the respondents were asked about the important characteristics of the JIT system

that it has contributed to the company. Table 1 shows the raw data answered by the 4 manufacturing industry. The question for this was intently left to be an open-ended question to not manipulate any of the ideas and answers from the respondents. The following results were ranked according to the list of importance by the respondents themselves.

Table 1. Most Important Characteristics of Just-in-Time System

RANK	COMPANY A	COMPANY B	COMPANY C	COMPANY D
1	Good relationship with supplier	Low finished goods inventory	JIT production	Inventory reduction
2	Suppliers deliver on time	Flexible production system	Kanban	High quality standards
3	High quality standards	Low work - in-process	Production flexibility	No delivery delays
4	Zero defects	Inventory reduction	Set - up reduction	Low work in process inventory
5	No delivery delays	Production flexibility	Low work in process	Continuous production flow
6	Raw materials arrive as soon as needed	Small lot sizing	Good information system	
7	Flexible production system	JIT production	High quality standard	
8	Good information system	Good relationship with suppliers	Lot sizing	
9	Good planning	Good information system	Good planning	
10	Production flexibility	Suppliers deliver in time	Zero defects	
11	Continuous production	Raw materials arrive as soon as needed		
12	Feasible equipment	Good planning		
13	Set – up reduction	Feasible equipment		
14	Inventory reduction	Continuous production flow		
15		High quality standards		
16		Zero defects		

To come up with better interpretation, the proponents used content qualitative analysis based on their categories and relativity. Thus, the following tables show the codified results

derived from the raw data from each manufacturing company. Also, a brief company profile of each respondent is provided.

Company A is a food manufacturing company in Pampanga that produces meat products. Moreover, it is considered as one of the major distributor of meat products in the Philippines. With its growing demands, the company implements the JIT system to control the materials inventory as well as the production to lessen wastes since the raw materials are mostly perishable goods. From the analysis, having a good relationship with supplier, suppliers deliver on time, no delivery delays, and raw materials arrive as soon as needed, fall in the same criteria and named as good relationship with supplier since the said characteristics talk about suppliers. High quality standards and zero defects can be codified as high quality. Also, flexible production system, production flexibility, and continuous production fall under flexible production. Next, good information system and good planning can be merged and named as good information system since both talk about information. The fifth, sixth, and seventh most important characteristics are feasible equipment, set-up reduction, and inventory reduction, respectively.

Table 2. Company A's Most Important Characteristics of Just-in-Time System

RANK	CHARACTERISTICS	CODE
1	Good relationship with supplier	1
2	Suppliers deliver on time	1
3	High quality standards	2
4	Zero defects	2
5	No delivery delays	1
6	Raw materials arrive as soon as needed	1
7	Flexible production system	3
8	Good information system	4
9	Good planning	4
10	Production flexibility	3
11	Continuous production	3
12	Feasible equipment	5
13	Set – up reduction	6
14	Inventory reduction	7

Table 3. Company A's Compressed Most Important Characteristics of Just-in-Time System

RANK	CHARACTERISTICS
1	Good relationship with supplier
2	High quality
3	Flexible production
4	Good information system
5	Feasible equipment
6	Set up reduction
7	Low inventory

Table 4 shows the coding of raw results while table 5 shows the synthesized results for the open question regarding the most characteristic of JIT system of the Company B. Company B is a feeds manufacturing company in the province. From the analysis, low finished goods inventory, low work-in-process, inventory reduction, small lot sizing, and JIT production fall in the same criteria and can be named as low inventory. The second most important characteristic is codified and named as flexible production as the flexible production system, production flexibility, and continuous production flow have the same definitions. Next, good relationship with suppliers, suppliers deliver on time, and raw materials arrive as soon as needed can be merged in one characteristic as good relationship with the suppliers. Having a good information system and good planning can also be compressed as good information system. The fifth most important characteristic of JIT system according to Company B is the feasible equipment. And lastly, high quality standards and having zero defects can be named as high quality.

Table 4. Company B's Most Important Characteristics of Just-in-Time System

RANK	CHARACTERISTICS	CODE
1	Low finished goods inventory	1
2	Flexible production system	2
3	Low work - in- process	1
4	Inventory reduction	1
5	Production flexibility	2
6	Small lot sizing	1

7	JIT production	1
8	Good relationship with suppliers	3
9	Good information system	4
10	Suppliers deliver in time	3
11	Raw materials arrive as soon as needed	3
12	Good planning	4
13	Feasible equipment	5
14	Continuous production flow	2
15	High quality standards	6
16	Zero defects	6

Table 5. Company B's Compressed Most Important Characteristics of Just-in-Time System

RANK	CHARACTERISTICS
1	Low inventory
2	Flexible production
3	Good relationship with supplier
4	Good information system
5	Feasible equipment
6	High quality

For the Company C, the most important characteristic of JIT system is having an empty warehouse or low inventories as shown in the Table 7. Under this characteristic fall the JIT production, low work-in-process, and lot sizing for they have the same criteria. The second, third, fourth, fifth, and sixth characteristics are the Kanban, production flexibility, setup time reduction, good information system, and high quality, respectively. Kanban is a Japanese term for "sign board" which notifies the employees regarding the management of the company within the premise. Company C is one of the biggest manufacturing companies in the Pampanga that produces quality car tires. Moreover, it is the major distributor of tires to all the automobile manufacturing within the country.

Table 6. Company C's Most Important Characteristics of Just-in-Time System

RANK	CHARACTERISTICS	CODE
1	JIT production	1
2	Kanban	2
3	Production flexibility	3
4	Set - up reduction	4
5	Low work in process	1

6	Good information system	5
7	High quality standard	6
8	Lot sizing	1
9	Good planning	5
10	Zero defects	6

Table 7. Company C's Compressed Most Important Characteristics of Just-in-Time System

RANK	CHARACTERISTICS
1	Low inventory
2	Kanban
3	Flexible production
4	Set up reduction
5	Good information system
6	High quality

Company D is a semiconductor manufacturing company located in Clarkfield, Pampanga. As one of companies that use the JIT system, Company D said that top 4 most important characteristics of JIT system include the low inventory, high quality, good relationship with suppliers, and flexible production, consecutively. Under the low inventory, low work-in-process inventory is also included.

Table 8. Company D's Most Important Characteristics of Just-in-Time System

RANK	CHARACTERISTICS	CODE
1	Inventory reduction	1
2	High quality standards	2
3	No delivery delays	3
4	Low work in process inventory	1
5	Continuous production flow	4

Table 9. Company D's Compressed Most Important Characteristics of Just-in-Time System

RANK	CHARACTERISTICS
1	Low inventory
2	High quality
3	Good relationship with supplier
4	Flexible production

It is important to note that even though the researchers synthesized the results, it does not mean that the other

characteristics especially the least important ones will be disregarded. Thus, based on the researchers' analysis the top 4 most important characteristics of the Just-in-Time model include the following:

1. Low inventory. Low inventory is the most important characteristic of JIT system. Storing excess inventory can cost a lot of money, and reducing the amount of inventory you keep on hand can reduce your carrying costs as well. Companies that implement the just-in-time inventory model may be able to reduce the number of warehouses they maintain, or even allow them to eliminate those warehouses altogether.
2. Flexible Production. A flexible production is one that can be changed or adapted rapidly to manufacture different products or components at different volumes of production. Flexible production systems are usually seen at their most efficient when manufacturing components rather than finished products.
3. High quality products. Companies implement a JIT system or lean manufacturing to satisfy the demands of customers. The voice of the customer is always present in a JIT manufacturing environment. Reductions in lead time and costs can help a company deliver a product to the customer faster and for a lower price.
4. Good relationship with the suppliers. An organization spends substantial portion of every dollar on the purchase of raw materials, components, and services. In fact, 60% of cost goods sold are consisted of purchased goods. Therefore, supplier quality can substantially affect the overall cost of a product or service. One of the keys to obtaining high-quality products and services is for the customer to work with suppliers in a partnering atmosphere to achieve the same quality level as attained within the organization. Customers and suppliers have

the same goal—to satisfy end user. The better the supplier quality, the better the supplier's long-term position, because the customer will have better quality. Because both the customer and suppliers have limited resources, they must work together as partners to maximize their return on investment.

Table 10. Summary of Most Important Characteristics of Just-in-Time System

RANK	CHARACTERISTICS
1	Low inventory
2	Flexible production
3	High quality
4	Good relationship with suppliers

Emerging Framework of the Study

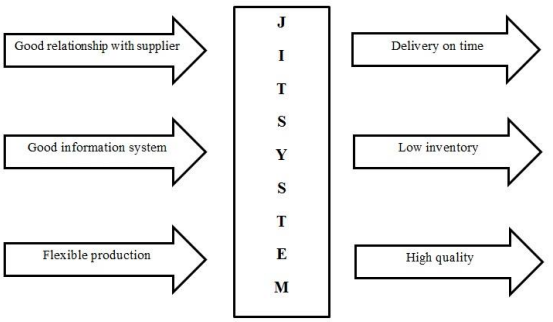

Figure 3. Emerging Framework of JIT System

Figure 3 depicts that delivery on time, low inventory level, and high quality of products can be achieved by having a good relationship with the suppliers, good information system, and flexible production through the JIT system. This emerging framework is the summary of results, including the interpretation and analysis.

Summary of Findings

With the basis of the data gathered, analyzed, and interpreted, the researchers come up with the major findings of this study:

1. Application of JIT. When the application of JIT system among the selected manufacturing industries described, it was found that 100% of the respondents (4 out of 4) are fully aware of the JIT system and is being applied to their premises.
2. Factors Impede the JIT system Integration. The common factors that impede the integration of JIT system include the unforeseen events such as typhoons that causes delayed deliveries from imported supplies. Moreover, financial aspect is also one of the drawbacks.
3. Important Characteristics. Out of all the characteristics of JIT system, the top 4 characteristics that makes a good JIT system are the low inventory, flexible production, high quality, and good relationships with the suppliers, respectively.

CONCLUSIONS

This study focuses on the assessment of Just-in-Time system. The study revealed that low inventory, high quality, good relationship with supplier and flexible production are the most important characteristics of JIT system among the four manufacturing sectors. Although the study was only limited to four different manufacturing industry, it reveals that they have still similar characteristics of Just-in-Time. Next, through conceptual content analysis the researchers are able to assess that to achieve efficiency these are the characteristics that must prevail within them. Moreover, the companies use JIT system in their production but this will be open for modifications to become acceptable in their industry. This is done to accomplish sustainable long term benefits from the principle. Nevertheless, Just-in-Time system has a positive and significant impact on each industry's strategy and performance.

RECOMMENDATIONS

One of the benefits of the Just-in-Time production (JIT) strategy is that it allows businesses to ensure that there is always a buyer for any item produced, causing to keep their inventories low. Using the JIT business strategy means that a business manufactures each item as it is ordered. If there are no customers want to purchase an item, production stops. After gathering data through interviewing qualified respondents, the researchers had been scrutinized and assessed that JIT was implemented to the different manufacturing firms and categorized what are the most important characteristics of JIT system. The researchers used an interview guide which is adapted from previous published studies therefore future module can be made with this study and hence will serve as a benchmark to the company who are not practicing JIT system and those who are using it presently but not intensive. These characteristics will be an eye opener for those who are using JIT system that low inventory, flexible production, good ationship with supplier and high quality products are the top four most important characteristics that must be prioritize to achieve better process and Just-in-Time implementation. This finding provides support to recent studies and can be expounded to future research.

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