

# JUST-IN-TIME AND MODERN MANUFACTURING ENVIRONMENTS: IMPLICATIONS FOR COST ACCOUNTING\*

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A work standard is a fortress against improvement of quality and productivity.

W. Edwards Deming [3, p. 40]

Cost accounting is enemy number 1 of production.

Eliyahu M. Goldratt [5]

With such damning statements about traditional cost accounting and its elements, one must wonder if cost accounting has any value, and indeed, why it is used at all. But cost accounting does have value and is needed. Accounting is an organization's information collection mechanism, and as such is a vital and necessarily integrated support system for any firm.

The primary issue regarding cost accounting for quality and productivity is not whether it should be used, but how. This article reviews the historical basis of cost accounting and introduces the subject of cost accounting for just-in-time and modern manufacturing environments.

## OBJECTIVES OF COST ACCOUNTING

To understand the role of cost accounting in the manufacturing environment, its objectives and outputs must be recognized. Cost accounting has three primary outputs: pricing information, inventory valuation data, and cost control evidence.

Determining the accurate cost of a product is necessary for finding optimal pricing for that product and, more importantly, whether that product can be profitable. Inventory in many firms is a significant asset, and is important in determining the financial position of the company. Accurate inventory valuations are needed as bases for management decision making and for reporting via financial statements to stockholders and various governmental agencies. The information

gathered by cost accounting must provide management with data useful for determining cost control measures and necessary manufacturing improvement actions.

With the end goals of cost accounting in mind, the objectives of cost accounting can be understood. The four objectives are

- to report accurate information.
- to have the information reported in a timely fashion.
- to provide this information at a reasonable cost.
- to be flexible enough to adapt to different informational needs.

These objectives take on even greater importance when seen in light of continuous and increasing manufacturing competition, dynamic governmental regulations, and introduction and implementation of new manufacturing philosophies and structures [2, 9].

Cost accounting, for all its lofty goals and purposes, must be kept in perspective. According to Hall, "cost allocations and attributions are judgment calls [6, p. 216]." Cost accounting can be a rough measure, and there is no reason to believe that several cost accountants would approach the same costing issue in the same, or even a similar, manner [6]. Another concern is that "one can measure [collect data] to death and still not know much [6, p. 134]." Also to be considered is what is cynically referred to as "the Heisenberg uncertainty principle in costing." This principle, borrowed from physics, is adapted to say that attempts to measure what is happening may distort what is happening [7].

## HISTORICAL BASIS FOR CURRENT COST ACCOUNTING PRACTICES

Modern accounting practices are anything but "modern"; most were developed in the early part of this century and were ingrained by World War II. The cost accounting methods designed then were developed for measurement of mass production of a few standardized items with a high direct labor content. The goal was to watch direct labor activities and costs

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closely, since typically direct labor was the largest cost determinant. The cost accounting systems designed for use in such environments worked well and were accurate, but today's manufacturing environments do not often have the same cost structure [4].

Other characteristics of the "old" manufacturing model that cost accounting systems were developed to measure and support include:

- Relatively low cost labor
- Capital (equipment), when used, intended to facilitate, rather than replace, labor
- Throughput controlled primarily by direct labor
- Production costs varying greatly with production quantity
- Most other costs associated with a product highly correlated with direct labor input
- Labor the highest cost determinant of a product
- Products highly standardized with few products, options, and variations
- Product life cycles long, new product development and introduction infrequent
- Slowly changing technology
- Record-keeping and analysis manual
- Foreign competition typically not a major factor.

To meet the cost-accounting objectives of the manufacturing environment, several simplifying assumptions were typically made which led to acceptable results while simplifying manual recordkeeping. One assumption was that all product costs were variable. Fixed costs were small enough to be considered insignificant, and so applicable to overhead. Another assumption was the use of direct labor hours input as the basis for applying other conversion costs, because indirect and overhead costs typically were consumed in proportion to direct labor input. Also, only one overhead application rate was utilized throughout the plant because these costs were small enough that it was uneconomical to accumulate more accurate costs at each cost center level [1].

Today the highest value-added element is no longer labor, but overhead. Overhead can run as high as 20 times that of direct labor in many contemporary manufacturing situations. Wantuck [12] shows that overhead as a percentage of product value has steadily increased from 1850 to 1980, and it appears that this trend has not abated.

Accounting theorists and users have only now started to rethink and reformulate accounting systems to correspond to this and other fundamental manufacturing changes. Many of the big eight accounting consulting firms are working on projects to define structures and systems for modern accounting [4].

What other new elements exist in modern manufacturing? Technological improvements first led to many individual capital investment decisions on the shop floor, resulting in a patchwork of capital projects. In time, this piecemeal approach was consolidated into more highly sophisticated and vertically integrated technical systems. Coherent company- and factory-wide management philosophies and structures were designed to support these technological process improvements.

What were the implications for cost accounting? The high-ticket cost element switched from direct labor to equipment, because labor moved away from producing items to supporting machines that produced items. Labor then became more of a fixed cost rather than variable and so must be treated as such. Labor employment flexibility once enjoyed by managers no longer holds due to combined elements of higher worker skill requirements, longer learning curves, and resulting greater investment in human resources.

Traditionally, accumulated overhead costs were distributed to products made on the basis of direct labor input into that product, since high direct labor/overhead correlations existed. But in today's environment of comparatively low direct labor levels that correlation no longer holds, and so overhead must be applied in a more accurate and suitable manner. The alternative to the direct labor hour basis is the time-in-system basis. That is, overhead can be applied on the basis of cycle time or flow time for a product in the manufacturing process.

While direct labor levels have fallen, equipment levels have increased in value and have been typically aggregated into the catchall cost category called overhead. But because of their size equipment costs must be identified separately, and establishing new cost categories (including one called "depreciation") has been suggested. Overhead must be stratified.

Cost-accounting systems must be developed to adapt to and accommodate costing in labor-intensive operations and highly automated cost centers. Many factories have and will have a mix of labor-paced and automated cost centers, each of which may require a different costing model [1].

## COST ACCOUNTING FOR JUST-IN-TIME

New cost-accounting methods are being developed for the radically different type of manufacturing called just-in-time (JIT), the structure of which departs from traditionally accepted orientations as a quality and production control system. Before describing cost ac-

counting for JIT, traditional cost accounting structures must be understood.

### Two Traditional Costing Methods

There are basically two kinds of cost accounting systems, job order costing and process costing. Both have many variations, and in some cases hybrid systems exist.

The full cost of something is exactly what it costs. For example, if you pay \$250 for a television set, its full cost to you is \$250. But determining the full cost for manufacturing that television set is not so simple or exact. As mentioned earlier, costing can be a rough or judgmental art. In other words, finding the full cost from the manufacturer's point of view is challenging. Full cost for the manufacturer may be defined as the sum of all direct costs (materials and labor) and the appropriate share of indirect costs (services that do not add value to the product). It is easy to account for the direct costs, but problems arise in trying to equitably accumulate and allocate the indirect costs.

Job order costing accumulates costs for each physically identifiable job (work batch) as it moves through the factory. On the other hand is process costing, which accumulates costs for all products worked on in a given accounting time period. These total costs are then divided among the total number of units made in that period [4].

The vehicle for collecting costs in a job-order environment is called the work order, shop traveler, or job-order cost sheet. The work order is essentially a cost summary sheet that includes information regarding the labor and materials applied to the job at each station in the manufacturing process. Overhead is sometimes accumulated on the sheet also. When the final operation is completed and charged to the work order, the costs for material, labor, and overhead are summed up and compared to standards. Variances from standards are then analyzed to determine their underlying causes. This process requires a great deal of discrete tracking of information and it is difficult to obtain the cost accounting information until the work order is completed, which may not be timely. Also, information integrity is often suspect due to the tremendous amount of discrete tracking of information that is required [2].

Process costing is used in factories where there exists a continuous and uniform flow of similar or identical products. Examples include process industries or repetitive manufacturers such as refineries, breweries, chemical factories, or packing plants. Unit costs are determined by dividing total costs for an accounting

period by the number of units produced in that period. The simplicity of this accounting system is readily apparent. The quality of information received from such an accounting system is often considered more reliable than that derived from job order costing.

### Cost Accounting For Just-In-Time Manufacturing

In the JIT manufacturing environment, inventory is "demand" pulled into and through the process on a part-by-part basis in small quantities (often called kanban quantities). The movement of inventory is no longer from the storeroom to a work center to the storeroom to a work center and so on. The inventory flow in JIT resembles a pipeline, where the pipeline is the production process.

Inventory movement within the pipeline is measured easily by counting individual units coming out of the end of the pipeline and then "backflushing." Backflushing means looking at the product's bill of materials and reducing inventory records according to what parts went into the product. Highly accurate bill of material information is required. The last location is called the backflush (or postdeduct) point. Discrete recording of material usage in the process above the level required on the bill of material is necessary. This may be compared to a "scrap ticket" reporting system for abnormal usage.

Manufacturing overhead, applied on the basis of cycle time of the product in the process, includes fixed overhead and any contributing variable overhead. The cycle time is determined by the critical path of the product's operations. The product absorbs overhead in direct relationship to how much time it spends in the process.

JIT accounting systems are similar to process costing; the vehicle for collecting costs is the time in system, not a work order. Direct labor does not have to be discretely tracked, and is often simply applied in total to overhead. This is referred to as "charging labor" to the process. Again, this can be done because the labor portion of the product in a JIT manufacturing operation is small relative to the total manufacturing cost. Standard setting and variance analysis methods can also be used in JIT accounting [2].

While JIT manufacturing inventory flows are often compared to pipelines, some authors refer to it as a "four-wall system." Once raw materials enter the four walls, they are not recorded at all again until they leave as finished goods.

Why is no discrete tracking required within the four walls? First, the product does not spend enough time in the plant to make several inventory recordings

needed or even economical. Secondly, the higher quality in JIT systems reduces rework and minimizes abnormal flow paths and times, lessening recording needs. Schonberger states [10] that in traditional manufacturing, 90% of lead time for a product is due to delays such as queue and wait times, and that in JIT these delays do not exist. If delays are reduced, so is the need to keep track of them. Finally, in a JIT system product flows are "disciplined" and flow distances are short, lending a visual aspect to work-in-process inventory control [10]. One can simply see the kanban containers to know where the orders are. One advantage of the standard container sizes that JIT requires is what Heard calls "a quick visual means of work-in-process control [8, p.21]." Others have referred to this as "management by eye" and "management by walking around."

Obstacles to JIT accounting success can arise. Suppliers whose quality and delivery are inconsistent are incompatible with JIT systems. In addition, if long processes within the four walls exist (say a 48-hour furnace operation), intermediate stock points for discrete measurement of items coming in ("plussed in") and leaving ("deduct out") may be set. The key is flexibility [10].

### Resulting Accounting Implications

Since the costing system changes from traditional job order costing (or less frequently, process costing) to modified process costing, the cost accountants have much less information to track due to fewer stations and transactions. Thus they have significant workload reductions, and can use their newly acquired free time to constructive advantage for the company. Accountants can be "redeployed" to aid in financial analysis for production and materials management in decisions such as make-versus-buy, cost reduction, and process improvements. Accountants should spend time on the shop floor just as manufacturing engineers would, and they should utilize accounting resources to perform modeling and forecasting to aid in managerial decision making [2, 4, 10].

New measurement systems must represent the strategies and technology and other characteristics of a firm. As such, the accountants must see that the cost accounting system continually evolves as these strategies and other characteristics change.

Implementing JIT accounting methods should start small and grow. A pilot program is often the best way to start. Also, non-shop-floor paperwork for accountants can increase greatly if no advance planning occurs. In a JIT environment, daily deliveries by a vendor

should not require daily invoicing, etc. Not converting to new accounting methods when JIT is implemented can cause paperwork overload. Since a work cell in a JIT environment may contain numerous stations, not changing the accounting system might mean that information is recorded at each station for each part.

Another barrier to cost-accounting implementation for JIT is the required financial reporting to external entities such as the government and stockholders. Financial and cost-accounting standards are not always in line with new JIT costing systems, and some companies may have to maintain parallel accounting systems and records for several years until JIT accounting methods are accepted. The Tennant Company found their outside auditors to be the biggest barrier to JIT accounting implementation [4].

JIT is a companywide philosophy, and so accountants must be part of its implementation and planning from day one. Accounting is the integrated informational support system for a company, and cannot be treated as an afterthought. Interestingly enough, a great deal of literature exists on many aspects of Japanese implementation of JIT, but none appears to discuss how the Japanese do their cost accounting [11].

### CONCLUSIONS

Traditional cost accounting was expected to be a support system for manufacturing and other business activities. Unfortunately, outdated cost-accounting systems have often become barriers to quality and productivity. Managers must be aware of the implications of decisions made based on the accounting data presented to them. Accounting information is needed, but must be used in an enlightened manner. To this end, managers should have greater levels of training in accounting system goals, methods, and use. Greater communication and interaction is required between manufacturing management and the accounting department. In addition, accounting systems must evolve to better represent and support the manufacturing environments of today.

There are many advantages for the company with a just-in-time manufacturing system, including increased product quality, reduced product costs, greater competitive ability, and improved profitability. In addition, JIT leads to process improvements, greater customer service, and drastic reductions in inventory levels.

Today's standard job-costing systems do not provide an adequate cost accounting framework for use in JIT systems. The objectives and outputs of cost accounting are the same regardless of which manufacturing sys-

tem is used, but the method of generating cost-accounting information varies with each manufacturing system. Perhaps the primary difference between traditional and JIT cost-accounting methods is the application of overhead on the basis of product time in system (cycle time) rather than direct labor or machine hours.

With modified cost-accounting systems, the quantity of information to be collected is reduced greatly, while still providing the needed cost-accounting outputs. With less burden on the corporate cost accountants, they can be "redeployed" to support financial analysis, production management, and materials management areas.

Clearly, cost accounting systems for use with JIT only started to evolve recently. Such systems must be designed with flexibility in mind. When new JIT manufacturing systems are implemented, management at all levels and functions must work with corporate accountants to communicate the objectives of the organization and to facilitate the collecting and processing of necessary information. The most accurate, timely, and efficient cost accounting systems will develop in those companies that involve their accountants early and throughout the decision making with respect to JIT.

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