NORTHERN ILLINOIS UNIVERSITY

A REVIEW OF PERFORMANCE MEASURES IN A JIT ENVIRONMENT

A Thesis Submitted to the

University Honors Program

In Partial Fulfillment of the

Requirements of the Baccalaureate Degree

With University Honors

Department of Accountancy

by

Michele Y. Lao

Dekalb, Illinois

December 1995

HONORS THESIS ABSTRACT

THESIS SUBMISSION FORM

AUTHOR: MICHELE Y. LAO

THESIS TITLE: A REVIEW OF PERFORMANCE MEASURES IN A JIT ENVIRONMENT

ADVISOR: JAMES A. HENDRICKS ADVISOR'S DEPT: ACCY

DISCIPLINE: ACCOUNTANCY YEAR: SENIOR

PAGE LENGTH: 20 BIBLIOGRAPHY: YES ILLUSTRATED: YES

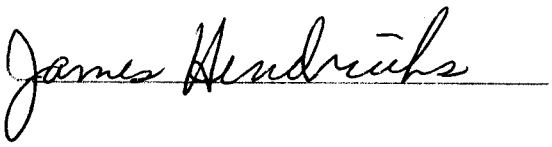
PUBLISHED: NO

COPIES AVAILABLE: HARD COPY

ABSTRACT:

With the ever changing environment that manufacturing companies face, there is an increased need for revisions to existing performance measures in a Just-In-Time environment. In order to accurately assess the status of their performance measures, companies need to consider their corporate mission, objectives, strategies, and critical success factors. Although making appropriate revisions to old performance measures is not an easy task, many similarities between manufacturing companies can serve as helpful guidelines. There are five common critical success factors in all manufacturing companies. These factors can help guide a company in developing its revised performance measures. Another established method for developing performance measures is to follow the balanced scorecard approach. The following thesis discusses all of the elements involved in reviewing performance measures in a JIT environment.

Student Name: MICHELE Y. LAO

Approved by: 

Department of Accountancy

Date: December 1995

With increasing levels of automation and dramatic changes sweeping the manufacturing environment, there is a definite need for revisions in many of our traditional performance measures. The success of a business is largely affected by the support that performance measures lend to the corporate mission, objectives, and strategies. Since many manufacturing companies have adopted the Just-In-Time (JIT) philosophy, existing company performance measures need to reviewed and revised as needed in order to adequately support the JIT philosophy.

Making appropriate revisions to company performance measures is not an easy task. A company must first understand the philosophies behind a just-in-time system. Second, existing performance measures must be assessed. Third, new performance measures must be implemented that cater to the needs of a particular company.

UNDERSTANDING JIT

Originating ~~from~~ in Japan, this concept has swept manufacturing companies on a global basis. In today's environment, the majority of successful manufacturing companies in the United States ~~alone~~, have implemented the JIT philosophies. These companies range from well-known names such as Black and Decker, Westinghouse, Borg Warner, Xerox, AT&T, and Motorola. In addition to this extensive list, all major U.S. automobile manufacturers practice the JIT techniques (Green 50).

In the purest of forms, JIT is an absolute concept. This philosophy dictates that each segment of the manufacturing process is conducted in such a highly efficient matter that zero

inventories exist. That is to say that purchased materials are acquired on a purely as-needed basis to be prepared for manufacturing, goods are processed on an as-needed basis when orders are received, and finished goods are delivered on an as-needed basis to be sold. Although achieving the ideal status of a JIT manufacturing environment may be quite difficult, the philosophies underlying its techniques have proven quite successful for many leading companies.

In its most basic form, JIT attempts to eliminate all areas of waste in the manufacturing environment. The philosophy focuses on only engaging in "value-adding activities". By doing so, the company hopes to reduce lead-time, improve quality, increase productivity, and enhance customer responsiveness. Each of these positive results will in turn allow the company to operate more competitively. Along with this desire to grow more competitive, companies must possess the ability to inspect existing measures and be open to possibilities for change.

PROBLEMS WITH TRADITIONAL PERFORMANCE MEASURES

Traditional performance measures can often be counterproductive in a JIT environment. Green and his co-authors describe six key features of traditional cost accounting that tend to impair successful implementation of the just-in-time system:

1. Reliance on standards.
2. Emphasis on variance and efficiency computations.
3. Preoccupation with direct labor.
4. Extensive inventory tracking.
5. Overhead allocations based on direct labor.

6. Inappropriate measures of performance (50).

Each of these features needs to be addressed in order to develop quality measures of performance for a JIT manufacturing environment. The first feature, for example, has caused many problems. The standard cost approach tends to emphasize standard measures rather than past actual performance, and the standards are often outdated, thus failing to recognize changes in material prices and new technologies.

Hewlett-Packard, Borg Warner, and other leading companies have found ways to deal with these problems. By focusing on continual improvement rather than adherence to standards, a company does not get caught up in the numbers game that standard cost systems often play. Instead, the company focuses on adhering to the JIT philosophy of maintaining highly efficient manufacturing processes.

In terms of recognizing changes in material prices and new technologies, companies can take various steps to account for these aspects. Companies can ~~make a habit of~~ replacing standard costs or other measures with actual costs from the previous year. Also, manufacturing companies can compute a rolling average of actual results to serve as a benchmark for monitoring current year performance. By making such changes in their approach to standard cost systems, companies could adhere to the JIT concept which dictates the need for continuous improvement.

The second feature addresses the existence of complex variance and efficiency computations. These calculations attempt to compare actual inputs at standard prices to standard inputs at

standard prices. The deviations from the standard are intended to indicate reasons for such inefficiencies. The JIT philosophy, however, eliminates the need for these computations. Instead of focusing on individual costs and deviations in a company, the JIT philosophy encourages executives to examine the "total picture". The JIT manufacturing environment attempts to eliminate all non-value adding activities, refocus analysis from individual cell level to line or plant level, and reduce the need for reporting detailed costs and variances on an individual level. Total cost reduction and complete company efficiency is the focus of JIT.

The third feature challenges companies that mistakenly overemphasize labor over materials cost. With the prevalence of automated environments and the fact that materials account for more than half of product costs, allocating overhead on direct labor hours is severely misleading. Under a JIT manufacturing environment, both direct and indirect labor function on an as needed basis. Work is scheduled such that production meets all demands, lot sizes are kept small, and inventories are nonexistent. For this reason, many companies tend to salary their employees and simply regard direct labor as another component of factory overhead.

Extensive inventory tracking is a fourth key feature which tends to inhibit the potential success of JIT implementation. Most importantly, excessive inventory levels should not exist. Maintaining zero or minimal inventory levels are necessary in order to promote a more efficient manufacturing environment. Yet even ignoring this goal, companies need to simplify their existing inventory tracking systems. Managers are often swamped with

paperwork involving vast numbers of job tickets and routing sheets. To help comply with the methodologies behind JIT, some companies have turned to adopting the Kanban card (Green 52).

The Kanban card is a reusable card that significantly reduces the amount of paperwork involved. A set number of withdrawal cards are issued to suppliers and attached to standardized containers. The suppliers use these containers to ship to the manufacturing company all purchased materials. Once the contents of the containers are fully fed into production by the manufacturing company, the cards are removed and sent back as authorization to the suppliers. The suppliers determine the necessary amounts of inventory to send out by multiplying the number of Kanban cards by the standard container amounts. This Kanban card system, in effect, helps to support a highly efficient JIT inventory system. Below is an example of a Kanban card.

Use of Kanban internally?

==========

REUSABLE KANBAN CARD
(Use Ball Point Pen)

"M" Number _____ Item Number _____

Quantity _____ Deliver To _____

Group Number _____
Sheer Size _____
Punch Tape Loc _____

Designed to Control daily Delivery of Sheet Metal Control Panels to Designated Assembly Sections at Westinghouse Plant, Asheville, N.C.

==========

The fifth feature focuses on the need to revise the overhead

allocation bases. Costs, such as, materials handling, maintenance, depreciation, setup time, warehousing, and others are often inappropriately allocated based on direct labor hours or dollars. As Feature Three pointed out, direct labor is highly overemphasized in today's automated, JIT environments. To improve current systems, manufacturing companies need to take several steps.

First, production labor should rarely be vouchered and production work orders should be eliminated entirely. Second, multiple allocation bases should be closely linked to their cost drivers. ~~And~~ Third, developing two separate allocation rates linked separately to labor and materials should be considered. For example, the Hewlett-Packard Personal Office Computer Division originally had its overhead allocation based on direct labor. After extensive revisions, however, the company now uses one allocation rate that is material-based for procurement overhead, and another rate that is labor-based for production overhead. By revising overhead allocation bases, a manufacturing company can be more accurately aware of specific cost drivers and search for appropriate means in approving their JIT environment.

Inappropriate measures of performance in a JIT environment is the sixth feature which may hinder the success of a manufacturing company. According to Hendricks, traditional performance measures inappropriately tend to be financial in nature and relate to external reporting requirements. Companies that possess these outdated performance measures tend to focus on short-term gains, rather than long-term benefits. Also, these same companies overemphasize costs and production on the departmental

and functional level. Although these concerns may appear to be important to managers doing business in this highly competitive business world, such practices ,in essence, conflict with the underlying principles of JIT. New performance measures need to be adopted which encourage the JIT philosophies of elimination of waste and continuous improvement.

THE OBJECTIVES OF JIT PERFORMANCE MEASURES

The corporate mission, objectives, strategies, and critical success factors should all be considered when a company is developing a revised set of performance measures. One objective of performance measures is to minimize the amount of time spent on production operations and to eliminate all nonvalue-adding activities. Key activities should be examined and improved in terms of their effect on the company as a whole. A second objective of these performance measures is to unite all company employees and management executives into a solid workforce. The goals of a company should be shared by all of its elements, thus promoting a more efficient work environment. A third objective of revised performance measures is to improve overall operational performance by decreasing lead time, improving productivity rates, and decreasing total company costs. Striving to attain each of these objectives will lead JIT manufacturing companies on the successful path of competing as a highly efficient, productive industry leader.

Identifying the company's critical success factors (CSFs) is an important step to revising appropriate JIT performance measures. By definition, CSFs are elements so essential to a company that without each of them ~~present~~, the company would fail. Generally, critical success factors vary from company to company. However, Beischel and Smith claim that there are five critical success factors that are commonly found in all manufacturing companies:

1. Quality,
2. Customer Service,
3. Resource Management,
4. Cost, and
5. Flexibility (25).

With careful management of the above five critical success factors, manufacturing companies should experience enhanced manufacturing performance. In order to do so, however, managers must understand why the above factors are so important to maintaining an effective JIT environment.

Quality. A manufacturing company should be concerned with both product and process quality. Product quality is the ability for a company to meet or exceed the needs of its customers. In essence, it is the degree to which a manufacturing company achieves high levels of customer satisfaction. Process quality concentrates on a company's ability to limit process variations and to complete a quality production cycle correctly "the first time around." Possessing both good product and process quality is essential in supporting the philosophy of continuous improve-

ment in a JIT manufacturing environment.

Customer Service. This CSF has two aspects that must be considered ~~as well~~. Manufacturing companies should concern themselves with external customer satisfaction. The ability to meet the needs of customers with quality finished goods in a highly efficient manner is one of the goals of a JIT manufacturing company. Internal customer service deserves an equal amount of attention as well. Other departments or different levels of the corporate structure should be able to function in symbiosis. A well serving company, both internally and externally, will generally reap ~~positive~~ the benefits of financial and operational success~~, as a result~~.

Resource Management. The objective of resource management is to achieve full optimization of all resources. Direct labor, purchased materials, existing technologies, fixed capital, etc. should each be used to their fullest potential in order to produce highly efficient goods. Proper management of resources is congruent with the JIT principle of reducing any excessive waste in the production process of a company.

Cost. As a critical success factor, costs are measured and analyzed at the level that they are reported. Generally, the JIT philosophy dictates that managing the other four critical success factors will naturally help limit costs, and thus, enhance the financial performance of a company. Keep in mind, that although costs at the departmental and functional level of the company need to monitored, it is the overall financial performance of a manufacturing company that truly dictates its success.

Flexibility. Flexibility is the ability for a comoany to

welcome change when necessary. In order to effectively compete in today's business world, companies need to keep abreast of any major changes in the industry, governmental regulatory sector, economic arena, physical and global environment, and technological sector. It is only with the ability to manage with flexibility that a company can effectively compete with other well informed, technologically advanced companies.

Because each of the five critical success factors listed above are so important to the success of manufacturing companies, appropriate performance measures should be chosen with care. It is essential that performance measures both relate to and support a specific CSF in order to promote a highly effective JIT environment.

CSFs AND THEIR PERFORMANCE MEASURES

Determining which performance measures are ideal for a particular company entails examining both nonfinancial and financial measures. Usually there are a number of performance measures for each critical success factor that a company may want to consider. The following selective list includes several performance measures that Hendricks feels appropriately relate to the five CSFs:

QUALITY

* Failure rate from suppliers;
* Percentage of good units produced;
* Customer returns;
* Customer complaints;
* Rework; and
* Warranty claims.

CUSTOMER SERVICE (Delivery ← in Hendricks article)	
* Design cycle time;	* Lead time
* Production schedule attainment;	* Throughput time; and
* Customer on-time delivery;	* Set-up time.
RESOURCE MANAGEMENT (Productivity)	
* Output/equipment dollar;	* Output/employee;
* Production cycle time;	* Sales per employee; and
* Inventory turnover;	* Capacity utilization.
~~cost~~ Financial Performance	
* Return on investment;	* Distribution cost;
* Total product cost;	* Conversion cost; and
* Value- vs. nonvalue-added costs;	* Materials cost.
FLEXIBILITY	
* Number of common parts;	* Downtime;
* Production cycle time;	* Parts availability; and
* Number of levels on bill of materials	* Set-up time (28).

Neil Gerstner Fortune

The performance measures listed above are not all inclusive

for all JIT manufacturing companies. Instead, the various performance measures may serve as a mere selection of the numerous measures that a company may choose to measure its critical success factors. In aggregate, these nonfinancial and financial performance measures attempt to present a picture of the success of a company. By no means should a company focus on any single measure. Instead, the ability for the manufacturing company to function as a whole should be the primary concern.

OVERVIEW OF THE BALANCED SCORECARD APPROACH

Managers who are relatively inexperienced at revising old systems and implementing new performance measures may need the help of an established method. The balanced scorecard was ~~studied~~ developed by Robert S. Kaplan and David P. Norton in a year-long research project consisting of twelve leading companies. This approach attempts to give top executives a quick, yet comprehensive view of the business (71).

The balanced scorecard gives management information from four different perspectives. Each of these four are equally important in assessing the status of the company. In order to better understand this theory, Kaplan and Norton relate the balanced scorecard to the dials and indicators of an airplane cockpit. Navigating and flying a plan is a complicated task for pilots. They need to be aware of information on air speed, fuel, altitude, bearing, and other factors in order to navigate the plane through current and approaching environments. Each of these airplane instruments are critical to the ability of the

pilot. Relying on merely one instrument could be misleading and thus result in tragedy. In this same sense, the balanced scorecard presents several aspects of the company that need to be assessed simultaneously in order to properly manage its decisions.

The balanced scorecard approach addresses four specific areas: customer perspective, internal perspective, innovation and learning perspective, and financial perspective. Respectively, the four perspectives address the following questions:

* How do customers view our company?
* What aspect of our company do we want to excel at?
* How do we commit to continuous improvement and elimination of waste?
* How do shareholders and other stakeholders view our company?

The balanced scorecard approach has already been adopted by several large manufacturing companies. These companies have already seen many benefits to adopting this approach. First, the scorecard helps prevent suboptimization. Oftentimes in companies, managers are concerned only with the quantitative success and measures of their particular department or division. The balanced scorecard, on the other hand, emphasizes the need for all areas of operational management to operate together in order to yield the greatest overall company improvement and success.

Second, the balanced scorecard compiles several seemingly unrelated areas of the company together onto one report. In this manner, company managers are able to assess the company's

progress in improving quality, strengthening teamwork, reducing the production process cycle time, and focusing on the long-term success of the company. With these benefits, many companies are welcoming the balanced scorecard approach with enthusiasm.

AN ILLUSTRATION OF THE BALANCED SCORECARD

Kaplan and Norton developed the following illustration to help understand the method of using the balanced scorecard approach:

FINANCIAL PERSPECTIVE Goals:	Measures:
Survive	Cash flow
Succeed	Quarterly sales growth and operating income by division
Prosper	Increased market share and ROE

CUSTOMER PERSPECTIVE Goals:	Measures:
New products	Percent of sales from new products Percent of sales from proprietary products
Responsive supply	On-time delivery
Preferred supplier	Share of key accounts' purchases
Customer partnership	Number of cooperative engineering efforts

INTERNAL BUSINESS PERSPECTIVE Goals:	Measures:
Technology capability	Manufacturing geometry vs. competition
Manufacturing excellence	Cycle time, Unit cost, Yield
Design productivity	Silicon efficiency, Engineering efficiency
New product introduction	Actual introduction schedule vs. plan

INNOVATION AND LEARNING PERSPECTIVE Goals:	Measures:
Technology leadership	Time to develop next generation
Manufacturing learning	Process time to maturity
Product focus	Percent of products that equal 80% sales
Time to market	New product introduction vs. competition

Granted that the above illustration is that of a semiconductor company, the benefits of using the scorecard are apparent to all manufacturing companies. This scorecard enables the semiconductor company to focus its attention on all the critical success factors of the company. These four factors help provide guidelines in measuring current and future performance.

Extensive research has shown that implementing the balanced scorecard approach cannot be achieved without the involvement of senior managers. Since these individuals possess the overall view of the strategies and goals of the company, their input is

essential.

An interesting aspect of the balanced scorecard approach is its focus on strategy. Traditional cost measurement systems have a tendency to possess a control bias. These traditional measures tend to dictate the actions of the employees. The balanced scorecard approach, on the other hand, is designed to bring all company personnel together in working towards a unified vision. This aspect of the balanced scorecard approach is very much in tune with the philosophies behind adopting revised JIT performance measures. With company strategies in the minds of all employees, such manufacturing companies can successfully work towards continual improvement in a JIT environment.

IN SUMMARY

With the manufacturing environment growing increasingly competitive, companies need to make appropriate revisions to their existing performance measures. Automation and obsolete measures from traditional cost systems can hinder the success of JIT implementation. Although making revisions to existing measures may seem difficult, such changes are essential. Corporate mission, objectives, strategies, and critical success factors should all be considered in the revision process. Regardless of whether the manufacturing company decides to use the balanced scorecard approach or its own particular method, the company should keep in mind the basic JIT philosophies of eliminating waste and continual improvement. With these principles as their guidelines for performance measure revisions, manufacturing

companies can effectively compete in today's ~~ever~~ challenging environment.

WORKS CITED

Beishel, Mark E. and K. Richard Smith, "Linking the Shop Floor to the Top Floor," Management Accounting, October 1991.

Fisher, Joseph, "Use of Nonfinancial Performance Measures," Journal of Cost Management, Spring 1991.

Green, F.B., Felix Amenkhienan and George Johnson, "Performance Measures and JIT," Management Accounting, February 1991.

Hendricks, James A., "Performance Measures For a JIT Manufacturer: The Role of the IE," Industrial Engineering, January 1994.

Johnson, Gene H., and James D. Stice, "Not Quite Just In Time Inventories," The National Public Accountant, March 1993.

Kaplan, Robert S. and David P. Norton, "The Balanced Scorecard-Measures That Drive Performance," Harvard Business Review, January-February 1992.

Keegan, Daniel P., Robert G. Eiler, and Charles R. Jones, "Are Your Performance Measures Obsolete?" Management Accounting, June 1989.

Maisel, Lawrence S., "Performance Measurement: The Balanced Scorecard Approach," Journal of Cost Management, Summer 1992.

Sellenheim, Michael R., "J.I. Case Company: Performance Measurement," Management Accounting, September 1991.