A CASE STUDY OF MANAGEMENT ACCOUNTING EVOLUTION IN THE WORLD-CLASS MANUFACTURING COMMUNITY

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Just as individual manufacturing cells strive for continuous improvement, reduced setup times, and elimination of nonvalue-added activities, the accounting organizations within the eight Shingo manufacturers examined in this study have been able to accomplish corresponding objectives by eliminating accounting wastes such as unnecessary transaction processing, excessive paper handling, unnecessary reports, outdated controls and procedures, and excessive historical analyses. Additional results from this field study suggest that reductions in manufacturing cycle times, changes to cellular manufacturing, and the implementation of JIT systems have reduced the need for much of the detailed transaction processing associated with tracking work-in-process inventories. As a result, accountants must re-evaluate the benefits of traditional costing measurements in light of modern manufacturing processes. Furthermore, accountants must be careful that the tracking of internal transactions and the measurement of resource utilization are not creating perverse incentives or perpetuating barriers to continuous improvement within the organization. Finally, the study findings suggest that accountants must develop methods to measure the prospective financial impact of employee actions.

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Although the management accounting function has historically played an important role in providing operating managers with the information needed to make decisions, severe criticism of the accounting profession has raised doubts about its long-term viability. The profession has been struggling with major changes in the industrial, economic, and technological landscapes. For example, competitive pressures in an increasingly global market have forced businesses to make continual improvements in both product quality and production efficiency. Technological advances and the emergence of new management paradigms have exerted a significant influence on the competitive structure of virtually all industries. Robotics and other computerized production technologies have eliminated the labor intensiveness of many production processes. Similarly, manufacturing philosophies such as just-in-time (JIT), total quality commitment, and zero waste have impacted significantly on manufacturing methodologies. Yet, according to some academicians and practitioners, management accountants have been deficient in providing decision-making information to managers that is relevant in light of new manufacturing and production paradigms. Johnson and Kaplan (1987) claim that "management accounting information is produced too late, too aggregated, and too distorted to be relevant for managers' planning and control decisions."

Other researchers propose various strategies for making management accounting more relevant. Boer (1991) suggests that accounting should undergo the same cost/benefit scrutiny as other functional areas. Such scrutiny should eliminate accounting activities that either promote dysfunctional behavior within the organization or fail to lead to higher quality products or more efficient production processes. McNair and Carr (1991) emphasize that management accounting should go beyond placing a value on inventory for financial reporting purposes. They suggest that the development of a system to measure the cost of quality is an example of an accounting activity with potential for adding value to the firm. Convey (1991) and Turney (1992) describe several approaches for analyzing the relevance and value-added nature of accounting activities. Opportunities also appear to exist for management accountants to improve decision support by providing managers with information across multiple dimensions such as products, distribution channels, and customers (Cooper and Kaplan, 1991; Rolfe, 1992). Similarly, supporting higher level decision making such as strategic planning offers a significant opportunity for accountants that has yet to be effectively exploited (Bromwich, 1990).

The increasing complexity and uncertainty confronting modern business operating environments has fueled the demand for increasingly sophisticated information support. While the management accounting profession scrambles to regain relevance in the modern manufacturing environment, it is clear that some innovative companies have already achieved levels of excellence in their manufacturing methodologies. For example, prestigious awards such as the Malcolm Baldridge National Quality Award and the Shingo Prize for Excellence in American Manufacturing have been bestowed upon American manufacturers who have achieved world-class status in competitiveness. Nevertheless, the role management accounting

has played in these successful organizations is not clearly understood. In order to more fully understand the contributions made by management accounting to manufacturing excellence, a study of eight Shingo Prize recipients (Appendix I) was conducted to help determine the impact of the world-class manufacturing environment on the management accounting function, and how the management accounting function contributed to the success of these world-class manufacturers. By compiling the results of these case studies, the authors sought to construct a profile of management accounting as practiced within several prize-winning organizations.

THE SHINGO PRIZE FOR EXCELLENCE IN MANUFACTURING

The Shingo Prize for Excellence in Manufacturing, named in recognition of the late Japanese industrial engineer, Dr. Shigeo Shingo, was established in 1988 to recognize North American companies that have demonstrated excellence in productivity and process improvement, quality enhancement, and customer satisfaction. The overriding philosophy of the Shingo Prize is that world-class manufacturing status is achieved by focusing on core manufacturing processes; implementing lean, flexible production systems; eliminating waste; and achieving zero defects. At the same time, the award fosters continuous product improvement and continuous cost reduction (Robson, 1991).

The Shingo Prize Model of Manufacturing

The Shingo Prize Achievement Criteria are based on the Shingo Prize Model of Manufacturing (Figure 1). The premise of the model is that the total quality and productivity management culture and infrastructure (category I) leads to the implementation of world-class manufacturing strategies, processes, and systems (category II). In turn, these strategies, processes, and systems should result in measured improvements in quality and productivity (category III). Finally, the ultimate measure of manufacturing success is viewed in this model as customer satisfaction (category IV). Applicants for the prize must therefore document their accomplishments within each of these categories in an achievement report submitted to the Shingo Prize Board of Examiners. The achievement reports are scored according to procedures outlined in the Shingo Prize Application Guidelines. Finalists emerging from this evaluation process are further evaluated on-site by a team of examiners (Shingo Prize Council, 1997).

RESEARCH METHODOLOGY

In 1993 Kaplan suggested that a field-study approach involving firms with "considerable experience with the new practices" may yield promising results for the discipline of management accounting. He cautioned, however, that because no "Japan" existed to serve as a laboratory for management accounting practices, field research studies would tend to "capture traditional

management accounting systems operating in environments radically different from the ones for which the system was designed" (Kaplan, 1993). Nevertheless, the authors of this manuscript assert that this field study offers a unique opportunity to capture a cross-section of American companies that have successfully adopted Japanese manufacturing methods and have demonstrated world-class manufacturing prowess, supported by innovative management accounting practices.

Figure 1

The Shingo Prize Model of Manufacturing

I	II	III
Total Quality and Productivity Management Culture • Leading • Empowering • Partnering	Manufacturing Processes and Systems • Manufacturing vision and strategy • Manufacturing process integration • Quality and productivity methods • Manufacturing and business integration	Measured Quality and Productivity • Quality enhancement • Productivity improvement
IV. Measured Customer Satisfaction		

The Advance Questionnaire

An advance survey questionnaire was sent to the eight participating Shingo Prize companies to help them prepare for the types of questions to be asked in the site interviews. The questionnaire was designed to elicit anecdotes and other documentation of the companies' experiences. Among the survey questions, key company personnel were asked to describe the role played by the management accounting function in the evolution of the organization toward world-class manufacturing. They were also asked about the changes in their management accounting function as a result of changes in the manufacturing environment, and they were asked to document any innovative management accounting applications they had developed.

Site Visits to Participating Companies

Visits to the eight participating companies were made to observe plant operations with emphasis on the supporting accounting functions and activities, and to conduct interviews with key personnel. An attempt was made to examine various perspectives both inside and outside the management accounting function. Therefore, key personnel interviewed typically included the plant manager, production foreman, procurement manager, engineering manager, chief financial officer, and cost accountants. Their responses to both the advance questionnaire and interviews were documented and transcribed.

THE RESULTS: THE SHINGO MANAGEMENT ACCOUNTING PROFILE

The experiences of the eight Shingo Prize recipients provided a basis for developing a profile of lean management accounting. In the following sections, an attempt has been made to compile a composite set of characteristics typical of the Shingo environment.

The Integration of Accounting and Manufacturing Cultures

As explained earlier, the Shingo Prize is awarded to companies demonstrating that they not only have achieved a world-class level of competitiveness within their manufacturing operations but also have integrated quality management, waste reduction, and productivity enhancement methods throughout the organization. According to Lifeline Operations Vice-President John Gugliotta:

> World-class quality will only be attained when continuous improvement philosophies extend into all departments within an organization (Gugliotta, 1991).

Therefore, service units such as accounting conduct themselves in much the same spirit as their manufacturing counterparts by decreasing their reporting cycle times, improving transaction processing accuracy, and eliminating unnecessary transaction processing and financial reporting. Not only do accountants in the lean manufacturing environment measure other departments, but they also scrutinize themselves, assuring through ongoing measurement that accounting processes are producing quality output and that accounting responsibilities are being effectively discharged.

The Effects of Lean Manufacturing on Management Accounting Measures

The move from functional batch-oriented manufacturing systems toward cellular continuous-flow manufacturing has forced management accountants to re-evaluate the methods

used to measure the efficiency of productive capital utilization. Similarly, the tenacious focus of the Shingo Prize recipients on agile production methods (such as setup reduction) continues to shorten manufacturing cycle times and diminishes the justification for in-process transactions. These concepts are more fully discussed in the following paragraphs.

Reduced Cycle Times

As manufacturing cycle times decline, the expenditure of human resources to record labor and material transactions as a product flows through its manufacturing processes would appear to make less sense. In many cases, the processing of such data lags significantly behind the physical flow of the product. A common practice in the Shingo environment is the use of back flushing in which the resource consumption of a finished product is computed *ex post* using the bill of materials to relieve raw materials inventory and standard conversion times to apply direct labor and burden to the product. United Electric Finance Vice President Brian Hallahan describes the need to simplify the accounting for work-in-process:

> You take a product from the raw materials stage, you build it in a day, and then you put a transaction through at the end of the day to pull it right through work-in-process and into finished goods. Because the manufacturing process happens so fast, you don't bother following the transactions with paper. Why move the product five times on paper when the product is gone before the paper is processed? (Hallahan, 1993)

As a result, production workers spend their time adding value to the product or improving processes, not recording transactions.

In addition to being nonvalue-added activities on the production line, recording in-process transactions can actually create perverse incentives leading to local optimization. This is especially true when a functional department is measured by how much it transfers to a subsequent manufacturing process rather than by actual finished product shipments. An example of this took place at AT&T Power Systems – Dallas (now a business unit of Lucent Technologies) as explained by Power Systems Administrative Director John Archer:

> The plant used to have a storeroom in the middle of the factory to store work-in-process inventory. Individual functional departments could remove raw material, perform their part of the process, then return it to the storeroom and receive recovery (credit for a sale) when the transfer transaction is processed. Another department would eventually retrieve the work-in-process item from the storeroom and perform its operations. Because each department got credit as soon as they completed their operation and returned it to inventory, their incentive was to build excess inventory. Therefore, the transfer transactions were causing three problems: (1) departments would tend to build excess inventories of selected parts because they got immediate

> shipping credit upon transfer; (2) the storage and transport of the excess inventory represented additional waste; and (3) significant wasted effort was involved in entering and processing the transactions themselves (Archer, 1993).

Now, when inventory leaves the storeroom, it is not transferred back. A cell will only work on a component or assembly that is needed for a customer shipment. In addition, as Power Systems has moved to JIT, unnecessary transactions have been eliminated, particularly those involving the transfer of work-in-process between departments. Archer continues:

> As you go to JIT you begin to realize that your in-process [inventory] is going down. You don't need to know where everything is because your cycle times are getting shorter and the materials are flowing through and you are doing a lot of unnecessary work [entering transfer transactions]. We eliminated all that...The only time a shop knows that they are getting "paid" for a product is when the product ships. We call that back flushing (Archer, 1993).

Cellular Manufacturing

The Shingo Prize recipients have recognized that the focus of efficiency measures should be at the manufacturing-cell level rather than at the machine or employee level. Clearly, the only meaningful utilization concern will be at each cell bottleneck; tracking the utilization of non-bottleneck resources is largely wasted effort.

Eliminating Accounting Barriers to Continuous Improvement

Traditionally, American management accounting measurements have focused on keeping labor fully utilized. As United Electric Electronic Operations Manager John Williams relates:

> The former manner in which costs were viewed became barriers to the continuous improvement process. Using old modes of thinking, it would not have been considered efficient to spend time training employees when they could be spending their time building more products (Williams, 1993).

The Japanese management style allows for time periods during which the worker is not physically engaged in production. This non-production time is expected to occur occasionally as pull system demands have been met (i.e., the kanban is filled). Workers finding themselves in this situation use this time to pursue continuous improvement efforts rather than to build excess inventory. Clearly, accounting systems that penalize workers and departments for such situations must be redesigned.

Continuous Accounting Improvement

While management accounting is no stranger to scrutinizing other functional departments, it has a relatively short history of self-evaluation. Because companies within the Shingo environment have integrated continuous improvement methodologies throughout the organization, service departments such as accounting find themselves with the same continuous improvement mandate as the production departments.

Efforts among the companies in this study show a variety of efforts aimed at continuous improvement. Some have involved the reduction in cycle times for reporting and month-end closing. Others have involved cause-and-effect analyses of credit memorandums and other transaction errors. Many of the companies were actively partnering with outside firms to reduce the complexity of transaction processing, the volume of paper document handling, and the resulting transaction costs. Most of the firms were actively pursuing mistake proofing of accounting processes. Also, metrics such as response time were used to measure and improve performance of the accounting function in returning bid quotations to customers. Lifeline Systems offers an interesting example of accounting self-measurement as explained by John Giannetto, Lifeline Corporate Manager for Materials and Purchasing:

> A measure of the effectiveness of the paperless purchasing system is the number of manual checks written. This is an activity that Lifeline wants to eliminate because it costs much more to write a check manually than to process it through the system. Another non-value-added activity performed by accounting is the month-end close. Therefore, the length of the closing process is measured and reported with the intent to reduce the closing duration (Giannetto, 1993).

Giannetto further believes that accounting must focus on the operational aspects of benchmarking. He believes that a metric should indicate progress toward eliminating non-value activities. Rather than asking "how many activities are you doing," we should be asking, "how well are you doing those activities"? For example, rather than measuring the number of line-items in the inventory, an accountant should measure the number of production days lost to take physical inventory. Instead of measuring the number of employees supported by payroll services, the ratio of employees to payroll staff could be computed. Giannetto believes the key question to be asked is, "What is the measurement that helps you understand what the process is doing?" For example, he suggests that rather than measuring number of expense reports processed, measure the number or reports processed without error. Instead of measuring how many products are produced, measure the number of products produced per employee (Giannetto, 1993).

The Elimination of Accounting Waste

In the area of waste elimination, management accountants must be as aggressive as their manufacturing counterparts in identifying and removing nonvalue-added activities. Several examples of accounting waste elimination follow:

1) *Unnecessary Transaction Processing.* Accountants understand the costs of transaction processing and should continually seek to eliminate transactions that do not lead to better decision making and organizational efficiency. The chart of accounts can be streamlined to reduce the time spent in account lookup and selection, minimize the chances for coding errors, and minimize computer storage and processing time. According to United Electric Cost Accounting Manager Alan Waugh:

> We have cut down on the number of general ledger accounts. We have cut down the number of departments we used to have. With the number of accounts we used to have, you would have thought we were General Motors. We had eighty or ninety departments, one-man bands, if you will. We don't need that kind of reporting. We are not General Motors (Waugh, 1993).

Accountants should also reduce the time spent on immaterial adjusting entries or unnecessary precision of accounting estimates--particularly if the adjustments cause delays in the closing and reporting process.

The Shingo Prize recipients have shown that travel expense transaction processing can be simplified through automation and reduced paper documentation processing. These firms have also shown that invoices can be consolidated and arrangements can be made with vendors to reduce the number of checks that need to be processed.

2) *Processing Paper Documents.* Clearly, the handling of paper documents results in several wasted actions and resources. These documents must be manually filed and retrieved, resulting in the waste of human effort and storage space. The documents must be physically routed, requiring additional time delays and often result in misplaced documents. Paper documents require human action and are therefore subject to wait time in the "in" basket, making them less accessible and more difficult to track.

Modern technology such as electronic data interchange (EDI) and electronic imaging should be aggressively explored as alternatives to paper handling.

3) *Unnecessary Reports.* Accountants need to determine the extent to which their products are being used. Accounting resources spent producing unused reports can be redeployed in other proactive efforts.

4) *Unnecessary Controls and Procedures.* The accounting profession must continue to re-evaluate the appropriateness and cost effectiveness of controls and procedures. This can be done without sacrificing prudence. For example, Iomega Corporation discontinued asset tagging because the fixed asset system already tracked capital purchases and associated serial numbers. United Electric reduced the number of employees in the authorization loop with respect to resolving small account discrepancies.

5) *Accounting Artifacts.* The term *artifact* often refers to a tool of an earlier civilization. Although such ancient tools at one time provided practical benefits to their users, these items are only curiosities today, having been rendered obsolete long ago by advancing technology. Similarly, some accounting procedures are rapidly becoming artifacts. For example, closing a plant or business to take a complete physical inventory is an artifact of an earlier era that was considered necessary before automated perpetual inventory and cycle counting. As Gugliotta observes:

> Most companies who have put in a computer system today have forgotten one major piece. They have forgotten to update the manual systems. Accountants are probably the worst ones. They still want a copy of the transaction ticket. They want a copy of the purchase order, a copy of the invoice, and a copy of the receiving ticket. You don't need most of that stuff if you have a system in place. We eliminate a lot of source documents when we do backflushing after the fact (Gugliotta, 1991).

As the reliability of modern systems becomes generally established, accountants can develop the expertise to audit and trust the systems rather than relying only on the system's outputs. The same can be said about any accounting procedure that forces the productive resources of the company to work around it. Gugliotta challenges the audit function in the following quotation:

> We've made your job easier ... it should be easier for you to audit us. Therefore, you should be here fewer days and charge us less money. We want you to tell us why you have to be here to audit some of these things or why you can't come during the year to audit some of the processes we use as opposed to auditing the numbers at the end of the year (Gugliotta, 1991).

6) *Historical Analysis.* Not surprisingly, production management finds little relevance in most historical reporting. For example, Dana Corporation has strictly limited

backward-looking analyses. A more productive use of accounting resources may be to study the linkage of production processes to financial results, thus giving managers a forward-looking financial tool.

Toward a Proactive Management Accounting Culture

The preceding sections may seem to suggest that the management accounting role will diminish as a result of new technologies and a tenacious focus on eliminating nonvalue-added activities. While this is probably a fair assessment of traditional management accounting activities, it overlooks the great need the modern manufacturing plant has for a proactive financial consultant. Interviews by the authors, both inside and outside the accounting function, suggest that there is a significant opportunity for management accounting to satisfy this need.

a) *Becoming Business Consultants*. Sentiments across the Shingo horizon are that manufacturing personnel would like to see less of the accountant in the role of a financial dictator, watchdog, or gatekeeper. Lucent Technologies - Power Systems Chief Financial Officer A. L. (Pete) Peterson believes that no financial officer should bear the title of "controller."

> I have a personal hangup about the word 'controller'. That word to me is like saying 'gotcha.' The objective used to be to catch somebody doing something wrong and point it out, as opposed to saying, 'if you do it this way it will lessen the risk, improve the return, or shorten the cycle time.' There is a completely different flavor to the controllership function. Unfortunately, here we are trying to overcome a history where the position has *demanded* rather than *offered* information (Peterson, 1993).

What manufacturing organizations do want are financial advisors to help them run their businesses. It is also clear that manufacturing would like to see increased emphasis by accountants on future-oriented support and decreased emphasis on historical analyses. Areas such as strategic planning, up-front system design, and up-front product design offer important consulting opportunities for the management accounting profession.

b) *Management Accounting Support That Empowers*. Within the Shingo culture, it is at the level of the manufacturing cell that empowerment is taking root. Cells need to be able to develop measures for tracking their own performance. They are likely to need the assistance of the management accounting function in developing these measures. Management accounting is also in an excellent position to show the manufacturing cells how to access relevant data from the database.

c) *Knowing the Core Business*. The proactive involvement of the management accountant will require that he or she fully understand the core business and the

> production processes that drive it. United Electric General Ledger Manager Kelly Tonner expects her staff to become involved in UE team projects outside the accounting area. Tonner's admonition to her staff is "you work in Finance, but you work for United Electric -- go find out what's going on in this company." She has also brought in sales representatives to give presentations to her staff on the types of products being produced at UE (Tonner, 1993).

As the Shingo companies have shown, this knowledge of the core business require more direct involvement with the production floor. This will take several forms, such as cross-training, physical placement within production, job enrichment, and team participation. Clearly, the credibility of management accounting products will hinge directly on the degree to which management accountants are perceived as understanding the business and its operating processes. As Lucent Technologies - Power Systems Senior Financial Planner Kevin Mortazavi observes:

> When I approach those financial people [those with operational experience] I always come away with a complete understanding of the process. When I go to a purely financial person who hasn't been out there, I can tell the difference. They know their job but they don't have a clear picture of the overall situation. Broadening financial personnel will give finance more credibility. It's a lot easier for me to meet with a Business Unit Head and talk about productivity when they know I have been out there and that I know what they are talking about (Mortazavi, 1993).

Management Accountants as Educators

This study of eight Shingo Prize manufacturers reveals that management accounting must develop its role as the financial educator to the organization. Management accounting should strive to raise the level of financial understanding and sophistication of their constituents. Gugliotta (1993) emphasizes that the primary job of the finance function is not merely to report what happened, but rather:

> One of the functions of any finance organization is to educate the world around them. Finance helps people understand how their activities affect the profits of the organization.

Management accounting is in the best position to study and articulate the linkages between operational measures and their corresponding financial results. These linkages will allow decision makers to evaluate prospective decisions and take them beyond postmortem analyses. Engineers will better understand the financial consequences of their design decisions. Finally, workers will better understand the financial consequences of their work patterns.

CONCLUSION

The results of a study of eight Shingo Prize recipients reveal that innovative management accounting practices are most often driven by and run parallel to innovative manufacturing practice. Like their manufacturing counterparts, management accountants within these recognized organizations have sought aggressively to eliminate accounting wastes, reduce accounting cycle times, and support the empowerment of the manufacturing cell. These accountants have also re-examined the motivational impact of accounting measurements in the context of modern manufacturing practice, being careful not to contribute to perverse behavioral incentives or inhibit continuous improvement within the plant. Finally, the Shingo management accounting culture encourages a proactive, future-oriented accounting stance.

Appendix

Brief Descriptions of Participating Shingo Prize Recipients

Dana Mobile Fluid Products Division, Minneapolis, Minnesota (1991 Shingo Prize)

The Minneapolis Plant of Dana Corporation - Mobile Fluid Products Division was founded under the name of Gresen Manufacturing in 1945. A manufacturer of hydraulic control valves for heavy off-highway equipment, Gresen was eventually acquired by Dana Corporation in 1981.

Gates Rubber Company, Siloam Springs, Arkansas (1993 Shingo Prize)

The Gates Rubber Company is the Gates Corporation's largest subsidiary. It manufactures and markets hose and connector products, V-belts, synchronous belts, conveyor belts, flat belts, and molded rubber products for automotive and industrial customers and boots and carpet underlay. Operations include 16 manufacturing plants in the U.S., 20 plants in eight other countries, and three international joint ventures.

Glacier Vandervell, Inc., Atlantic, Iowa (1991 Shingo Prize)

Glacier Vandervell, Inc., formerly JPI Transportation Products, Inc., manufacturers heavy-duty engine bearings in its Atlantic, Iowa production facility. JPI was purchased in 1990 by T&N Plc of Great Britain. This merger has positioned Glacier Vandervell as part of the world's leading engine producers.

Iomega Corporation, Roy, Utah (1992 Shingo Prize)

Iomega Corporation is a leading manufacturer of removable computer storage and backup devices. Founded in 1980, the company went public in 1983, and presently employs 3,000 people in its worldwide operations.

Lifeline Systems, Inc., Watertown, Massachusetts (1991 Shingo Prize)

Lifeline Systems, Inc., founded in 1974, is a manufacturer of personal emergency response systems. The company also provides real-time monitoring services to elderly subscribers.

Lucent Technologies - Power Systems, Dallas, Texas (1992 Shingo Prize; 1994 Deming Prize)

Lucent Technologies – Power Systems (formerly AT&T Microelectronics Power Systems), located in Dallas, Texas, is one of eleven strategic business units within Lucent Technologies, and is a world-class manufacturer of energy systems, electronic power supplies, and components for the data processing and telecommunications industries. Power Systems was the first U.S. manufacturer to receive the Deming Prize (Japan).

United Electric Controls Company, Watertown, Massachusetts (1990 Shingo Prize)

Founded in 1931, United Electric Controls, Inc. (UE), located in Watertown, Massachusetts, is a manufacturer of electronic and electromechanical temperature and pressure controls and sensors.

Wilson Sporting Goods Company, Humboldt, Tennessee (1993 Shingo Prize)

Wilson Sporting Goods Company has been manufacturing and marketing golf, baseball, basketball, football, and other sporting goods for well over three-quarters of a century.

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