THE EFFECTS OF PERFORMANCE MEASURES AND INCENTIVE SYSTEMS ON THE DEGREE OF JIT IMPLEMENTATION

(An Empirical Study at Manufacturing Firms in Central Java)

THESIS

Submitted as partial requirements

For the degree of Master of Science in Accounting

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SEMARANG

2007

ABSTRACT

As organizations adapt to technological change, globalization, and customer demand, they must ensure that the management accounting systems (MAS) are design congruent with decision making and control requirements (Fullerton & McWatters, 2002). This research empirically examines the impact of performance measures and incentive systems that are incorporated in the firms' MAS on the degree of JIT implementation by Central Java manufacturing firms. The model draws on Fullerton & McWatters (2002) to develop a theoretical argument concerning the impact of performance measures and incentive systems on the degree of JIT implemented.

Data for the research were collected through survey question administered to production managers of 453 firms located in Central Java. The ANOVA comparison of the means were constructed to determine if differences in the degree of JIT implementation exist between firms which use job order production system and firms which use mass production system. Multiple Linear Regression is used to test the statistical effect of the 5 performance measures variables (frequency quality results reported, use of bottom-up measures, use of benchmarking techniques, performance measures of waste, and vendor reliability) and 3 incentive systems variables (compensation for quality and throughput, compensation for variances and budgets, and compensation for non-financial measures) on the use of JIT practices.

The results of the research show that the items represented by the factors used to explain the degree of JIT implementation are adopted more fully by job order firms. Performance measures of waste have weak effects on the degree of JIT implementation. Moreover, the use of non-traditional performance measures such as frequency quality results reported, bottom-up measures, and vendor reliability as well as incentive systems of compensation rewards for quality production and budgets have insignificant impact on the degree of JIT practices implemented. The use of benchmarking techniques and compensation for non-financial measures have unexpected negative effects on the degree of JIT implemented.

Key words: management accounting systems, performance measures, incentive systems, the degree of JIT implementation.

ABSTRAKSI

Saat organisasi dihadapkan pada perubahan tehnologi, globalisasi, dan permintaan pelanggan, organisasi harus memastikan bahwa sistem akuntansi manajemen didisain sesuai dengan kebutuhan pengambilan keputusan dan pengendalian (Fullerton dan McWatters, 2002). Riset ini menguji secara empiris pengaruh ukuran kinerja dan sistem insentif yang terdapat dalam sistem akuntansi manajemen perusahaan terhadap tingkat implementasi JIT pada perusahaan manufaktur di Jawa Tengah. Model diadopsi dari Fullerton dan McWatters (2002) untuk mengembangkan suatu argumentasi teoritis mengenai pengaruh ukuran kinerja dan sistem insentif terhadap tingkat implementasi JIT.

Data penelitian dikumpulkan melalui instrumen penelitian yang dikirimkan kepada 453 manajer produksi perusahaan-perusahaan yang berlokasi di Jawa Tengah. ANOVA digunakan untuk menentukan apakah terdapat perbedaan dalam tingkat implementasi JIT antara perusahaan yang menggunakan metode pesanan dan perusahaan yang melakukan produksi massa. Regresi linear berganda digunakan untuk menguji pengaruh statistik dari 5 variabel ukuran kinerja (frekuensi pelaporan kualitas, ukuran bottom-up, penggunaan tehnik benchmarking, ukuran kinerja produksi, dan reliabilitas pemasok) dan 3 variabel sistem insentif (kompensasi untuk kualitas produksi, kompensasi untuk varians dan anggaran, dan kompensasi untuk ukuran non keuangan) terhadap penggunaan praktek-praktek JIT.

Hasil penelitian menunjukkan bahwa item-item yang digunakan untuk menjelaskan tingkat implementasi JIT lebih banyak diadopsi oleh perusahaan yang melakukan produksi berdasar pesanan. Ukuran kinerja produksi memiliki pengaruh lemah terhadap tingkat impmentasi JIT. Penggunaan ukuran kinerja seperti frekuensi pelaporan kualitas, ukuran bottom-up, dan reliabilitas pemasok serta sistem insentif yang memberikan kompensasi untuk produksi yang berkualitas dan kompensasi terhadap anggaran tidak berpengaruh signifikan terhadap tingkat implementasi JIT. Penggunaan tehnik benchmarking dan kompensasi untuk ukuran non keuangan ternyata berpengaruh negatif terhadap tingkat implementasi JIT.

Kata kunci: sistem akuntansi manajemen, ukuran kinerja, sistem insentif, tingkat implementasi JIT.

ACKNOWLEDGEMENTS

I thank Mr Abdul Rohman, chairman of advisory committee and Mr Fuad Mas'ud, member of advisory committee for their comments, suggestions and on-going support. I wish to express my sincere gratitude to the reviewers: Mr Anis Chariri, Mrs Zulaikha, and Mr Jaka Isgiyarta. Their suggestions and thorough review of the previous draft for this thesis made this a better thesis.

I thank Mr Mohamad Nasir, Head of Program of Master of Science in Accounting Diponegoro University. I also would like to thank Satya Wacana Christian University gave scholarship and fund for my research project.

Special thanks go to respondents who were willing to take parts in filling the survey instrument. I appreciate their efforts.

Paskah Ika Nugroho

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CHAPTER I

INTRODUCTION

1.1 Research Background

Management accounting systems (MAS) play important roles in an organisation (Mia, 2000, p. 137). One such role is the provision of information on target (budget) and actual performance for evaluation of actual performance against the target. Fullerton & McWatters (2002) noted that as organizations adapt to technological change, globalization, and customer demand, they must ensure that the MAS, specifically the performance measures and incentives systems are designed congruent with decision-making and control requirements. Performance measures and incentives systems are required to motivate organizational members in implementing organizational strategy.

To date, relatively little research has examined what design of the MAS, organizational structures, and contexts is consistent with the adoption of lean manufacturing systems, such as JIT (Fullerton & McWatters, 2002, p. 711). The just-in-time (JIT) production-planning and control system has been the subject of an increasing amount of research (Spencer & Guide, 1995). JIT continues to be referred to as a "revolution in world manufacturing," which, with the help of the Internet, is making dramatic changes to the traditional production system (Zurawski, 2001 in Fullerton & McWatters, 2002, p. 712). Research has shown that a JIT organizational philosophy has the potential to increase organizational efficiency and effectiveness (Wafa & Yasin, 1998).

Most economic theories analyzing the choice of performance measures and reward systems should incorporate any financial or nonfinancial measure that provides incremental information on managerial effort (Ittner & Larcker, 1998, p. 206). Wisner & Fawcett (1991, p. 5) noted that many American companies are ….. adopting new manufacturing philosophies, such as just-in-time (JIT) ….. leaving traditional performance measurement systems incomplete since those systems do not provide all the necessary information for decision making in these new environments. Moreover, Perera, Harrison, & Poole (1997) argued that traditional cost and financially-oriented performance measurement systems lack relevance in the new manufacturing environment in that such systems do not reflect, and are inconsistent with, the customer focus factors of quality, flexibility and dependability which have become critical to firm success. JIT's focus on excellence through continuous improvement requires a decision-making system that evaluates the changes in quality, setup times, defects, rework, and throughput time (Fullerton & McWatters, 2002, p. 711).

Snell & Dean (1994) advocated the redesign of incentive systems to match the needs of integrated manufacturing. In an advanced manufacturing environment, incentive systems should reflect critical success factors of product quality and team-based performance (Fullerton & McWatters, 2002). Through aligning the formal performance measurement system (and subsequent systems of reward and compensation) with non-financial performance measures, managers have an incentive to concentrate on, and will seek to maximize performance against, those activities on which their performance is measured (Perera, et al., 1997).

Young & Selto (1993, p. 322) suggest that management accounting field studies need to concentrate on design and implementation of process/organization-compatible management controls, for implementation is the hidden obstacle between managers' claims of progress and actually improved productivity and effectiveness. In a JIT environment, the control system should be linked to critical success factors at all organizational levels, but as Langfield-Smith (1997) and Mia (2000) discuss, the need for performance measurements as controls is particularly important at the operational level of the organization.

Previous studies have indicated that organizations using more efficient production practices make greater use of non-traditional information and reward systems (Fullerton & McWatters, 2002, p. 714). Despite the call for more broadly based strategic measures, the majority of firms rely on traditional financial performance measures as compensation incentives. Mazachek (1993) in Fullerton & McWatters (2002, p. 715) demonstrated that managers considered accounting criteria to be significantly more important than non-accounting criteria as indicators of firm performance and evaluators of managerial performance. Ittner and Larcker's (1998) review of trends in performance measurement reiterated this point. Snell & Dean (1992, p. 1136) noted that it is still not clear how, if at all, the manufacturing-compensation relationship affects performance.

Using survey data obtained from top manufacturing executives at 253 US firms, Fullerton & McWatters (2002) examined the relationship between the level of just-in-time (JIT) practices implemented by US manufacturing firms and the performance measures and incentive systems that are incorporated in their MAS. The statistical tests provide empirical evidence that the use of non-traditional performance measures such as bottom-up measures, product quality, and vendor quality, as well as incentive systems of employee empowerment and compensation rewards for quality production are positively related to the degree of JIT practices implemented.

Classification as a “JIT firm” can range from the implementation of an inventory management system to the total integration of JIT practices throughout the manufacturing system (Fullerton & McWatters, 2002, p. 713). Many firms may practice a majority of JIT practices, as defined in this research, without identifying themselves as JIT firms. The current research examines the degree of JIT implementation by capturing the extent to which sample firms have adopted 10 JIT practices classified and utilized in Fullerton & McWatters (2002). Survey data are obtained from production managers since they have broad enough understanding of operations to complete the questionnaire.

The current research examines the effects of performance measures and incentive systems on the degree of JIT implementation with a model used by Fullerton & McWatters (2002). Fullerton & McWatters didn’t examine partial effect of performance measures and incentive systems on the degree of JIT implementation. There is motivation, therefore, for extending the research to analyze performance measures and incentive systems more detailed. Inconsistency from previous research is another reason in this replication of Fullerton & McWatters research.

1.2 Problem Formulation

With respect to production systems, firms may employ job order manufacturing systems or mass production systems. This might affects the degree of JIT implementation by those firms. The shift to world-class, integrated manufacturing strategies, including a JIT management philosophy, requires accompanying changes in the management accounting system (MAS) that support their implementation (Fullerton and McWatters, 2002, p. 711). The MAS also must provide the requisite performance measures and incentive systems to motivate organizational members in terms of JIT strategies. From the statement above, the main problem of this research is do performance measures and incentive systems affect the degree of JIT implementation, which can be divided into two research questions below:

1. Do performance measures of quality results, bottom-up data, benchmarking, waste, and vendor quality affect the degree of JIT implementation?
2. Do incentive on quality and throughput, incentive on variances and budgets, and incentive on non-financial measures affect the degree of JIT implementation?

1.3 Research Purpose

The purpose of this research is to test and analyze the impact of performance measures and incentive systems on the degree of JIT implementation by manufacturing firms in Central Java.

1.4 Research Contributions

1.4.1 Theoretical Development

The research contributes to the management accounting literature in a number of ways.

1. It responds to the call for further survey research that focuses on the combination of manufacturing techniques and management accounting.

2. Rather than arbitrarily classifying firms into JIT or non-JIT categories, a contribution of this research is its provision of a comprehensive assessment of JIT implementation by capturing the degree to which manufacturing firms have implemented 10 basic practices supporting the JIT philosophy.

1.4.2 Practical Contribution

Empirical evidence from this research is expected to give practical contribution for firms employed more JIT practices if those firms should emphasizes more non-traditional performance measurement and incentive system.

1.5 Thesis Organization

First section describes research background. The next section examines the prior literature related to grand theory, JIT, performance measures and incentive systems, and outlines the research hypotheses. Chapter 3 describes the research method. Chapter 4 presents and discusses the empirical results. The final chapter summarizes the study, and identifies limitations and future research directions.

CHAPTER II

LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Resource-Based Theory

The resource-based theory prescribes that firm resources are the main driver of firm performance (Ravichandran & Lertwongsatien, 2005, p. 240). Firm resources include all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness (Daft, 1983 in Barney, 1991, p. 101).

There has been a resurgence of interest in the role of the firm's resources as the foundation for firm strategy (Grant, 1991, p.114). Moreover, Ravichandran & Lertwongsatien (2005, p. 240) stated that the resources needed to conceive, choose, and implement strategies are likely to be heterogeneously distributed across firms, which in turn are posited to account for the differences in firm performance.

This research draws on the resource-based theory to examine how performance measures and incentive systems affect the degree of JIT implementation. Previous studies have indicated that organizations using more efficient production practices make greater use of non-traditional information and reward systems (Abernethy & Lillis, 1995; Banker, Potter, & Schroeder, 1993; Durden, Hassel, & Upton, 1999; Ittner & Larcker, 1998; Jazayeri & Hopper, 1999). The lack of slack and cushion in a JIT environment renders MAS information on targets and actual performance more critical than in non-JIT situations (Fullerton & McWatters, 2002, p. 714).

Implementation of JIT practices puts the control of production in the hands of the workers, and therefore increases the value of reporting manufacturing performance information to line personnel (Banker, et al., 1993). Successful implementation of JIT requires a shift from measures which focus on manufacturing efficiency to measures which encourage interfunctional co-operation and adaptation and which capture the critical success factors related to customer-initiated demands (Abernethy & Lillis, 1995). Perera et al., (1997) argued that JIT requires non-financial indicators given their ability to measure factors such as delivery schedule maintenance, product characteristic variation and product quality. Durden et al., (1999, p. 114) argued that the use of non-financial performance indicators and performance will be more strongly associated in JIT companies than non-JIT companies.

2.1.2 The JIT Manufacturing Environment

Toyota's effort to continuously improve their production system during the last 40-plus years, along with diffusion of their improved production system to other Japanese companies and a dedicated effort to pursue perfection by participating Japanese companies, has resulted in the efficient, integrated, manufacturing system known as Just-In-Time (JIT) manufacturing (White, Pearson, & Wilson, 1999, p. 1). JIT is a Japanese-developed manufacturing philosophy emphasizing excellence through the continuous elimination of waste and improvement in productivity (Fullerton and McWatters, 2002, p. 712). According to Durden et al., (1999, p. 111), Just-in-time (JIT) production processes have been advanced as an alternative to traditional (e.g., large batch) production systems.

Traditional manufacturing plants tend to be laid out by machine or process function (Banker et al., 1993, p. 34). Line personnel, separated from their co-workers by inventory, become specialized by repeatedly processing large batches of similar materials. Inventories are pushed through the system with quality inspections conducted by quality control personnel occurring at the end of production.

Just-in-time (JIT) production (also called lean production) is a “demand-pull” manufacturing system in which each component in a production line is produced immediately as needed by the next step in the production line (Horngren, Foster & Datar, 2000, p. 726). In a JIT production line, manufacturing activity at any particular workstation is prompted by the need for that station’s output at the following station. Demand triggers each step of the production process, starting with customer demand for a finished product at the end of the process and working all the way back to the demand for direct materials at the beginning of the process. In this way, demand pulls an order through the production line. The demand-pull feature of JIT production systems achieves close coordination among workstations. It smoothes the flow of goods, despite low quantities of inventory. JIT production systems aim to simultaneously (1) meet customer demand in a timely way, (2) with high-quality products, and (3) at the lowest possible total cost (Horngren, et al., 2000, p. 726).

Mia (2000, p. 139) noted that a successful implementation of JIT results in a number of benefits in terms of improved flexibility, productivity, quality, lead-times, setup times, customer responsiveness, and inventory holdings. JIT adoption is commonly associated with reduced inventory levels and increased inventory turns leading to increased profitability (Balakrishnan, Linsmeier, & Venkatachalam, 1996).

Continuous monitoring of production processes with the goal of eliminating all forms of waste is a key point in understanding JIT (Wafa & Yasin, 1998). JIT is expected to reduce manufacturing costs continuously through better quality, lower inventory, and shorter lead times. Management of existing physical resources, quality management throughout the organization as well as in the supplier base, human resource management, and the overall understanding of JIT's philosophy by all levels of the organization were found to be viewed as important to JIT success (Spencer & Guide, 1995).

Previous research frequently has classified firms as JIT or non-JIT based on their use of ”continuous manufacturing” or a ”pull system” (e.g. Balakrishnan et al., 1996). However, classification as a "JIT firm" can range from the implementation of an inventory management system to the total integration of JIT practices throughout the manufacturing system (Ahmed, Tunc, & Montagno, 1991; Safayeni, et al., 1991). Confusion remains over what exactly constitutes JIT (Mia, 2000).

While the JIT philosophy is both broad and ambiguous in nature, this research operationalizes JIT in terms of the 10 JIT practices classified and utilized in Fullerton & McWatters (2002). , i.e. focused factory, group technology, action plan to reduce setup times, total productive maintenance, multi-function employees, uniform work load, product quality improvement, process quality improvement, kanban system, and JIT purchasing. These practices are described in Table 1.

TABLE 1

JIT PRACTICES

Focused factory	This program would attempt to reduce the complexities of the manufacturing process. This may include any or all of the following: simplifying the organizational structure, reducing the numbers of products or processes, and minimizing the complexities of physical constraints.
Group technology	This program would attempt to improve scheduling efficiencies through grouping families of parts to minimize duplication of effort and problem solving situations. This program may also involve changes of physical facilities, i.e., cellular arrangement, in the improvement effort.
Reduced setup times	This program would attempt to reduce the time and costs involved in changing from the tooling, layout, etc. required to produce one product to that required to produce other products. Reducing the setup times will allow for reduced economic lot sizes produced and reduced need for buffer inventories.
Total productive maintenance	This program would attempt to establish and refine routine preventive maintenance and replacement programs. This also involves getting the machine operator actively participating in the minor machine maintenance functions.
Multi-function employees	This program would attempt to formally cross train employees on several different machines and in several different functions.
Uniform workload	This program would attempt to stabilize and smooth the production workload (level schedule).The product/unit mix each day would be the same. Variations to the demand would be handled through varying frequency of the product/unit mix.
Kanban	This program would attempt to eliminate the “PUSH” system of material flow and develop a “PULL” system which is dependent upon the operators at downstream workstations to initiate material movement and control the pace of material flow for upstream work stations versus the traditional management control of the initiation of material movement.
JIT purchasing	This is a supplier participation and partnership program. This program would involve suppliers in long-range mutually rewarding cost-reduction efforts, such as value analysis and the implementation of JIT management practices. The objective is to improve quality, flexibility and levels of service from suppliers by increasing the quantity of orders, reducing the number of suppliers and developing a long term relationship based on trust.
Process-based quality control	An approach in which quality is “built into” a product by workers as it moves along an assembly line.
Product-based quality control	An approach in which quality is said to be “inspected into” a product

Source : White et al., 1999

2.1.3 Performance Measures

The choice of performance measures is one of the most critical challenges facing organizations (Ittner & Larcker, 1998, p. 205). Balancing outcome measures with performance drivers is essential to linking with the organization's strategy (Hansen & Mowen, 2005, p. 406). According to Wisner & Fawcett (1991, p. 10) the role of performance measure is twofold: (1) to provide the firm with a method to assess its current competitive position with respect to its competitors and the demands of the market and identify avenues for improvement; and (2) to monitor the firm's progress in moving towards its strategic objectives.

The traditional focus of performance measures in management accounting has been on quantitative financial measures such as cost and profit, rather than quantitative nonfinancial and qualitative measures (Atkinson, Kaplan & Young, 2004, p. 327). Perceived limitations in traditional accounting-based measures, competitive pressure, and outgrowth of other initiatives were three principal reasons firms adopting nonfinancial measures (Ittner & Larcker, 1998, p. 217).

Extensive discussion exists of the association between increased reliance on non-financial performance measures and strategic manufacturing change (Lillis, 1999 in Fullerton & McWatters, 2002, p. 714). Said, HassabElnaby & Wier (2003) argued that nonfinancial measures should be included in management compensation contracts if nonfinancial measures provide incremental information about manager's actions beyond that conveyed by financial measures.

Performance criteria that focus on inventory levels, throughput lead time, defect rates by category, equipment downtime, and employee training not only enhance the firm's ability to successfully implement JIT but also provide the information necessary for continual improvement of the firm's competitive position (Wisner & Fawcett, 1991, p. 7). Moreover Fullerton & McWatters (2002) proposed that firms implementing a higher degree of JIT elements such as lean manufacturing practices, quality improvements, and kanban systems were more likely to use more non-traditional performance measures of quality results, bottom-up data, benchmarking, waste, and vendor quality.

The management control systems are implemented to support a zero defect quality strategy should provide more frequent feedback about quality to production personnel than a system supporting an economic conference level (ECL) quality strategy (Daniel & Reitsperger, 1991, p. 605). Since assembly line personnel are responsible for quality and considered to be the quality experts, this information must be widely disseminated to focus the attention of all production personnel to continuously improve quality levels.

Workers need to gather their own "bottom-up" information using statistical process control (SPC), Pareto analysis, histograms, and flow charts, rather than be dependent upon "top-down" information that emphasizes standards and budgets (Johnson, 1992 in Fullerton & McWatters (2002, p. 715). Fullerton & McWatters (2002) added the use of cause-and-effect diagrams and scatter diagrams as bottom-up data gathering techniques. Descriptions of all bottom-up data gathering techniques are listed in Table 2.

Benchmarking is an improvement process in which a company measures its performance against that of best-in-class companies, determines how those companies achieved their performance levels, and uses the information to improve its own performance (Gaspersz, 2005, p. 457). Chenhall & Langfield-Smith (1998, p.

246) stated that benchmarking involves more than establishing best practice standards, and includes examining the processes used by high performing organizations.

TABLE 2

DESCRIPTIONS OF BOTTOM-UP DATA GATHERING TECHNIQUES

Cause-and-effect diagram	A tool for analyzing process dispersion. The diagram illustrates the main causes and subcauses leading to an effect (symptom).
Histogram	A graphic summary of variation in a set of data. The pictorial nature of the histogram lets people see patterns that are difficult to see in a simple table of numbers.
Flowchart	A graphical representation of the steps in a process. Flowcharts are drawn to better understand processes.
Pareto chart	A graphical tool for ranking causes from most significant to least significant. The principle suggests that most effects come from relatively few causes; that is, 80% of the effects come from 20% of the possible causes.
Scatter diagram	A graphical technique to analyze the relationship between two variables. Two sets of data are plotted on a graph, with the y axis being used for the variable to be predicted and the x axis being used for the variable to make the prediction.
Statistical process control chart	A chart with upper and lower control limits on which values of some statistical measure for a series of samples or subgroups are plotted. The chart frequently shows a central line to help detect a trend of plotted values toward either control limit.

Source : Gaspersz, 2005

Firms should provide information on productivity and quality. Charts displaying defect rates, schedule compliance and machine breakdowns represent information that can be identified easily with specific production cells or work stations (Banker et al., 1993, p. 38). Rejects, rework, and scrap should be readily available and understood by both assembly line workers and upper management meanwhile downtime provides a measure of progress toward a zero defect manufacturing environment (Daniel & Reitsperger, 1991).

According to Hedin & Russell (1992, p. 69) under the JIT philosophy, production of items prior to the time when needed to satisfy demand is waste. Companies with just in time production systems depend on suppliers to deliver quality goods on time. Suppliers must deliver goods as frequently as required and suppliers also have the burden of inspecting goods before shipping them out (Swanson & Lankford, 1998). Golhar, Stamm, & Smith (1990) noted that in JIT philosophy the vendor-vendee long-term relationship is a point of focus: the aim is improved quality of incoming parts and more frequent deliveries.

2.1.4 Incentive Systems

Incentives are the essence of economics (Prendergast, 1999, p. 7). Incentives are provided to workers through the compensation practices of firms, encompassing monitoring, evaluation, and contracting. Incentive systems represent a network of contingent promises for reward and the basis for an inducements-contribution exchange (Snell & Dean, 1994). This implies that, if the required contribution of employees changes, so too will the nature of inducements. Atkinson et al., (2004, p. 332) noted that incentive compensation systems work best in organizations in which employees have the skill and authority to react to conditions and make decisions.

A critical feature of the assembly line worker employment relationship in many large manufacturing firms are incentive systems either contingent on performance or those based on fixed pay per unit of time (Young, Shields, & Wolf, 1988, p. 611). Economists have demonstrated analytically that performance is better with contingent rather than fixed incentives because workers are more motivated when their compensation increases with performance, as most workers prefer more to less compensation (Young, et al., 1988, p. 611). Moreover, Young & Selto (1993, p. 309) stated that compensating workers for improvements and allowing them to share the gains of improvements should be extremely important for motivating workers to increase their performance.

Gomez-Mejia (1992, p. 381) suggested that different compensation strategy is needed for integrated manufacturing than for a traditional factory. Comparison of compensation practices in traditional and integrated manufacturing firms is shown in Table 3.

TABLE 3
COMPARISON OF COMPENSATION PRACTICES IN TRADITIONAL AND INTEGRATED MANUFACTURING FIRMS

Traditional Factory	Integrated Manufacturing
Focus on individual incentives reflects division of labor and separation of stages and functions.	Extensive use of group incentives to encourage team work, cooperation, and joint problem solving.
Use of hourly wage assumes that the differences in employee contribution are captured in job classifications and that performance is largely determined by the production system.	Use of salary assumes that employees' contributions transcend the job per se to substantially affect output. The distinctions between classes of employment are diminished.
Seniority pay rewards experience as a surrogate for knowledge and skill in a stable environment and rewards loyalty to reduce uncertainty within the system.	Skill-based pay rewards continuous learning and the value-added derived from increased flexibility in a dynamic environment.

Source : Snell & Dean, 1994, p. 1113

Fullerton & McWatters (2002) noted that compensation incentives are given to encourage team-oriented, quality work in JIT-oriented firms. Group incentives had more than a simply motivational effect - workers soon learned how various activities fit together and made process and quality improvements as a team (Snell & Dean, 1994).

Many firms believe that the heavy emphasis placed on financial measures is inconsistent with their relative importance (Ittner & Larcker, 1998, p. 206). Wisner & Fawcett (1991) argued that excessive dependency on budgets can lead to an overemphasis on cost reduction along with a shortsighted view of profits.

As noted by Perera et al., (1997, p. 569),"changes in manufacturing strategies to emphasize quality, flexibility, dependability, and low cost should be accompanied by changes in formal performance measurement systems to place greater emphasis on non-financial (operations-based) measures." Durden, et al., (1999, p. 114) proposed that the adoption of non-financial performance indicators by JIT firms will be positively associated with performance.

2.2 Conceptual Framework

In pursuing competitive advantage, many organizations have sought to implement manufacturing processes and administrative functions which support their particular strategic priorities (Chenhall & Langfield-Smith, 1998, p. 244). "Just-in-time" manufacturing (JIT) is viewed by many companies as one of the major ways in which they can reduce costs while improving quality (Safayeni, et al., 1991, p. 27).

Managers working in JIT environments have a greater need for management accounting information on targets and actual performance. This is because in JIT environments, little or no slack resources are available to managers to cushion against the difficulties caused by defective raw materials, production errors, irregular supply and demand schedules, or to mask inefficiencies (Griffin & Harrell, 1991). As a result, continuous monitoring of actual performance is required for the operation of the production process under JIT (Mia, 2000, p. 140). Management Accounting Systems can provide managers with information that they need to monitor performance.

Durden et al., (1999, p. 112) argued to be effective, JIT adoption and implementation should influence the entire organization including its management accounting system. The development in management accounting systems makes management accounting information even broader. This is because the approach incorporates qualitative, quantitative, financial and non-financial information on performance indicators including operating income, revenue growth, cost controls, defects, yield, manufacturing lead time, time to market, market share, customer response time, customer satisfaction, product reliability, quantity of defective products shipped to customers, and the ratio of good output to total output (Mia, 2000). An explanation for JIT's limited success in the USA is the failure of the MAS to provide appropriate performance measures and incentives to support JIT objectives (Fullerton & McWatters, 2002, p. 713).

Ittner & Larcker (1998, p. 206) noted that most economic theories analyzing the choice of performance measures indicate that performance measurement and reward systems should incorporate any financial or nonfinancial measure that provides incremental information on managerial effort (subject to its cost). While traditional performance criteria provide the firm with relevant cost accounting and financial information, they lack the ability to fully guide the firm in its efforts to achieve manufacturing excellence (Wisner & Fawcett, 1991, p. 7). Financial measures are too aggregate and not timely enough to provide effective feedback on how the organization is maintaining product quality and timely delivery (Chenhall & Langfield-Smith, 1998, p. 246).

Although the objective of JIT is the same as that of all manufacturing systems-to obtain low-cost, high-quality, on-time production-its emphasis on continual improvement is beyond the scope of traditional performance measurement systems (Wisner & Fawcett, 1991, p. 7). The use of non-financial indicators and personal observations are proving useful at the production level of JIT production processes (Durden et al., 1991).

Griffin & Harrell (1991, p. 99) argued managers may be reluctant to support implementation of the Just-In-Time concept. Without their support, however, it is unlikely that Just-In-Time procedures can be implemented. Banker et al., (1993, p. 38) state that when perceived rewards are attached to specific performance measures, behavior is guided by the desire to optimize those performance measures. When systems reward managers and employees for efforts counterproductive to JIT, instead of for efforts designed to increase quality, eliminate waste, and reduce throughput time, the wrong incentives are communicated (Fullerton & McWatters, 2002, p. 714).

Although evidence shows the MAS is expanding to include more non-financial information, the majority of firms still use traditional accounting criteria much more than non-traditional for both internal and external performance evaluation (Fullerton & McWatters, 2002, p. 714). The current research examines the effects of non-traditional performance measures and incentives systems on the degree of JIT implementation in Central Java manufacturing firms.

Control variables are used to account for factors other than the theoretical constructs of interest, which could explain variance in the dependent variable (Ravichandran & Lertwongsatien, 2005, p. 247). In this research, innovation and structure are used as control variables. Whether a firm follows a more innovative strategy can affect its willingness to make changes while organizational structure can influence a firm's ability to be flexible and make major operational changes (Fullerton & McWatters, 2002, p. 720)

Figure 1 depicts the conceptual framework.

FIGURE 1

CONCEPTUAL RESEARCH FRAMEWORK

Performance Measures

- Frequency quality results reported
- Use of bottom-up measures
- Use of benchmarking techniques
- Performance measures of waste
- On-time and vendor performance

Incentive Systems

- Compensation: quality and throughput
- Compensation: variances and budgets
- Compensation: non-financial measures

H_1 **H_2**

Control Variables

- Structure
- Innovation

The Degree of JIT Implementation

2.3 Research Hypotheses

2.3.1 Performance Measures and the Degree of JIT Implementation

It is important that performance measures match the production management system of an organization (Durden, et al., 1999, p. 114). Performance measures should be adopted for each of the firm's many value-adding activities required to produce and support its products, including activities such as materials acquisition, product design, production, and distribution (Wisner & Fawcett, 1991, p. 10).

Fullerton & McWatters (2002, p.714) recommended that to make decisions in a JIT environment, a firm must measure and report those items that are affected by JIT adoption (i.e. inventory turns, delivery time, scrap, quality, setup times, and vendor performance). Inappropriate performance measures can both misrepresent and undermine JIT manufacturing efforts (Durden et al., 1999, p. 114). According to Horngren, et al., (2000), in JIT firms personal observations and non-financial performance measures are the dominant methods of control.

Ittner & Larcker (1998) reported more extensive use of non-financial performance measures to supplement traditional accounting-based measures. A case study of a UK chemical company, British Vita, implementing world-class manufacturing practices found that non-financial measures such as quality, on-time deliver, inventory levels, and productivity replaced the previous emphasis on budgets and financial measures (Jazayeri & Hopper, 1999).

Daniel and Reitsperger (1991) conducted a study relates quality strategies with the management control information provided for quality in 26 Japanese automotive and consumer electronic firms and found that setup times, scrap, and downtime were reported more frequently to managers supporting zero-defect strategies than managers supporting more traditional strategies. Results in a related study by Banker et al., (1993) which used a sample of 362 worker responses from 40 plants indicated that the availability and use of productivity measures were related to the implementation of JIT and TQM.

Young & Selto (1993) field-based study of workgroup differences in performance for a single division of a facility that uses JIT manufacturing found little evidence that the provision of nonfinancial operational measures to workers was associated with differences in manufacturing performance or workgroup performance ratings. Abernethy & Lillis (1995) study of management control system in 42 flexible manufacturing plants implied that greater reliance on nonfinancial manufacturing measures had a greater positive effect on perceived performance in flexible firms than in nonflexible firms.

Using survey data obtained from top manufacturing executives at 253 US firms, Fullerton & McWatters (2002) provided empirical evidence that the use of non-traditional performance measures such as bottom-up measures, product quality, and vendor quality were positively related to the degree of JIT practices implemented.

The following hypotheses examine the effects of five performance measures variables on the degree of JIT implementation:

Hypothesis 1a: Frequency quality results reported positively influences the degree of JIT implementation.

Hypothesis 1b: Use of bottom-up measures positively influences the degree of JIT implementation.

Hypothesis 1c: Use of benchmarking techniques positively influences the degree of JIT implementation.

Hypothesis 1d: Performance measures of waste positively influence the degree of JIT implementation.

Hypothesis 1e: On-time and vendor performance positively influence the degree of JIT implementation.

2.3.2 Incentive Systems and the Degree of JIT Implementation

If firm incentives are not aligned with organizational changes, the desired behaviors for new, integrated manufacturing systems are difficult to achieve (Fullerton & McWatters, 2002, p. 715). Durden et al., (1999, p. 114) noted that the role of variance analysis and other traditional measures of performance need to be critically examined in a JIT production setting. Adjusting compensation systems may be among the most instrumental methods for eliciting and reinforcing behavior required for the success of integrated manufacturing (Snell & Dean, 1994, p. 1110).

Gomez-Mejia (1992, p. 381) noted that if a different compensation strategy is needed for integrated manufacturing than for a traditional factory, then it follows that systematic matching of compensation and integrated manufacturing should have a positive impact on plant performance. Using survey data obtained from top HRM executive at 243 firms, the results of that study generally support the notion that firm performance is a positive function of the degree to which compensation strategies reinforce or match corporate strategies.

Young et al., (1988) conducted an experiment using 120 undergraduates enrolled in an introductory course in management at a large state university. Each received course credit and financial compensation for participation. Results of hypotheses testing showed that performance effectiveness and production efficiency were higher with the contingent rather than with the fixed incentive system.

Reitsperger (1986) used sample of 4 firms, 2 Japanese, 1 UK and 1 US, found that workers in Japanese-managed corporations outperformed their counterparts in US- and UK-managed companies, because incentive pay was tied to quality and productivity measures. Using survey data obtained from top manufacturing executives at 253 US firms, Fullerton & McWatters (2002) provided empirical evidence that compensation rewards for quality production were positively related to the degree of JIT practices implemented.

The following hypotheses examine the effects of incentive systems variables on the degree of JIT implementation:

Hypothesis 2a: Compensation on quality and throughput positively influence the degree of JIT implementation.

Hypothesis 2b: Compensation on variances and budgets don't influence the degree of JIT implementation.

Hypothesis 2c: Compensation on non-financial measures positively influences the degree of JIT implementation.

CHAPTER III

RESEARCH METHOD

3.1 Research Design

This research is an explanatory research since the purpose of this research is to evaluate empirically the effect of performance measures and incentive systems on the degree of JIT implementation by Central Java manufacturing firms through hypotheses testing. Relationships type between variable operationalized in this empirical research is causal relationship. This research wants to delineate the antecedents of the degree of JIT implementation by Central Java manufacturing firms.

The unit analysis in this research is Central Java manufacturing firm. Analysis is done based on survey toward production manager at each manufacturing firms in Central Java.

3.2 Population and Sample

Survey instrument was sent to one production manager at each manufacturing firms in Central Java. There are 453 firms listed in BADAN PENANAMAN MODAL PROP JATENG SUBID DALWAS on February 27 2006. This is considered appropriate enough to represent manufacturing firms in Indonesia.

Minimum sample requirement are 80, determined using Rea & Parker's formula (Mas'ud, 2004, p. 80)

$$n = \frac{Z^2{}_{\alpha}\left[0.25\right]N}{Z^2{}_{\alpha}\left[0.25\right] + \left[N - 1\right]C^2{}_{p}}$$

$$= \frac{1.96^2\,[0.25]\,453}{1.96^2\,[0.25] + [453-1]\,0.1^2}$$

$$= 80$$

where

Z_α = Z score (1.96 for 95% confidence level)

Cp = margin of error (0.1)

Sample selection procedure is convenience sampling i.e. choose sample from population which are easier in the process of data gathering (Indriantoro & Supomo, 1999, p. 130). This method is the fastest and the cheapest method.

3.3 Research Variable, Variable Definitions and Research Instrument

3.3.1 The Degree of JIT Implementation (dependent variable)

The degree of JIT implementation is the extent to which firms have adopted a combination of JIT elements. The ten items employed to measure the extent to which a company has adopted JIT were: focused factory, group technology, reduced setup times, total productive maintenance, multi-function employees, uniform workload, kanban, JIT purchasing, and total quality control (Fullerton & McWatters, 2002). Ten six-point Likert-scaled questions on the survey instrument measure the extent to which firms use JIT.

3.3.2 Performance Measures (independent variable)

Performance measures are critical success factors; if they are improved, the company has implemented its strategy (Anthony & Govindarajan, 2003, p. 493). In this research, performance measures were measured using five variables used by Fullerton & McWatters (2002) including bottom-up data gathering techniques; benchmarking for products, services, and processes; frequency of measurements and reports on quality; performance measures of waste; and vendor reliability.

Bottom-up data gathering techniques refer to the use of bottom-up data gathering techniques such as Pareto analysis, histograms, and cause-and-effect diagrams to evaluate operations. Benchmarking for products, services, and processes refer to the use of benchmarking to evaluate operations. Frequency of measurements and reports on quality is the frequency with which quality issues are measured and reported to management strata. Manufacturing performance measures consists of the use of performance measures related to waste and inefficiency in evaluating the manufacturing system and the use of performance measures related to timeliness and vendor performance in evaluating the manufacturing system.

3.3.3 Incentive Systems (independent variable)

Incentive systems represent a network of contingent promises for reward and the basis for an inducements-contribution exchange (Snell & Dean, 1994). Three constructs related to performance incentives through compensation will be adopted from Fullerton & McWatters (2002) which are the importance of quality and teamwork in determining compensation, the importance of adherence to budget items in determining compensation, and the use of non-financial measures to determine compensation.

3.3.4 Control Variables

Two control variables were used in this study, organizational structure and innovation. Organizational structure is the extent of centralization or decentralization of a firm's organizational structure while innovation is the extent to which the firm considers itself a leader in product and process design and product technology (Fullerton & McWatters, 2002, p. 722).

Organizational structure can influence a firm's ability to be flexible and make major operational changes. The organizational structure (STRUCTR) of a firm is identified on the questionnaire. Innovation (INNOV) is measured by a firm's response on the survey instrument as to whether it is a leader or a follower in product technology, product design, and process design. Six survey questions related to firm innovation and organizational structure.

3.4 Data Collection Procedure

Survey instrument was sent through mail survey and self administered. In the survey instrument, the purpose of the survey is explained, along with a request for participation.

3.5 Analytical Technique

3.5.1 Descriptive Statistics

Data were analyzed with the use of descriptive statistics to capture the degree to which the sample firms have implemented JIT practices. Descriptive statistics depict the means for each of the individual elements and the total combination of the JIT elements.

Firms were classified as job order firms and mass production firms. ANOVA comparison of the means between the job order and mass production firms was used to show whether there are significant differences in the degree of JIT implementation between job order and mass production firms.

3.5.2 Non-Response Bias Test

The means of the responses for data collected through mail survey and self administered were compared to determine if there was a response bias. Levene test was conducted to determine whether data collected through mail survey and self administered have same mean value. If statistics t test < t from table then there are no differences in mean value between data collected through mail survey and self administered.

3.5.3 Construct Validity and Reliability Analysis

Bivariate correlation between each indicator score and total construct score is conducted to measure validity. If sig (2-tailed) < 0.05 then the indicator is valid. Cronbach's alpha is used as the coefficient of reliability for testing the internal consistency of the constructs. According to Nunnally (Ghozali, 2005, p.42), a construct or variable is reliable if the alpha coefficient of the construct is in excess of 0.60.

3.5.4 Classical Assumption Tests

In regression analysis, classical assumption tests are needed. Classical assumption tests in this research are performed by doing normality test, multicollinearity test and heteroscedasticity test. Normality is detected with Kolmogorov-Smirnov (K-S) test. If asymp. sig. 2-tailed > 0.05 then data is normally distributed (Ghozali, 2005, p. 115).

Multicollinearity can be seen from tolerance value and variance inflation factor (VIF). Cutoff value usually used to detect multicollinearity is tolerance value < 0.10 or VIF > 10 (Ghozali, 2005, p. 92). Park test is performed to detect heteroscedasticity by regress logaritm value of the residual square (LnU^2i) as the dependent variable and independent variables. If beta parameter is not significant, then there isn't heteroscedasticity in the regression model (Ghozali, 2005, p. 108).

3.5.5 Hypotheses Testing

Multiple Linier Regression was used to test the statistical effects of various sets of the independent performance measures and incentives system variables on the use of JIT practices. If statistics t test > t from table then hypothesis is supported.

This regression equation is tested :

JITIMP = b0 + b1 STRUCTR + b2 INNOV + b3 QLTYREV + b4 BOTTOM + b5 BENCH + b6 PERFWASTE + b7 PERFVEND + b8 COMPQLTY + b9 COMPBGT + b10 COMPNF (1)

Where

JITIMP : degree of JIT implementation

STRUCTR : organizational structure

INNOV : innovation

QLTYREV : frequency of measurements and reports on quality

BOTTOM : bottom-up data gathering techniques

BENCH : benchmarking for products, services, and processes

PERFWASTE : use of performance measures related to waste and inefficiency in evaluating the manufacturing system.

PERFVEND : the use of performance measures related to timeliness and vendor performance in evaluating the manufacturing system.

COMPQLTY : the importance of quality and teamwork in determining compensation.

COMPBGT : the importance of adherence to budget items in determining compensation.

COMPNF : the use of non-financial measures to determine compensation.

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Data

Good questionnaire will result in appropriate data (information) related to the research objective (Mas'ud, 2004, p. 57). For readability, completeness, and clarity, questionnaire was evaluated in a limited pretest by three production managers from three manufacturing firms. Appropriate changes were made based on their comments and suggestions.

The answers of the questionnaire from thirty production managers in thirty manufacturing firms are evaluated first to see whether the questionnaire is valid and reliable. Validity is the ability of a survey instrument to measure what should be measured (Mas'ud, 2004, p. 68). From SPSS output, correlations between each indicator toward total construct scores indicate significant result. Conclusion can be made that each indicator is valid.

Reliability is the ability of a survey instrument to collect consistent data from a group of individual (Mas'ud, 2004, p. 69). Table 4.1 shows SPSS output. From Nunnally criteria (Cronbach Alpha > 0.60), these values can be said reliable.

Questionnaires were sent to production managers representing 453 manufacturing firms in Central Java. 404 questionnaires were sent through mail survey and 49 questionnaires were self administered. Table 4.2 shows results of data collection.

TABLE 4.1

RELIABILITY TEST FOR 30 SAMPLE

	Cronbach's Alpha
STRUCTR	0.795
INNOV	0.953
BOTTOM	0.849
BENCH	0.840
PERFWASTE	0.901
PERFVEND	0.864
COMPQLTY	0.845
COMPBGT	0.707
JITIMP	0.891

Source : Primary data processed, 2006

TABLE 4.2

DETAIL OF DATA COLLECTION

Mail survey	404	
Self administered	49	
Total questionnaires delivered		453
Questionnaires returned because of wrong address		32
Total questionnaires after deduction by questionnaires returned because of wrong address		421
Response from respondents		
- Mail survey	14	
- Self administered	42	
Total responses		56
Usable response rate (56/453 x 100%)		12.36%

Source : primary data, processed 2006

Table 4.2 shows that 56 out of the 453 firms surveyed completed and returned the questionnaires, for an overall response rate of 12.36 %. Of the 56 questionnaires returned, every respondent returned the questionnaires not more than one month. This return rate is far from that reported in Fullerton & McWatters (2002) study, 254 out of the 447 firms completed and returned the questionnaires, for an overall response rate of 56.8%.

Table 4.3 shows profile of the respondents. Respondents are dominated by men (76.79%). Production manager position requires physical ability more than other abilities so man is seen more suitable for the position than woman. With respect to tenure, most of the respondents (48.21%) work in their firms in 1 until 5 years.

TABLE 4.3

PROFILE OF THE RESPONDENTS

	Frequency	Percentage
Gender		
Male	43	76.79
Female	13	23.21
Total	56	100.00
Tenure (years)		
1-5	27	48.21
6-10	12	21.43
11-15	4	7.14
16-20	8	14.29
21-25	2	3.57
26-30	2	3.57
31-35	1	1.79
Total	56	100.00

Source : primary data processed, 2006

4.2 Descriptive Statistics

One objective of this research is to capture the degree to which the sample firms have implemented JIT practices. Firms are classified by two categories with respect to their production system, firms which use job order system and firms which use mass production (process firms). On the questionnaire, the respondents were asked to provide the degree to which they were using 10 individual aspects of JIT (scaled from 1 to 6). Descriptive statistics depicting the means for each of the individual elements and the total combination of the JIT elements are shown in Table 4.4. The data are presented in terms of the total sample, the job order firms, and the mass production (process) firms.

TABLE 4.4
DESCRIPTIVE STATISTICS FOR JIT CONSTRUCTS AND COMPARISON OF MEANS BETWEEN JOB ORDER FIRMS AND PROCESS FIRMS

	Full sample means (n = 56)	**Job order firms means (n = 32)**	**Process firms means (n = 24)**	**ANOVA F-value**	**Sig F**
Focused factory	3.607	4.031	3.042	6.366	0.015
Group technology	4.661	4.875	4.375	2.077	0.155
Reduced setup times	4.018	4.156	3.833	0.646	0.425
Productive maintenance	4.375	4.375	4.375	0.000	1.000
Multi-function employees	3.875	4.000	3.708	0.708	0.404
Uniform work load	4.214	4.719	3.542	9.826	0.003
Product quality improvement	5.393	5.656	5.042	6.962	0.011
Process quality improvement	5.268	5.563	4.875	6.423	0.014
Kanban system	3.768	4.406	2.917	12.491	0.001
JIT purchasing	4.536	4.844	4.125	3.871	0.054
JIT elements combined	4.371	4.663	3.983	10.110	0.002

Implementation scale for these survey items: No intention = 1; Considering = 2; Beginning = 3; Partially = 4; Substantially = 5; Fully = 6. n = 56.

Source : primary data processed, 2006

The ANOVA comparison of the means between the job order and process firms, found in Table 4.4, shows highly significant differences between job order and process firms. For each JIT measure, the mean for the job order firms exceeds 4.0, whereas only five of the individual elements of the process firms have a mean greater than 4.0. Job order firms have an average mean of 4.663 for all JIT elements combined, compared to 3.983 for process firms (F=10.110, sig F=0.002). The results provide statistical evidence that the items represented by the individual factors used to explain the degree of JIT implementation are adopted more fully by job order firms. No significant differences exist between the job order and process firms in relation to group technology, reduced setup times, productive maintenance, and multi-function employees.

Quality management has been recognized as a necessary component in successful JIT implementation (Fullerton & McWatters, 2002, p. 723). The highest means of the JIT factors are for the adoption of quality practices. The means of these two constructs, product and process quality improvement, are both greater than 5.0.

4.3 Non-Response Bias Test

Levene test shows no statistical differences in the means between data collected through mail survey and self administered (see Appendix 3). Thus, there does not appear to be a response bias related to either data collected through mail survey or self administered.

4.4 Validity and Reliability

Questionnaires are valid if the questions in the questionnaires are able to express what will be measured by the questionnaires. Validity test in this research is conducted by doing bivariate correlation between each indicator score with total construct score. From Appendix 4, correlation between each indicator score with total construct score is significant at the 0.01 level for control variables, performance measures and incentive system variables. Correlation between each indicator score with total construct score for JIT implementation is significant at the 0.05 level.

Questionnaires are reliable if respondents' answer toward a statement is consistent or stable. Reliability in this research is measured with Cronbach Alpha. A construct or variable is reliable if Cronbach Alpha value is higher than 0.60 (Nunnally, 1967 in Ghozali, 2005, p. 42). SPSS 13.0 output is shown in Table 4.5. All constructs have Cronbach Alpha value higher than 0.60. Conclusions can be made that all constructs used in this research are reliable.

TABLE 4.5

RESULTS OF RELIABILITY TEST

Constructs	Cronbach's Alpha
STRUCTR	0.774
INNOV	0.931
BOTTOM	0.821
BENCH	0.846
PERFWASTE	0.791
PERFVEND	0.822
COMPQLTY	0.836
COMPBGT	0.615
JITIMP	0.834

Source : Primary data processed, 2006

4.5 Classical Assumption Tests

4.5.1 Test of Normality

If normality exists, then residual will be normally distributed. Differences between predicted value and actual value or error are equally distributed around means value equal to zero. Kolmogorov-Smirnov test can be used to detect normality. Results are presented in Table 4.6.

K-S value for QLTYREV, PERVEND, COMPQLTY, and COMPNF are 3.137, 0.000, 0.002, and 0.001 with significancy probability below 0.05 which means that QLTYREV, PERVEND, COMPQLTY, and COMPNF are not normally distributed. Other variables are normally distributed.

TABLE 4.6

RESULTS OF NORMALITY TEST

	Kolmogorov-Smirnov Z	Asymp. Sig. (2-tailed)
STRUCTR	0.892	0.403
INNOV	0.877	0.426
QLTYREV	3.137	0.000
BOTTOM	0.670	0.760
BENCH	0.898	0.396
PERFWASTE	1.088	0.187
PERFVEND	2.283	0.000
COMPQLTY	1.874	0.002
COMPBGT	1.184	0.121
COMPNF	1.899	0.001
JITIMP	0.971	0.302

Source : Primary data processed, 2006

4.5.2 Multicollinearity Tests

One of the assumptions of the classical linear regression model is that there is no multicollinearity among the explanatory variables (Gujarati, 2003, p. 374). Multicollinearity tests were performed to assure independence of the variables. If multicollinearity exists then population values of the coefficients cannot be estimated precisely.

From Pearson correlation coefficients in Appendix 4, highest correlation coefficient is – 0.460 between COMPQLTY variable and COMPBGT variable. Because this correlation is below 95%, it can be said that there is no serious multicollinearity.

Tolerance values also show that none of the independent variables have tolerance value below 0.10 which means that there is no correlation between independent variables that have value greater than 95%. Results of the Variance Inflation Factor (VIF) values also show the same thing in which there is no independent variable that have VIF value higher than 10. It can be concluded that there is no serious multicollinearity between independent variables in the regression model.

4.5.3 Heteroscedasticity Tests

An important assumption of the classical linear regression model is that the disturbances appearing in the population regression function are homoscedastic; that is, they all have the same variance (Gujarati, 2003, p. 387). If this assumption is not satisfied, there is heteroscedasticity. In the presence of heteroscedasticity, the t and F tests based on OLS formulas can be highly misleading, resulting in erroneous conclusions.

Park test can be used to detect heteroscedasticity. Park suggests that variance is some function of the explanatory variable. Table 4.7 shows that none of the coefficient is significant. It can be concluded that there is no heteroscedasticity in the regression model.

TABLE 4.7

RESULTS OF HETEROSCEDASTICITY TEST

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-1,792	3,443		-,521	,605
	STRUCTR	-,381	,370	-,163	-1,029	,309
	INNOV	-,072	,425	-,027	-,170	,865
	QLTYREV	1,050	,583	,296	1,801	,078
	BOTTOM	,300	,575	,102	,521	,605
	BENCH	,200	,394	,074	,508	,614
	PERFWASTE	-,266	,631	-,073	-,422	,675
	PERFVEND	-,472	,647	-,122	-,729	,470
	COMPQLTY	-1,099	,661	-,384	-1,662	,103
	COMPBGT	,761	,685	,255	1,110	,273
	COMPNF	-,207	,529	-,080	-,391	,698

a. Dependent Variable: RES_3

Source : SPSS output

4.6 Tests of Hypotheses

4.6.1 Results

Multiple Linear Regression is used to test the statistical effect of various sets of the 8 independent performance measures and incentive system variables on the use of JIT practices. The regression models are statistically significant at the 0.05 level with explained variances 22% as shown in Table 4.8. It means that 22% of the variances in the degree of JIT implementation are caused by the control variables, performance measures and incentive systems.

TABLE 4.8
REGRESSION RESULTS FOR THE EFFECTS OF PERFORMANCE MEASURES AND INCENTIVE SYSTEMS ON THE DEGREE OF JIT IMPLEMENTATION (DEPENDENT VARIABLE = JITIMP)

Independent Variables		Beta	t	Sig.	R^2	F	Sig. F
					0.22	2.547	0.016
Organizational structure of firm	STRUCTR	-0.038	-0.275	0.784			
Firm's innovation strategy	INNOV	0.298	2.161	0.036			
Frequency quality results reported	QLTYREV	0.037	0.258	0.797			
Use of bottom-up measures	BOTTOM	0.151	0.895	0.376			
Use of benchmarking techniques	BENCH	-0.119	-0.945	0.35			
Performance measures of waste	PERFWASTE	0.257	1.705	0.095			
On-time and vendor performance	PERFVEND	0.228	1.573	0.123			
Compensation:quality and throughput	COMPQLTY	0.084	0.421	0.675			
Compensation:variances and budgets	COMPBGT	-0.203	-1.023	0.312			
Compensation:non-financial measures	COMPNF	-0.123	-0.693	0.492			

Source : primary data processed, 2006

The control variable of innovation (INNOV) is significant, supporting earlier research by Fullerton & McWatters (2002). As expected, larger firms that view themselves as leaders in innovation employ more JIT techniques. A larger firm likely would have more resources to study the ramifications of JIT and to make the necessary changes for its adoption. Leaders in product technology and design are less resistant to change, and are more likely to be leaders in manufacturing technology. However, organizational structure has insignificant effect on the degree of JIT implementation.

Support for hypothesis 1a – 1e would be reflected in significant positive effects of the performance measures variables on the degree of JIT implementation variables. Regression results show that of the five performance measures variables, only performance measures of waste has a weak effect on the degree of JIT implementation (supporting hypothesis 1d). Use of benchmarking techniques (BENCH) has an unexpected negative effect on the degree of JIT implemented. The results failed to support hypothesis 1a, 1b, 1c, and 1e.

Neither compensation for quality and throughput, compensation for variances and budgets, nor compensation for non-financial measures has a significant effect on the degree of JIT implementation. Thus, there is no support for hypothesis 2a and 2c, but hypothesis 2b is supported. Compensation for non-financial measures (COMPNF) has an unexpected negative effect on the degree of JIT implemented.

4.6.2 Discussion

4.6.2.1 Performance Measures and the Degree of JIT Implementation

The findings indicate that non-traditional performance measures do not affect the degree of JIT implementation. This support Ittner & Larcker (1998) review, that the majority of firms still use traditional accounting criteria much more than non-traditional for both internal and external performance evaluation.

TABLE 4.9

DESCRIPTIVE STATISTICS FOR RESEARCH VARIABLES 1

Variable	Average	Standard Deviation	Actual Range	Average	Theoretical Range
QLTYREV	4.54	0.79	2 – 5	3	1 – 5
BOTTOM	19.02	5.67	6 – 30	18	6 – 30
BENCH	9.43	3.07	3 – 15	9	3 – 15
PERFWASTE	16.75	3.08	8 – 20	12	4 – 20
PERFVEND	9.02	1.45	3 – 10	6	2 – 10
JITIMP	43.71	8.54	16 - 57	35	10 – 60

Source : Appendix 2

Frequency quality results reported (QLTYREV) has a mean value of 4.54, higher than the theoretical mean, with relatively high standard deviation 0.79. The data show that majority of production managers receive information on quality results attained weekly, irrespective of the degree of JIT implementation which has a mean value of 43.71, slightly higher than its theoretical mean.

Frequency quality results reported has insignificant effect on the degree of JIT implementation. This contrasts with Daniel & Reitsperger (1991) proposition which stated the management control system supporting a zero defect strategy will provide more frequent quality feedback than the system supporting an Economic Conformance Level strategy. The research results do not support Fullerton & McWatters's (2002) research which found that firms employing higher level of JIT practices more frequently measure and report quality results to their employees. This is also contrary to the findings of Banker et al., (1995) that the availability of information on productivity and quality is positively related to the extent of implementation of just-in-time, quality, and team work programs.

The use of bottom-up measures (BOTTOM) has a mean value of 19.02, higher than the theoretical mean, with relatively high standard deviation 5.67 (see Table 4.9). Statistical Quality Control (SQC), frequency charts, scatter graphs, and Pareto charts are available to assist in the quality control area (Swanson & Lankford, 1998). The results here show that the use of bottom-up measures has insignificant effects on the degree of JIT implementation. This fact does not support Banker et al's (1993) argument that in implementing JIT, analytic tools for process control, such as process flowcharts, Pareto analysis plots, fishbone charts, histograms, run diagrams, control charts and scatter diagrams also require the posting of specific performance information on the shop floor. This is also contrary to the findings of Fullerton & McWatters (2002) that the use of bottom-up measures such as cause-and-effect diagrams, histograms, flowcharts, pareto analysis, scatter diagrams, and SPC charts are usually associated with JIT.

The use of benchmarking to evaluate operations (BENCH) has an unexpected negative effect on the degree of JIT implemented. The use of benchmarking has a mean value of 9.43, slightly higher than the theoretical mean, with high standard deviation 3.07 (see Table 4.9). This failing to support Ittner & Larcker (1997) argument that the extent to which an organization follows quality oriented strategy is positively related to its use of benchmark of performance relative to competitors or other industry leaders. The results do not support earlier research by Chenhall & Langfield-Smith (1998) who found that benchmarking can assist in successfully developing strategies emphasizing either customer service or low price.

Performance measures of waste (PERFWASTE) has a mean value of 16.75, much higher than the theoretical mean, with relatively low standard deviation 3.08 (see Table 4.9). The use of manufacturing performance measures related to equipment downtime, scrap, rework, and setup times has positive and significant effects on the degree of JIT implementation, supporting earlier research by Fullerton & McWatters (2002). This result can be compared to those of Daniel & Reitsperger (1991), which found that quality goals and feedback about rejects and downtime are more frequently provided to managers adhering to a zero defect strategy than to managers who are economic conference level proponents.

Vendor reliability (PERFVEND) has a mean value of 9.02, much higher than the theoretical mean, with relatively high standard deviation 1.45 (see Table 4.9). Managers who are most committed to JIT appear to be concerned that vendors deliver high quality products in a timely fashion. Companies with just in time production systems depend on suppliers to deliver quality goods on time (Swanson & Lankford, 1998). As noted by White, et al., (1999, p. 13) with just-in-time purchasing, the interdependence between manufacturer and supplier increases; this requires improving communication and quality (this should be a cooperative effort between manufacturer and supplier) as inventories are decreased. The research results do not provide support for the importance of vendor reliability. This contrasts with the findings of Fullerton & McWatters (2002).

The research results don't support Fullerton & McWatters's (2002) research which suggests that firms striving to implement JIT may need to modify their performance measures to provide more non-traditional performance measures. This is also contrary to the findings of prior research (Abernethy & Lillis, 1995). There may be several reasons for this. First, it may reflect the anecdotal evidence noted in Abernethy & Lillis (1995) that changes to the performance measurement system were considered less important than organizational structural arrangements in the ability to enhance performance under flexible manufacturing strategies. Such structural arrangements were not examined in this research.

Second, and consequently, the main benefits of increasing the use of operations-based measures may be motivational rather than instrumental; that is, through aligning the formal performance measurement system (and subsequent systems of reward and compensation) with those factors that production managers know they must pay attention to under a customer-focused manufacturing strategy (Perera, et al., 1997). If so, a match between such a strategy and non-financial performance measures may be reflected in production manager-affective outcomes such as increased satisfaction and motivation and reduced stress rather than in direct performance outcomes.

Third, the absence of results on performance might be a consequence of two related limitations of the research; the cross-sectional methodology employed and the measure of the degree of JIT implementation variable. Careful attention to the way in which the independent construct was defined and operationalized also allowed for greater attribution of this performance measures construct to the degree of JIT implementation.

4.6.2.2 Incentive Systems and the Degree of JIT Implementation

Compensation for quality and throughput (COMPQLTY) has a mean value of 12.79, much higher than the theoretical mean, with relatively high standard deviation 2.92 as shown in Table 4.10. The data show that product quality, throughput time, and team performance are important in determining compensation for production managers. However, the degree of JIT implementation has a mean value of 43.71, slightly higher than its theoretical mean.

TABLE 4.10

DESCRIPTIVE STATISTICS FOR RESEARCH VARIABLES 2

Variable	Average	Standard Deviation	Actual Range	Average	Theoretical Range
COMPQLTY	12.79	2.92	3 – 15	9	3 – 15
COMPBGT	7.7	1.87	2 – 10	6	2 – 10
COMPNF	3.7	1.08	1 - 5	3	1 – 5
JITIMP	43.71	8.54	16 - 57	35	10 – 60

Source : Appendix 2

This research does not support Snell & Dean (1994) conclusion that integrated manufacturing frequently alters the nature of employee contribution and, in the process, requires a different set of inducements to motivate performance. This is also contrary to the findings of prior research (Fullerton & McWatters, 2002). However, this is similar to those in a study by Ittner & Larcker (1997) which found that quality-based rewards were not a significant determinant of performance differences between low and high quality companies. Based on the discussion with some production managers, they receive only monthly salary and do not get additional incentives.

Compensation for compliance with budgets and variances (COMPBGT) has a mean value of 7.7, higher than the theoretical mean, with relatively high standard deviation 1.87 (see Table 4.10). Compensation rewards for compliance with budgets and variances have negative and insignificant effect on the degree of JIT implemented, supporting hypothesis 2b. Durden et al., (1999, p. 114) noted that the role of variance analysis and other traditional measures of performance need to be critically examined in a JIT production setting. The research results support earlier research by Abernethy & Lillis (1995) and Fullerton & McWatters (2002).

Compensation for non-financial measures (COMPNF) has a mean value of 3.7, higher than the theoretical mean, with relatively high standard deviation 1.08 (see Table 4.10). Compensation for non-financial measures has an unexpected negative effect on the degree of JIT implemented. The research results suggest that compensation for non-financial measures does not have positive effect on the degree of JIT implemented. In this sense, these results support Ittner & Larcker's (1998) conclusion that firms traditionally have relied almost exclusively on financial measures such as budgets, profits, accounting returns and stock returns for measuring performance. Durden et al., (1999) found that greater use of non-financial performance indicators is associated with higher performance irrespective of the production management system adopted.

CHAPTER V

CONCLUSIONS AND SUGGESTIONS

5.1 Conclusions

This research aim to test and analyze the impact of performance measures and incentive systems on the degree of JIT implementation by Central Java manufacturing firms through survey question delivered to each production manager. Production managers are confronted daily with the tasks of reducing costs and improving productivity. JIT as a manufacturing strategy has been proposed to do both (Ahmed, et al., 1991, p. 799).

Firms are classified by two with respect to their production system, firms which use job order and firms which use mass production. Evidence is provided that the items represented by the individual factors used to explain the degree of JIT implementation are adopted more fully by manufacturing firms which used make-to-order production system. It should come as no surprise that JIT operators produce a part or product only in response to an order from an internal or external customer (Selto, et al., 1995, p. 666). Implementation scale of JIT for sample test shows that in average, Central Java manufacturing firms partially implement JIT.

The results of this research demonstrate that successful implementation of JIT practices also requires a complementary management accounting system. Specifically, firms need a decision-making system that incorporates bottom-up measures, performance measure of waste, and vendor reliability. Firms also must adapt their control system by linking compensation rewards to quality results.

However, the results failed to confirm that the effective use of non-financial performance indicators was restricted to high degree of JIT implementation.

The limitations of this research constrain the interpretation of the findings. First, respondents might have been unfamiliar with questionnaire terms used to describe JIT methods so they didn't answer the questions well. Second, ten JIT indicators on the survey might not have been indicative of actual company practices. Finally, with response rate only 12.36%, the relatively small sample firms might make the test sample non-representative of other Central Java manufacturing firms. Together, these limitations might lead to relatively low contribution of control variables, performance measures and incentives systems variables on the degree of JIT implementation.

Despite the noted limitations, this research contributes to understanding of the links between manufacturing strategy and management accounting systems. The results indicate that the MAS employed by firms adopting more JIT practices as an organizational strategy do not need to emphasize more non-traditional performance measurement and incentive system.

3.2 Suggestions for Future Research

The research results show that control variables, performance measures, and incentive systems account for below 25% of the explained variance in degree of JIT implementation. Ahmed et al., (1991) explain that many factors affecting the implementation of JIT which are top management commitment, the number of suppliers and relationships with suppliers, employee readiness, labour-union support, reliable equipment and technical support. These factors should be considered in the future research.

A low response rate indicates that the measures representing performance measures, incentive systems, and the degree of JIT implementation need to be explored in greater depth. Also, the relative importance of financial versus non-financial measures in different types of performance evaluation contexts could be considered. Future research might further examine how various pay plans associated with JIT manufacturing affect subsequent productivity and firm performance.

It is difficult to establish why the management accounting systems tested in this research would have a direct influence on the degree of JIT implementation (see Durden et al., 1999). Additionally, it is unclear whether management accounting system is influencing the degree of JIT implementation or vice versa. It may be that firms implementing higher degree of JIT implementation are more likely to make modifications to their management accounting systems to support JIT adoption. Therefore, degree of JIT implementation may be driving the management accounting changes in the firms studied. Further research is needed to investigate this aspect.

References

Abernethy, M. A. and Bouwens, J. 2005. "Determinants of Accounting Innovation Implementation". *ABACUS*. Vol.41 No.3. pp. 217-240.

Abernethy, M. A. and Lillis, A. M. 1998. "The Impact of Manufacturing Flexibility on Management Control System Design". *Accounting, Organizations and Society*. Vol.20 No.4. pp. 241-258.

Ahmed, N. U., Tunc, E. A., and Montagno, R. V. 1991. "A Comparative Study of US manufacturing Firms at Various Stages of Just-In-Time Implementation". *International Journal of Production Research*. Vol. 29 No. 4. pp. 787-802.

Atkinson, A. A., Kaplan, R. S., and Young, S. M. 2004. *Management Accounting*. 4th Ed. Pearson Education, Inc., Upper Saddle River. New Jersey.

Balakrishnan, R., Linsmeier, T. J., and Venkatachalam, M. 1996. "Financial Benefits from JIT Adoption: Effects of Customer Concentration and Cost Structure". *The Accounting Review*. Vol. 71 No. 2. pp. 183-205.

Banker, R., Potter, G., and Schroeder, R. 1993. "Reporting Manufacturing Performance Measures to Workers: An Empirical Study". *Journal of Management Accounting Research*. 5. pp. 33-53.

Barney, J. B. 1991. "Firm Resources and Sustained Competitive Advantage". *Journal of Management*. Vol. 17 No. 1. pp. 99-120.

Bouwens, J. and Abernethy, M. A. 2000. "The Consequences of Customization on Management Accounting System Design". *Accounting, Organizations and Society*. Vol 25. pp. 221-241.

Chenhall, R. and Langfield-Smith, K. 1998. "The Relationship Between Strategic Priorities, Management Techniques and Management Accounting: An Empirical Investigation Using A Systems Approach". *Accounting, Organizations and Society*. Vol. 23 No. 3. pp. 243-264.

Daniel, S. J. and Reitsperger, W. D. 1991. "Linking Quality Strategy with Management Control Systems: Empirical Evidence from Japanese Industry". *Accounting, Organizations and Society*. Vol 16 No. 7. pp. 601-618.

Durden, C. H., Hassel, L. G., and Upton, D. R. 1999. "Cost Accounting and Performance Measurement in a Just-in-time Production Environment". *Asia Pacific Journal of Management*. Vol. 16. pp. 111-125.

Fullerton, R. R. and McWatters, C. S. 2002. “The Role of Performance Measures and Incentive Systems in Relation to the Degree of JIT Implementation”. *Accounting, Organizations and Society*. Vol. 27. pp. 711-735.

Gaspersz, V. 2005. *Total Quality Management*. Jakarta. PT Gramedia Pustaka Utama.

Ghozali, I. 2005. *Aplikasi Analisis Multivariate dengan Program SPSS*. Edisi 3. Semarang. Badan Penerbit Universitas Diponegoro.

Golhar, D., Stamm, C., and Smith, W. 1990. “JIT Implementation in Small Manufacturing Firms”. *Production and Inventory Management Journal*. 2nd Quarter. pp. 44-48.

Gomez-Mejia, L. R. 1992. “Structure and Process of Diversification, Compensation Strategy, and Firm Performance”. *Strategic Management Journal*. Vol. 13. pp. 381-397.

Grant, R. M. 1991. “The Resource-based Theory of Competitive Advantage: Implications for Strategy Formulation”. *California Management Review*. 33,3. Spring. pp. 114-135.

Griffin, L. and Harrell, A. 1991. “An Empirical Examination of Managers’ Motivation to Implement Just-In-Time Procedures”. *Journal of Management Accounting Research*. pp. 98-112.

Gujarati, D. N. 2003. *Basic Econometrics*. 4th Ed. McGraw-Hill Companies.

Hansen, D. R. and Mowen, M. M. 2005. *Management Accounting*. 7th Ed. Thomson. South-Western.

Hedin, S. R. and Russell, G. R. 1992. “JIT Implementation: Interaction Between the Production and Cost-Accounting Functions”. *Production and Inventory Management Journal*. 3rd Quarter. pp. 68-73.

Horngren, C. T., Foster, G., and Datar, S. M. 2000. *Cost Accounting A Managerial Emphasis*. 10th Ed. Prentice Hall International, Inc.

Indriantoro and Supomo, B. 1999. *Metodologi Penelitian Bisnis Untuk Akuntansi & Manajemen*. Edisi Pertama. Yogyakarta. BPFE.

Ittner, C. D. and Larcker, D. F. 1997. ”Quality Strategy, Strategic Control Systems, and Organizational Performance”. *Accounting, Organizations and Society*. 22(3/4). pp. 293-314.

Ittner, C. D. and Larcker, D. F. 1998. ”Innovations in Performance Measurement: Trends and Research Implications”. *Journal of Management Accounting Research*. 10. pp. 205-238.

Jazayeri, M. and Hopper, T. 1999. ”Management Accounting within World Class Manufacturing: A Case Study”. *Management Accounting Research*. 10(3). pp. 263-301.

Mas’ud, F. 2004. *Survai Diagnosis Organisasional, Konsep & Aplikasi*. Semarang. Badan Penerbit Universitas Diponegoro.

Prendergast, C. 1999. “The Provision of Incentives in Firms”. *Journal of Economic Literature*. Vol. XXXVII March. pp. 7-63.

Ravichandran, T. and Lertwongsatien, C. 2005. “Effect of Information Systems Resources and Capabilities on Firm Performance: A Resource-Based Perspective”. *Journal of Management Information Systems*. Spring. Vol. 21. No. 4. pp. 237-276.

Reitsperger, W. D. 1986. “Japanese Management : Coping with British Industrial Relations”. *Journal of Management Studies*. January. pp. 72-87.

Safayeni, F., Purdy, L., Van Engelen, P., and Pal, S. 1991. ”Difficulties of Just-in-time Implementation: A Classification Scheme”. *International Journal of Operations & Production Management*. 11(7). pp. 27-36.

Said, A. A., HassabElnaby, H. R., and Wier, B. 2003. “An Empirical Investigation of the Performance Consequences of Nonfinancial Measures”. *Journal of Management Accounting Research*. 15. pp. 193-223.

Snell, S. A. and Dean, J. W. Jr. 1994. “Strategic Compensation”. *Academy of Management Journal* October. pp. 1109-1140.

Spencer, M. S. and Guide, V. D. 1995. “An Exploration of the Components of JIT”. *International Journal of Operations and Production Management*. 15(5). pp. 72-83.

Swanson, C. and Lankford, W. M. 1998. “Just-in-time Manufacturing”. *Business Process Management Journal*. 4(4). pp. 333-341.

Wafa, M. A. and Yasin, M. M. 1998. “A Conceptual Framework for Effective Implementation of JIT: An Empirical Investigation”. *International Journal of Operations and Production Management*. 18(11). pp. 1111-1124.

White, R. E., Pearson, J. N., and Wilson, J. R. 1999. “JIT Manufacturing: A Survey of Implementations in Small and Large US Manufacturers”. *Management Science*. 45. pp. 1-15.

Wisner, J. D. and Fawcett, S. E. 1991. "Linking Firm Strategy to Operating Decisions through Performance Measurement". *Production and Inventory Management Journal*. 3rd Quarter. pp. 5-11.

Young, S. M. and Selto, F. H. 1993. "Explaining Cross-Sectional Workgroup Performance Differences in a JIT Facility: A Critical Appraisal of A Field-Based Study". *Journal of Management Accounting Research*. 5. pp. 300-326.

Young, S. M., Shields, M. D., and Wolf, G. 1988. "Manufacturing Controls and Performance: An Experiment". *Accounting, Organizations and Society*. 13(6). pp. 607-618.